ABSTRACT

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What happens to the welfare of people, especially in developing countries, when their government strengthens intellectual property rights (IPR)? Existing research provides conflicting answers. This project is one of the few to provide large-N analysis of the impact of IPR on social outcomes: specifically health, education, and inequality. Results suggest that stronger IPR are associated with better outcomes on some key indicators of health, education, and inequality, and worse outcomes on other indicators. A detailed case study suggests that the process of IPR reform, the motivations behind IPR reform, and the institutions involved in the adoption and enforcement of IPR partially determine the impact of IPR on each set of outcomes.

THE SOCIAL IMPACT OF INTELLECTUAL PROPERTY RIGHTS: PUBLIC HEALTH, EDUCATION, AND INCOME INEQUALITY

By

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Chapter 1

Introduction

On May 12, 2015, Senate Democrats delivered a surprise defeat to President Obama, blocking the advance of a bill designed to grant the President "Fast Track" authority to complete negotiation of the Trans Pacific Partnership (TPP), a free trade agreement between the United States and eleven countries in North American and Asia (Milbank 2015). President Obama had been working with a coalition of pro-trade Republicans in the Senate on a bill to grant "Fast Track" authority, which is formally called Trade Promotion Authority. Fast track authority would grant the President an up-or-down vote on the TPP when it is completed, rather than allowing the Senate to filibuster the treaty or offer amendments on specific aspects of the trade deal. Fast Track authority has been granted to several Presidents in the past, and the approval of Fast Track is seen as an essential condition for any eventual approval of the TPP by Congress. Having won the support of most Republicans, the May 12 defeat was delivered by the President's own party. Senator Elizabeth Warren, an opponent of the TPP, lead the change against Fast Track, and Senate Democrats voted 44-1 against the President. Following a few more weeks of tense negotiations, the Administration was able to win the support of a total of fourteen Democrats, and on May 22, the Senate eventually passed Fast Track by a vote of 62-37 (CNN 2015). At the time of this writing in June 2015, the President was in the process of negotiating with Representatives in the House to earn their support of Fast Track as well. The future of Fast Track authority and the TPP

are as yet unknown, but pushback against the TPP, especially from the President's own party, is noteworthy.

Opponents of the TPP have several complaints, including the extraordinary secrecy with which the TPP has been negotiated. The Wikileaks website has published several drafts of TPP chapters, but other than these leaks there has been no public disclosure of the details of the trade agreement over the past five years. The lack of transparency aside, many in the public and private domain criticize the TPP on it substantive merits. Many are concerned about the impact of the trade deal on American workers. In December 2012, twenty-four Senators sent the White House a letter asking the Obama administration to priorities workers' rights during the negotiations over the TPP. Then, in April 2014, three US House members wrote an op-ed highlighting the potential ramifications the TPP would have on middle class Americans. Reflecting on job losses experienced after NAFTA was passed in 1993, Reps. George Miller (D-CA), Rosa DeLauro (D-CN), and Louise Slaughter (D-NY) said, "this agreement would force Americans to compete against workers from nations such as Vietnam, where the minimum wage is $2.75 a day" (Miller, Delauro, and Slaughter 2014).

Other Democratic opponents of TPP and Fast Track authority, Massachusetts Senator Elizabeth Warren chief among them, express concerns that the TPP could weaken the Dodd-Frank financial industry regulations, environmental and pollution regulations, and introduce a binding dispute settlement mechanism that might allow foreign companies to challenge US laws, weaken US regulations, and sue American individuals and businesses without ever stepping foot in an American courtroom (Warren 2015).

Most relevant to this project, a good deal of push-back to the TPP has centered on intellectual property rights. The international trade regime has focused on intellectual property rights since the formation of the WTO in 1994. The WTO'S Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS), which is discussed in more detail in Chapter 2, required all WTO members to protect intellectual property rights according to a set of minimum standards common in the United States and other industrialized countries. Since 1994, trade agreements have included the strengthening of intellectual property rights. The United States, along with the EU and other large wealthy countries routinely pressure trading partners to strengthen their IP protections even beyond the standards set forth in the TRIPS agreement, what opponents call "TRIPS-plus" conditions. Drafts of the intellectual property chapter of the TPP were leaked on a couple of occasions, exposing the extensive IP rules the agreement would impose on all of its signatories. Several IPR scholars and advocates have suggested that these IP provisions are TRIPS-plus in nature, and would impose a heavy burden on TPP countries. Among other effects, they suggest this will increase the monopoly pricing ability of pharmaceutical companies, leading to higher drug costs (especially for HIV drugs) in the developing countries of the TPP (Democracy Now 2015; Fuller 2014; Lee 2013). The intellectual property portion of the TPP even persuaded Senator Ron Wyden – who had been the administration's biggest supporter among Congressional Democrats – to vote against the approval of Fast Track authority. Wyden was more concerned about copyright provisions in the TPP that threaten net neutrality and support big-content providers at the expense of users and small creators, but nonetheless it was intellectual property provisions that cost the Administration its biggest supporter in the Senate (Wyden 2015).

Some IPR experts have compared the IP provisions in the TPP to the Stop Online Piracy Act (SOPA), which failed dramatically in Congress last year. Bill Watson, a trade scholar at the libertarian Cato Institute, said, "It's impressive to me how well this chapter plays into fears that folks who are concerned about intellectual property expansion have about the TPP. It really seems to be their worst nightmare" (qtd. in Lee 2013). As Watson notes, the IP-related pushback to the TPP fits into an existing debate between supporters of stronger IPR and opponents of stronger IPR. For two decades this debate has taken place in public policy circles and among lobbyists, activists, NGOs, and scholars. These political campaigns have generated a research agenda in the fields of political science and international law examining the impact of intellectual property rights (IPR) on access to lifesaving medicines in developing countries (F. M. Abbott 2005; Correa 2006; Sell 2001, 2004, 2007). Growing out of the "access to medicines" movement, a second group of scholars have focused on the impact of intellectual property on access to knowledge resources, forming a new movement known as the "access to knowledge" (A2K) campaign (Chon 2005; Nicholson 2006; Rens, Prabhala, and Kawooya 2006). In the most general terms, these two research agendas argue that stronger IPR represent a burden to developing countries, ultimately restricting their access to lifesaving medicines and knowledge resources. They suggest developing countries should be wary of strong IPR regimes that will retard social and human development without sufficiently helping grow the economy. I discuss both of these literatures in detail in the next chapter.

These research agendas join a much older literature in the field of economics which has examined the role of intellectual property rights in countries' *economic* development (G. Grossman and Helpman 1992; Helpman 1993; Mansfield 1994; Maskus

2000a; Maskus and Penubarti 1995; Schneider 2005). Some in the economics field agree that stronger IPR represent a burden to developing countries, but the overwhelming consensus within economics is that stronger IPR are a boon for economic development and an overall positive choice for developing countries to make.

1.1 The Purpose and Significance of this Research

Unfortunately there has been little dialogue between the political science literature, which is largely critical of strong IPR, and the economics literature, which is largely supportive of strong IPR. The central question propelling this project is *not* which of these arguments about IPR is correct. In fact, I argue that both stories are right: IPR has both potential positive impacts on *economic development* and potential negative impacts on *human development*.[1] The question I hope to answer is whether the benefits of adopting strong IPR outweigh the costs, and under what conditions we might expect the benefits to outweigh the costs.

My expectation going into the project is that both narratives regarding IPR are correct. Economists are correct that stronger IPR stimulate economic growth through innovation, FDI, and technology transfer. Likewise, IPR skeptics are correct that stronger IPR drive up the prices of medicines, medical inputs, textbooks, learning resources, and other educational inputs, increasing the cost of both medical treatment and attending school, and leading to worse overall health and education outcomes. Since economic

[1] In the literature on non-economic development, some scholars use the term "human development" and others use the term "social development". These terms are largely interchangeable, but for the sake of consistency I use the term "human development" throughout this project to refer to all forms of non-economic development, especially the three social outcomes at the center of the project.

growth can create additional resources, which can then be used to improve health and education, the statistical analyses presented in this project can be seen as a test of which effect of IPR is larger. Do stronger IPR generate sufficient economic growth to see overall improvements in health and education, or is the increased cost of health and education larger, resulting in overall decline in health and education outcomes. This is a question I hope to answer. I also expect that the relationship between IPR and social outcomes is more complicated than either side of this debate admits. Political and institutional factors surely matter, and in Chapter 6 I attempt to explore those factors through a case study.

Therefore, my principal contribution to this debate, and to the political science literature, is to empirically examine the relationship between IPR and social outcomes, especially health, education, and income inequality. I chose health and education because these are the social outcomes at the heart of the access to medicines and access to knowledge campaigns. I chose income inequality as a third social outcome because of its relationship to IPR, to health, and to education. Inequality has a complex relationship to both IPR and the other social outcomes, which is discussed in detail in Chapter 2 and Chapter 5.

The access to medicines and access to knowledge literatures have generally offered only anecdotal and single-case examinations of the link between IPR and the prices of drugs and knowledge resources, which represents one of the largest gaps in the literature. This project seeks to fill that gap by presenting the first large-N cross-national, time series study of the impact of IPR on health and education outcomes, as well as income inequality levels.

This project also contributes to the discussion of IPR in the literature by pointing out that IPR reform, and the impact of IPR on human development, always occur within a political context. Too often both the pro-IPR and the anti-IPR arguments ignore politics and the context in which IPR reform occurs. When scholars, activists, or other commentators ignore the reasons countries adopt stronger IPR, the ancillary political and trade benefits that come with IPR reform, and the impact politics have on the implementation and enforcement of IPR, they miss critically important factors in understanding the relationship between IPR and human outcomes.

In addition to a contribution to the political science literature and our collective understanding of the role IPR play in development, I believe this project has significant public policy implications, especially for developing countries. Sorting through competing theoretical arguments about how stronger IPR affect one's country is a difficult task. Empirical evidence of the role IPR plays in human development will inform the public policy process and give developing countries important information. As developing countries face mounting pressure to strengthen their IPR, both from business interests within the country and political pressure from outside, understanding whether the benefits of strong IPR outweigh the costs may help them create IP regimes that meet their developmental needs. For instance, if strong IPR generate worse macro-level health, education, and inequality outcomes in least-developed countries but not in middle-income and developed states, countries may postpone IPR reforms until they reach a certain level of development, and then adopt them eagerly. On the other hand, if the economic benefits outweigh the costs, even in the least developed nations, earlier adoption of strong IP protections may be in order.

1.2 Research Design

This project employs a mixed methodology, with three large-N statistical chapters and a detailed case study of the Kingdom of Jordan. The quantitative analysis allows me to explore the relationship between IPR and health, education, and inequality across a diverse group of countries at all levels of development. The goal for these chapters is to provide the first large-N analysis of this relationship, and to explore the balance between the benefits and costs of strong IPR in developed vs. developing states. As noted above, all existing research on the social and human impacts of IPR has come in the form of single case studies or anecdotal and descriptive evidence. The quantitative chapters bring a higher level of empirical rigor to the study of these relationships, and provide more generalizable conclusions.

The challenge for studying the impact of IPR on health, education, and inequality through statistical tools is that these relationships are theoretically complex, and large-N data on all the important intervening factors is limited. I discuss the data limitations in detail in each empirical chapter. As a result of these data limitations the quantitative chapters are suggestive rather than conclusive. I argue that one important factor intervening in the relationship between IPR and social outcomes is process. The process of IPR reform, the motivations behind IPR reform, and the institutions involved in the adoption and enforcement of IPR partially determine the extent to which stronger IPR negatively influence these outcomes. These factors are not captured in the large-N data that is available, and they are the focus of the case study in Chapter 6. The goal of the

case study is to bring politics back in, and to examine how the political context of IPR reform matters. To that end, I have selected the Kingdom of Jordan as an ideal case to examine.

Jordan is an appropriate case for a number of reasons. First, Jordan reformed its intellectual property law between 1997 and 2001. It was one of the first countries in the Middle East to adopt strong IP protections, and it made these reforms within a relatively short period of time. The condensed timeline makes it easier to examine the impact of IPR reform. Second, Jordan is a middle-income developing country. Many of those writing in the "access to medicines" and "access to knowledge" campaigns argue that strong IPR will have the largest negative impact on developing countries. Choosing a developing country for the test case allows for a "most likely" scenario, and avoids one potential line of criticism from IPR skeptics. Furthermore, one might argue that the least developed countries of the world have so little intellectual property to protect that any strengthening of IPR could only benefit foreign firms. As a middle income country Jordan has enough economic activity and knowledge economy to theoretically benefit from strong IPR. Finally, Jordan's decision to strengthen its IPR law could have been endogenous or exogenous. The reforms came at a time when Jordan was making other economic reforms intended to stimulate economic growth and local industries. The choice to strengthen IPR could have been an economic decision meant to increase local innovation and foreign direct investment. At the same time, however, Jordan was in the process of joining the WTO and signing bilateral free trade agreements with the US and EU. The choice to strengthen IPR could equally have been a political decision acquiescing to the demands of powerful developed states. By examining the process of

IPR reform in Jordan, we can determine whether the impetus for IPR reform was, in fact, exogenous or endogenous, and whether the endogeneity of the decision affected the impact of IPR on health, education, and inequality. Thus, examining Jordan will allow me to explore the process of IPR reform and the role of political and institutional factors.

1.3 The Plan of this Study

In Chapter 2, I establish the theoretical links between intellectual property rights and human development, particularly regarding health, education, and inequality. I offer background on intellectual property rights; review the history of the development literature; discuss the developmental impacts of intellectual property rights and the determinants of public health, education, and income inequality; and provide a theoretical link between IPR and each set of outcomes.

Chapter 3 presents the statistical analysis for health. I explore the impact of IPR on two key indicators of health: life expectancy rates and mortality rates.

Chapter 4 presents the statistical analysis for education. Here, I examine the impact of IPR on three sets of educational outcomes for various levels of education: enrollments, school life expectancy, and completion rates.

Chapter 5 presents the statistical analysis for income inequality. I explore the impact of IPR on two measures of inequality: the Gini index and the Palma ratio. The Gini index is likely familiar to the reader, and the Palma ratio is a relatively new way to operationalize income inequality. The Palma ratio is the share of income held by the top 10% of households to the share of the income held by the bottom 40% of households. In

the chapter I discuss the origin, construction, and theoretical significance of the Palma ratio as an inequality statistic.

In Chapter 6, I supplement the statistical models with a single case study. By examining IPR reform in Jordan, the chapter makes the case that the process of IPR reform, the political motivations behind reform, and the institutional players responsible for regulating and enforcing stronger IPR partially determine the impact of IPR on social outcomes.

Chapter 7 concludes with a brief summary of the findings and recommendations for future research on this topic.

Chapter 2

Linking Intellectual Property Rights to Human Development

This chapter focuses on the relationship between intellectual property rights and human development. Existing scholarly research offers two schools of thought regarding the role of intellectual property rights in the process of international development. On the one hand, economists and supporters of intellectual property rights argue that stronger IPR are a boon for economic development, and that developing countries would do well to adopt stronger intellectual property protections. On the other hand, some scholars, NGOs, and activists have been critical of intellectual property rights, arguing that stronger IPR are harmful to developing countries. While each side of the debate has offered some evidence in support of its position, there is too little dialogue between the schools of thought and too little empirical analysis to examine the true impact of IPR on health, education, and income inequality. The overall goal of this project is to fill that gap.

This chapter examines the debate, setting the stage for the analysis that follows. I begin first with a discussion of the definition and history of intellectual property rights. The second section focuses on *international development* as a concept, the expansion of development to include social outcomes, and the history of scholarship on the topic. In the third section, I discuss what we currently know about the developmental impacts of intellectual property rights and the debate between IPR supporters and IPR skeptics which has taken place among policymakers, activists, industry leaders, and academics. The fourth section discusses what we know about the determinants of health, education,

and income inequality, the human development outcomes at the heart of the project. This information will be critical if I am to isolate the impact of IPR on each outcome. In the final section, I provide a theoretical link between IPR and each outcome from both the pro-IPR and anti-IPR perspectives.

2.1 The Definition and History of Intellectual Property Rights

The term "intellectual property" refers to inventions, literary and artistic works, scientific discoveries, industrial designs, and trademarks. Intellectual property (IP) is generally divided into two categories. First, *industrial property* includes patents for inventions, trademarks, industrial designs, and geographic indications. Second, *copyright* covers literary works, films, music, artistic works, and architectural design. Intellectual property rights are legal protections that allow the inventors and creators of intellectual property to benefit from their own work or investment in a creation (WIPO 2004).

2.1.1 Historical Notions of IP Rights

Intellectual property rights have a long history. Some scholars point as far back as the first century Roman Empire, whose jurists publicly discussed notions of ownership for intellectual work, poetry, and art (Bugbee 1967). However the first modern patent system – one based on the objective evaluation of the novelty of an invention – dates back to the Venetian Republic in 1474 (Filippetti and Archibugi 2010). The British introduced patent laws in 1624 (The English Statute of Monopolies), the USA in 1836

(United States Patent Act), and the Germans in 1877 (the German Patent Act). Modern copyright law was also introduced first by the British in 1710 with the English Statute of Anne. IPR systems developed over time in Europe and America, but the spread of IPR law around the world truly began with the first two international conventions that recognized the importance of intellectual property: the Paris Convention for the Protection of Industrial Property (1883) and the Berne Convention for the Protection of Literary and Artistic Works (1886).[2]

2.1.2 International IPR Governance and IPR Harmonization

The Paris Convention covered industrial property, including patents, trademarks, industrial designs, utility models, service marks, trade names, and geographical indications. The treaty provided that each contracting state must grant the same protection to nationals of other contracting states as it grants its own nationals – a principal known as *national treatment*. The Convention also provided for the *right of priority* in the case of patents, marks and industrial designs. When an inventor or creator files for a patent in one country, the right of priority grants them a period of time in which they may apply for protection in any other contracting country, guaranteeing that these subsequent applications will be considered as if they had been filed on the same day as the original filing. Finally, the convention lays down common rules for all contracting states regarding the process and granting of IP protections (*Paris Convention for the Protection of Industrial Property* 1883).

[2] For an exhaustive history of IPR, see (May and Sell 2006).

Similarly, the Berne Convention protected author's rights over literary and artistic works. The Berne Convention established three basic principles of protection. The first is national treatment, as discussed above, which grants protection in all contracting states to works published in any contracting state. The second principal is known as *automatic protection*, which means that protection must not be conditional upon compliance with any formality. Works are protected by copyright as soon as they are created and must not be subject to any registration requirement. The third principal is known as *independence of protection*, which means that protection is not dependent on the existence of copyright protection in the country of origin of the work.

In addition to these general principles, the Berne Convention establishes minimum standards giving exclusive rights to authors including the right to translate, the right to make adaptations, the right to perform in public, the right to recite, the right to communicate the work to the public, the right to broadcast the work, the right to make reproductions, and the right to use the work for audiovisual products. The Convention also provides for *moral rights*, or the right to claim authorship of the work. The Convention establishes the duration of protection to be 50 years after the author's death, with some exceptions. Finally, the Convention allows for certain limitations of these rights, which would become the basis for future "fair use" policies (*Berne Convention for the Protection of Literary and Artistic Works* 1886).

The Paris and Berne conventions established a baseline of protection for all types of intellectual property that was quite extensive, and these two conventions became the foundation on which the modern system of IPR is built. Both conventions have undergone several updates and revisions, and several new treaties have supplemented the

conventions. In 1893, the two secretariats set up to administer the Paris and Berne Conventions merged and formed the United International Bureaux for the Protection of Intellectual Property (BIRPI). In 1970 the BIRPI transformed into the World Intellectual Property Organization (WIPO), which was given the mandate to promote the protection of intellectual property worldwide and ensure administrative cooperation among the intellectual property unions established by various international treaties (*Convention Establishing the World Intellectual Property Organization (WIPO)* 1967). A few years later, in 1974, WIPO joined the United Nations as a specialized agency of the UN. In 1978 the Patent Cooperation Treaty came into force, establishing a global patent filing system that allowed inventors and creators to file a single patent application and seek protection in over a hundred countries around the world (*Patent Cooperation Treaty* 1978). Finally, the most recent development in the international IP regime is the 2007 WIPO Development Agenda, which attempts to ensure that development issues are taken into consideration throughout WIPO's work. WIPO is still in the process of fully implementing the Development Agenda, which focuses on providing technical assistance, capacity building, legislative and policy advice, and various IP strategies to developing countries.

The evolution of the Paris and Berne conventions and the creation and development of WIPO has been a constant process of harmonization of IPR rules around the world. Rather than several IPR systems emerging to meet the needs of countries at various levels of development, the process has involved all countries adopting the same set of strong intellectual property protections. At the time they were adopted, these international IPR standards were not discussed widely among the population and average

citizens. IPR was viewed as an economic tool that would support innovation and allow industry to grow and internationalize, and little politics was involved in the creation of international IPR.

Of course, politics has since entered the discussion, with economists and IPR supporters celebrating the convergence of IPR standards as a driver of economic growth and prosperity. Meanwhile, IPR skeptics criticize what they call a one-size-fits-all maximalist perspective on IPR that ignores the unique needs of developing nations. This debate over IPR runs throughout this project and is discussed more in section *2.3* of this chapter.

2.1.3 IPR and TRIPS

Since 1994, WIPO has shared the international governance of intellectual property rights with the World Trade Organization. In the mid-1990s, when the global trading regime transitioned from the GATT to the WTO, the mandate and purview of the world's multilateral trading system drastically widened. As a part of that process, negotiators at the Uruguay round crafted what has become the most significant piece of international public law governing intellectual property rights: the WTO'S Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS). The TRIPS agreement introduced IP rules into the multilateral trade regime for the first time. TRIPS covers several aspects of intellectual property, including how to give protection to intellectual property rights, how to enforce those rights, how to settle disputes between WTO

members, and how basic principles of the trading system and other IP agreements should be applied.

TRIPS continued the harmonization process of IPR around the globe. All WTO members, including many that had never provided protection for intellectual property before, were required to do so. Developing countries were given extra time to come into compliance with the agreement, but by 2005 the requirements of TRIPS applied to all WTO member states. Much has been written about TRIPS, the powerful corporations of the Intellectual Property Committee (IPC) of the WTO who are largely responsible for its existence, and its specific details and provisions (see for instance Correa 2000; Helfer 2004; Matthews 2003; Yu 2006; Yusuf 2008).[3] For our purposes it will suffice to say that TRIPS represents the first comprehensive and enforceable agreement on intellectual property, and it applies to a staggeringly diverse and increasingly comprehensive set of countries.

Economists have examined the economic impact of IPR on developing countries for a long time. Recently, however, scholars have joined activists, NGOs, development agencies, and others in examining the human and social impact of IPR on developing countries. In the next section, I discuss the history of the development literature, and in the following section the developmental impacts of intellectual property rights.

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[3] See Braithwaite and Drahos. *Global Business Regulation*. Cambridge: Cambridge University Press, 2000. Also Sell. "TRIPS-Plus Free Trade Agreements and Access to Medicines." *Liverpool Law Review*. Vol. 28: 41-75, 2007 and Sell. "The Quest for Global Governance in Intellectual Property and Public Health: Structural, Discursive, and Institutional Dimensions." *Temple Law Review*. Vol. 77, 2004.

As Susan Sell has noted, the Intellectual Property Committee, throughout the decade between 1985 and 1995, included corporations such as Bristol-Myers Squibb, Digital Equipment Corporation, FMC, General Electric, Hewlett-Packard, IBM, Johnson & Johnson, Merck, Pfizer, Procter & Gamble, Rockwell International, and Time Warner. See for more information: Sell. "TRIPS and the Access to Medicines Campaign." *Wisconsin Journal of International Law*. Vol. 20, 2001-2002.

2.2 The Meaning and Measurement of "Development"

If there ever was a cohesive academic field focused on the study of international development, it no longer exists. Over three decades ago, James Caporaso lamented, "Currently, the field of development is in disarray" (Caporaso 1980). That sentiment is even truer today. It would be impossible and unhelpful to attempt an exhaustive summary of the history of development studies. Instead, I will briefly discuss the history of the field as it moved from early development economics to a debate between modernization theory and dependency theory, and finally to a relative (Washington?) consensus under the moniker of neoclassicism. With that overall history in mind, I then discuss the more recent effort to broaden the research agenda beyond economic development to embrace 'human development' and many non-economic objectives for developing countries.

A quick word about language is in order. The terms "neoclassicism" or "neoclassical economics" and "neoliberalism" are often confused or conflated. Neoclassical economics is a branch of economic theory that rejects the government interventionist policies of Keynesian economics and advocates for a return to the free market mentality of classical economic theory. Neoliberalism, on the other hand, has been used to refer to many different things. Typically, the term refers to a set of political economic policies that encourage free markets and limited government intervention, market liberalization, and free trade. Clearly these terms are related, and often they are used interchangeably. Other scholars treat "neoclassicism" as an economic theory and "neoliberalism" as a political theory, much like the difference between "socialism" and "communism", where there political theory is essentially the implementation of the

economic theory. In this chapter, I use the term neoclassicism and neoclassical economics rather than neoliberalism. I do this primarily because I am situating the neoclassical consensus in the field of economics as a response to and in opposition to development economics built on Keynesian principles. That said, this economic consensus around free markets in developing countries is part and parcel to the neoliberal political consensus around free market policies, which we have often called the "Washington consensus." In my opinion, the choice to use *neoclassical* rather than *neoliberal* is one of style rather than substance, but I want to be clear and consistent about the terminology used here.

2.2.1 Development Economics

The field of development economics was the first systematic effort to address the situation of developing countries and explain why some countries remained poor while others became rich. Originating not in the developing world, but in the West among economists writing in the Keynesian tradition, development economics proposed that less developed countries were fundamentally different from developed countries and operated according to different economic principles. Rather than functioning according to classical economics, developing countries had excessive labor, low productivity, and subsistence wages that kept them from competing on the open market with more developed nations (A. W. Lewis 1954; Mandelbaum 1945; Nurkse 1953; Rosenstein-Rodan 1943). The inability of the least developed countries to compete with the industrialized world led development economists to recommend interventionist government policies in the

developing world with protectionist trade policies and import-substitution strategies to build productive capacity and protect native companies.[4]

Paul Rosenstein-Rodan advocated a world-wide development strategy which he called the "Big Push" – an effort to catapult the developing world through the various barriers to economic development and help them catch up with the rest of the world (Rosenstein-Rodan 1943). This policy would encourage not only the interventionist state role within developing countries, but also a pro-development agenda amongst the already-developed countries. Rich countries would provide large foreign aid packages and assistance, as well as favorable terms of trade. The big push optimistically assumed that it was in everyone's interest to promote development, and that the industrialized world would embrace the endeavor.

By the late 1970s and early 1980s, import-substitution policies had failed to generate substantial economic growth in the countries where they were implemented, and economists began looking for alternatives to development economics. The transition from the 60s to the 70s saw an evolution within economics of both theory and methodology. Formalization and econometric analysis began to replace the historical and descriptive writing of many development scholars such as Arthur Lewis and Albert Hirschman, while at the same time economic theory began to move away from the Keynesian revolution and toward neoclassicism.

[4] For the counter-argument, see (Gerschenkron 1962) on the advantages of "backwardness".

2.2.2 Modernization Theory and Dependency Theory

As development economics was on the downward arc in the late 1960s and early 1970s, another economic school of thought developed around Walt Rostow's theories, formalized in his 1960 book *The Stages of Economic Growth* (Rostow 1960). Modernization theory's main point of departure from development economics was in treating all economies the same, under the rules of classical economics, rather than as fundamentally different types operating under different economic rules.

Modernization theory argues that "development" is a process of moving from traditional society to modern society, and from traditional modes of economic activity to modern ones (Apter 1967; Eisenstadt 1966; Lerner 1958; McClelland 1967; Rostow 1960). Through efficient production, free enterprise, and free trade, traditional societies would move down a linear path of development and eventually "take off" and catch up to the rich world. As was the case with development economics, modernization theory imagines an important role for the state in the process of development. Unlike development economics, however, modernization theory does not require fundamentally different economic policies in developing countries. The role and responsibility of the developed world is to provide expert advice, aid, and the 'missing components' of development such as capital and FDI, to assist in the process of modernization.

It is important to note that few adherents to modernization theory would self-identify as part of this school. In many ways, modernization theory is an umbrella concept scholars have adopted, and under which we have placed various scholars who

may or may not welcome the label, so that we might compare them to a second school of thought: dependency theory.

While modernization theory operates at the domestic level of analysis, locating the cause of underdevelopment in the economic conditions of traditional societies, dependency theory locates the cause of underdevelopment at the international level. The dependency literature is large and diverse, but most dependency theorists suggest that the international capitalist system is to blame for underdevelopment (F. H. Cardoso 1979; Gunder Frank 1967; Palma 1978; Prebisch 1950). As Thomas Shannon puts it, dependency theorists argue that underdevelopment "is not a stalled stage of linear development" but rather a result of exploitation of the poor nations of the world by the rich (Shannon 1989).

Dependency theory has its roots in radical theory and Lenin's critique of imperialism, but many dependency scholars have gone on to account for more recent developments (see for instance Kegley and Blanton 2010). Dependency theory is a much more diverse literature with lively debates between liberal reformers, Marxists, and World Systems Theorists. While no unified theory of dependency exists, most dependency theorists argue that the economic development of a state is due – at least in part – to outside political and economic influences, including other countries, multinational corporations, and global economic institutions. Most dependency theories also focus on the division of the world into rich countries and poor countries, and a persistent pattern of international economic behavior that reinforces rather than mitigates international inequality. Post-colonial developing nations have inherited a situation in which they export natural resources and raw materials while importing finished goods,

which leads to an economy that produces primary products with many competitors and limited demand. At the same time, multinational corporations from the developed world co-opt leaders and business elites in developing countries and aid in the rich world's exploitation of the developing world. These trends create and maintain a system of dependence that help the rich get richer while the poor remain poor.

Immanuel Wallerstein blends dependency theory with Marxism to create World-System Theory. Maintaining a focus on the world capitalist system and division of labor, Wallerstein describes the international system as containing three structural positions: an industrialized core of strong, industrialized, capitalist states; a periphery of weak states producing unfinished goods with low-skill, low-wage labor; and a semi-periphery in between of states attempting to move from the periphery into the core (Wallerstein 1974).

Modernization theory and dependency theory thus offer competing worldviews and competing theories about the root causes of underdevelopment and potential solutions for the developing world. Modernization theory offers a domestic-level, economic, and generally optimistic account where developing countries move along a linear path toward development. Meanwhile, dependency theory offers an international-level, political and economic, generally pessimistic account of the rich world maintaining a system of exploitative dominance over the developing world. While most of the scholarship and debate happens within each of these disparate schools of thought, a larger debate is present in the literature concerning which worldview maps best to reality.

2.2.3 The Neoclassical Consensus

The debate between modernization theory and dependency theory continues today, especially in the disciplines of political science and sociology. Within the field of economics, however, a relative consensus has emerged in the last few decades around a neoclassical model of development. According to neoclassical theory, underdevelopment is the result of government policies that distort economic incentives and inhibit market forces, which if left alone would lead to economic growth. While the early field of development economics blamed market failures for underdevelopment, neoclassical theorists point to government failures. Bad government policies have led to high inflation rates, large government debts, a lack of entrepreneurship, outright corruption, and the distortion of market incentives (Little 1982).

While the modernization literature finds some of its roots in neoclassical economic theory, it is important to distinguish modernization theory from neoclassical approaches to development. The main difference involves the role of the state. Where modernization theory imagines a strong state with a technocratic bureaucracy pushing economic policies that will lead to development, neoclassical theory fundamentally rejects state intervention and points to government policies as the problem rather than the solution. For neoclassical theory, the best thing a developing country government can do is step aside, open markets, and reduce regulation. If they do so, economic growth will lead to a convergence with the developed world.

2.2.4 Human Development

The vast majority of scholarship on development through the late 1980s shared a singular focus on national income (or income per capita) as the variable of interest. Economic growth, understood as income growth, was assumed to be the end goal for developing countries and the factor most likely to improve the quality of life and living conditions in the developing world. Frustrated with this focus on income, Pakistani economist Mahbub ul Haq and others formulated an alternate approach to development at the United Nations that has become known as the Human Development Approach.

As of 1990, this concept of development has been used to produce annual human development reports under the auspices of the UN Development Program (UNDP). Nobel laureate Amartya Sen, as well as colleagues and students of Sen, have been at the forefront of scholarship on human development, focusing on human capabilities and freedoms that promote individual agency in the developing world. As Sen has put it, "Human development, as an approach, is concerned with what I take to be 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" (UNDP).

As part of the human development approach and through the human development report program, UNDP has created several composite indices that can be used as dependent or independent variables in the study of development. Created by Mahbub ul Haq and Amartya Sen, and introduced in the 1990 Human Development Report, the original index is the human development index (HDI), a composite measure of income, education, and health.

Scholarship on human development has continued to evolve and spread, creating a diverse and growing subset of the development literature. What this body of work shares is the belief that a strict definition of development that looks only at income, or even at economic growth alone, does not provide sufficient insight into the process and challenges of development.

2.2.5 Defining Development for This Project

Of course it matters which definition of development one uses. Each understanding of development prescribes a different set of government and economic policies intended to generate growth. Each theory of development also understands the role of intellectual property rights in different ways. Development economists writing in the Keynesian tradition in the 1940s-1960s did not focus on intellectual property rights, but with their emphasis on protectionist trade policies, the protection of native industry, and import-substitution strategies, we can speculate on their view. Intellectual property rights would be seen by most in this school as a threat to developing states. Countries at lower levels of development do not generate significant intellectual property of their own, so strong IPR regimes are likely to benefit foreign firms more than domestic ones. As countries develop, this calculation shifts, but for most developing countries the Keynesian development economist would view strong IPR as a net negative. Dependency theorists are also likely to hold negative views of IPR, considering them a tool by which capitalist states keep poor countries dependent on innovations and products from the rich world. On the other hand, neoclassical theory (and modernization theory, which is

generally neoclassical in orientation) views IPR as an important economic tool for countries at all levels of development. Since neoclassicists argue that all countries require the same economic policies to generate growth, they view strong IPR as a benefit to even the least developed states. It is no surprise, then, that the push for harmonization of IPR across the world in the latter part of the 20th century has come on the heels of the neoclassical triumph in mainstream economic theory and in the global institutions responsible for trade and development.

It also matters whether one adopts a view of development that focuses exclusively on economic growth or a view that includes human and social outcomes as core measures of development. This project embraces the expanded definition that includes both economic and human development. If we are concerned about both economic and human development, we need a more nuanced view of the role of IPR. It is entirely possible that strong IPR are both good and bad for developing countries, and our focus should be on the balance between the positive and negative impacts of strong IPR on developing countries. To that end, the following section examines the developmental impacts of IPR through two narratives found in the literature: one that argues for strong IPR, and a second that argues against strong IPR.

2.3 The Developmental Impacts of Intellectual Property Protection

Scholars, NGOs, and journalists have examined the impact of IPR on developing countries for many years. The existing literature on this issue can be viewed through two narratives: the first an optimistic view of stronger IPR as a tool for economic

development, and the second a pessimistic view of IPR as a barrier to human development. By and large, these two narratives have been presented as opposing viewpoints, but there has been very little direct dialogue between the schools of thought. The proponents of stronger IPR point to economic theory and some empirical support to show that IPR are powerful economic tools, but for the most part the empirics come from the developed world and focus exclusively on economic variables. The opponents of stronger IPR generally point to single-case descriptive examples of developing countries being harmed by IPR, focusing almost exclusively on social / human variables. What is missing is a large-N empirical examination of which narrative holds true for the majority of countries at all levels of development.

It may also be the case that both narratives are true: stronger IPR may lead to economic growth while also hurting health and education outcomes. If there is such a tradeoff in which IPR are good for the economy but bad for human development, our focus must be on determining which side of the tradeoff is more important in the short and long term. This project seeks to fill some of these gaps. In this section, I briefly review the two opposing sides and their main arguments.

An important caveat is needed. There is and has always been healthy debate not only *between* these theoretical approaches, but also *within* each school of thought. Within each approach scholars disagree on how IPR functions and how it impacts health, education, and inequality. The framework of two competing narratives is useful as a heuristic device, but it should not be mistaken for an argument that these two camps are uniform in their opinions.

2.3.1 Narrative I: IPR Are Good for Development

For the most part, support for strong IPR has come from economists. This should hardly be surprising, given the fact that IPR regimes are fundamentally economic tools. They have two main functions: to promote investment in the development of new technology and to promote the dissemination of technology by encouraging producers to make their products and processes available to the public (Maskus 2000a, 2000b).

Most economists make a theoretical case in support of IPR as a boon for development (for instance, Grossman and Helpman 1992; E. Helpman 1993; Mansfield 1994; K. Maskus and Penubarti 1995; K. Maskus 2000; Schneider 2005). They focus on IPR as a driver of local innovation and an impetus for technology transfer through trade, foreign direct investment, and licensing of technology. Each of these benefits of IPR will lead to economic growth, as innovation, technology, and investment are used to increase economic activity and boost productivity. Since most economists view IPR as universally good for an economy, there is little discussion of potential negative impacts from "too much" IPR, or even a "sufficient" level of IPR. Instead, most economists argue what we might call "full protection" of IPR along the standards enshrined in the international IPR treaties discussed above.

Since many developing countries lack domestic capacity for large scale innovation, IPR could benefit the developing world by encouraging research on products uniquely beneficial to the global South (Chen and Puttitanun 2005). Empirical tests of the impact of IPR on GDP/capita growth (Ginarte and Park 1997; Gould and Gruben 1996; Thompson and Rushing 1996, 1999), and foreign direct investment (Mansfield 1994;

Maskus 1998; Schneider 2005) generally confirm the positive relationship hypothesized between IPR strength and economic development.

2.3.2 Narrative II: IPR Are Bad for Development

Despite the Western economic orthodoxy in support of IPR, some economists have identified negative impacts. Strong IPR tend to increase the cost of imitation, a main economic driver in developing countries. Most least-developed countries have little intellectual property to protect since they have few resources available to spend on research and innovation. As a result, most domestic manufacturing is of products that imitate higher-quality imports (Maskus 2000b). As a result, countries at lower levels of development have usually preferred weaker intellectual property protections. As countries develop and begin creating their own intellectual property, domestic firms begin pushing for stronger IPR protections.

Strong IPR can also lead to monopolistic behavior by foreign firms (Maskus 2000a, 2000b). When developing countries lack the ability to produce domestic competitors to critical imported goods, foreign firms enjoy monopoly power in the market. Stronger IP regimes can strengthen the market power of 'Northern' innovating firms and raise prices in developing countries on patented products and products that depend on patented processes and/or inputs (Chen and Puttitanun 2005).

In recent years, some political economists and political scientists, as well as international advocacy organizations, have joined the discussion, bringing new theoretical perspectives to the literature. Several scholars have framed the discussion in

terms of human rights (Cooper Dreyfuss 2010; Gana 1996; Helfer 2006; Okediji 2007; Walker 2001; P. K. Yu 2007).[5] Much of this work looks to a human rights framework as a way to push back against IP regimes that are seen as detrimental to human development. An early treatment of the relationship by Ruth Gana is couched in the language of dependency theory (Gana 1996). Not only is Gana skeptical of intellectual property regulation, but she also frames the more general notion of technology transfer as being detrimental to development, suggesting it allows the owners of intellectual goods to control access to knowledge while extracting huge transactions costs and licensing fees. The promised fruits of this process – domestic innovation – were never realized. Gana frames the global movement to reform intellectual property rights as taking place within a colonial-development agenda that depicts development as linear with a specific model of IP protection that is a necessary condition for growth.

Dependency theory is not a requirement, however, for a human rights approach to intellectual property. Simon Walker, former human rights officer at the UN Office of the High Commissioner for Human Rights, offers a slightly different argument focused on the impact of IPR on HIV/AIDS treatment (Walker 2001). Walker views HIV/AIDS as a drain on society's productivity and resources, as households caring for sick family members see a reduction in income. The disease has also led to an erosion of the supply of teachers in many societies, and there is a similar link to health, agriculture, and business, as community leaders fall sick and die at alarming rates. IP policy that limits HIV/AIDS treatment may well contribute to these problems.

Most of the literature linking IPR and human rights shares an emphasis on balancing the right to IP with a "right to development." The authors all focus on self-

[5] See Okediji 2007 for a more complete review of the literature on human rights and intellectual property.

determination and a set of social objectives that they argue should be put at the same level of importance as economic objectives. While this body of work contributes to the discussion of IPR and development, each author stops short of any empirical evaluation of the impact of IPR on the social objectives they champion.

Additionally, a great deal of work has been done on two particular social issues: access to essential medicines, and access to knowledge. These two research agendas argue that stronger IPR limit developing country access to life saving drugs and educational materials.

Led by a network of NGOs including Oxfam International and Médecins Sans Frontières (Doctors Without Borders), as well as several key academics, the access to medicines campaign contends that IPR have been used to protect pharmaceutical profits at the expense of the developing world's ability to acquire and use lifesaving drugs at affordable prices (F. M. Abbott 2005; Correa 2006; Malpani 2007; Sell 2001, 2004, 2007).[6] In particular, this literature focuses on the flexibilities built into the TRIPS agreement. These flexibilities would ostensibly allow developing countries to override pharmaceutical patents in the event of a public health emergency (such as the HIV/AIDS pandemic) or for public non-commercial use (such as government treatment programs). The access to medicines campaign has focused much attention on efforts by the United States and other developed countries to prevent the exercise of such flexibilities. Developed/innovating countries have done this by pushing IPR regulation that goes beyond TRIPS in regional and bilateral free trade agreements and through direct political

[6] The access to medicines literature is large and sprawling, so these are just a few of the more important and more academic contributions. A more complete set of the NGO resources and publications can be found through the websites of Essential Action (http://www.essentialaction.org/access/), Oxfam International (http://www.oxfamamerica.org/campaigns/access-to-medicines), and MSF (http://www.msfaccess.org/).

pressure (TRIPS-Plus legislation). While this literature contributes to the conversation and highlights an important social and public health consequence of strengthened IPR, the work done by these authors does not offer systematic empirical evidence to demonstrate negative impacts of IPR regimes. The scholarship also does not make explicit links back to development at large to make claims about broader public health outcomes.

The Access to Knowledge (A2K) campaign grew out of and has built upon the successes of the access to medicines campaign. A2K scholars maintain a focus on intellectual property, but switch from examining patents to a concern over copyright. Noting that education is a critical element of human development, A2K scholars argue that education, especially in the developing world, is hindered by limited access to educational materials (Chon 2005; Commission on Intellectual Property Rights 2002; Nicholson 2006; Rens, Prabhala, and Kawooya 2006). To be sure, copyright is only one factor affecting access to educational materials, but in many cases it is an important factor. Likewise, IPR law is just one element of a country's overall copyright environment, which also includes copyright-related practices, regulations, policies, cases and judicial attitudes (Schonwetter et al. 2010). Copyright grants exclusive rights to produce and distribute protected material. This is the case in all countries, however it creates a particularly acute situation in the developing world, where only a few firms control the market for educational resources. This leads to a situation of excessive pricing of textbooks and other material, resulting in a lack of affordability and limited access (Rens, Prabhala, and Kawooya 2006).

In addition to high prices, copyright protections contribute to unavailability and unsuitability of educational materials. Many developing countries provide such a limited market for educational resources that copyright holders lack the market incentive to provide their products at any price. Similarly, many citizens of developing countries are fluent only in indigenous languages. Already small markets become even smaller when local translations are needed. Copyright holders have little incentive to translate their product into local and regional languages, leading to a lack of suitable educational resources in many places (Rens, Prabhala, and Kawooya 2006).

Scholars have also examined the relationship between IPR and the third social outcome: income inequality. Most of this work has been theoretical, with only a few empirical analyses. The theoretical work hypothesizes a few mechanisms by which stronger IPR could lead to worsened income inequality in developing countries. Stronger patent protections can worsen inequality by increasing the return to research and development and thus the wages of R&D workers, who are mostly skilled labor (Cozzi and Galli 2011). Stronger IPR may also increase income inequality indirectly through differences in income growth rates. Stronger IPR may lead to economic growth, and higher growth rates are associated with higher real interest rates. Higher interest rates increase the return on assets, and a higher return on assets benefits asset-wealthy households relative to asset-poor households. This leads to higher income growth for the rich and lower income growth for the poor (Chu and Peng 2009).

To my knowledge there are only two empirical studies of the relationship between IPR and income inequality. Samuel Adams (2008) examined a cross section of 62 developing countries from 1985 – 2001 and found that strengthening of IPR was

positively correlated with income inequality. That is to say, *ceteris paribus*, developing countries with stronger IPR have worse levels of income inequality (Adams 2008). Similarly, Swati Saini and Meeta Mehra (2014) examined 65 developed and developing countries from 1995-2001 and also found a positive relationship between stronger IPR and income inequality. They suggest that stronger IPR increased both the demand for and wages of skilled workers relative to unskilled labor, thus aggravating income inequality. They also found this impact was strongest in developing countries experiencing high growth rates. For the developed countries in the study, the opposite effect was present. Stronger IPR were associated with less income inequality (Saini and Mehra 2014).

We are therefore left with the question: which narrative is correct? If both are right, which is more important for developing countries? I take at face value the economic argument that IPR facilitate foreign direct investment and technology transfer, and ultimately aid in economic growth. Economic theory on IPR clearly suggests a positive relationship between strengthening IPR and growth, and the empirical evidence of this relationship is compelling, although not conclusive. This project focuses instead on the human development impacts of IPR, and in particular on public health and education outcomes, as well as income inequality, which I argue is a third element of human development that is both important and closely related to the other two. In order to isolate the impact of IPR on health, education, and inequality, it is important to understand what we know about the other determinants of each outcome.

2.4 The Determinants of Public Health, Education, and Income Inequality

Turning attention to the human development outcomes at the heart of this project, the logical place to being is with a discussion of what we know about the determinants of public health, education, and income inequality. With a big picture understanding of the various factors affecting these social outcomes, the following chapters attempt to control for several key determinants in order to isolate the impact of IPR on each social outcome.

2.4.1 Public Health

Health outcomes and healthcare systems have been discussed in the development field since its beginning, and conventional wisdom held that public health outcomes were a function of the level of development in a given country. As nations developed, they would expect to see higher levels of overall health and wellbeing. The 2001 World Health Organization's Commission on Macroeconomics and Health turned that accepted view on its head. The Commission argued that good health was not only a benefit of development, but that it was also indispensable to development (WHO 2001). Given this mutually reinforcing relationship, understanding the determinants of public health outcomes has been an important objective of development scholars.

Early efforts operated at an individual level of analysis and focused on individual socioeconomic status as the principle driver of health in the developing world (Antonovsky 1967; Carroll, Smith, and Bennett 1996; Grosse 1980; Lynch 1996; Lynch et al. 1994; M. G. Marmot et al. 1991). Family incomes and educational attainment of the

parents – especially maternal education – were seen as the primary determinants of infant and child health. One's own individual income level and educational attainment were seen as the primary determinants of adult health. Empirical evidence was scarce and contradictory, but until very recently most research focused on individual socioeconomic status.

Several studies pointed to specific issues beyond socioeconomic status as primary factors, including the quality of basic infrastructure, the delivery of low cost technologies (Jamison and Mosley 1991), and maternal literacy (Grosse and Auffrey 1989). More recently, the WHO and several affiliated scholars have championed a social set of determinants of health (M. Marmot 2005; M. Marmot et al. 2008; M. Marmot and Wilkinson 1999; Wilkinson and Marmot 2003). Led by the WHO's Commission on the Social Determinants of Health, this body of research argues that regardless of income, or at all levels of income, health follows a social gradient. The Commission identified a set of daily living conditions and power relationships that impact public health. Daily living conditions include early childhood development and education, living and working conditions, social protection policies, conditions for a flourishing older life, the environment, and social stratification (which determines differential access to and utilization of healthcare).

Harder to define and measure, power relationships with distributional consequences include legitimacy and support for civil society, an accountable private sector, public interest and investment in collective action, gender equity, and empowerment and voice for all citizens (M. Marmot et al. 2008).

Related to the social determinants literature, recent work by Ronald Labonte focuses on globalization's impact on health (Labonte 2009). The author identifies five main drivers of health outcomes, including (1) material deprivation (household income, income stability, inequality, education, access to services, demographic factors, and environmental contaminants); (2) progress in health technology (Labonte suggests this is proxied by coverage rate of immunization, oral rehydration, clinic-based delivery, and access to fresh water); (3) acute psychosocial stress (from social upheavals, unemployment, inability to fulfill ones obligations, changes in social hierarchy, widowhood/divorce/distress migration); (4) unhealthy lifestyles (including smoking, alcohol, and excess salt and saturated fat); and (5) income inequality, hierarchy, and social disintegration (factors that erode social cohesion, a lack of which hurts the diffusion of medical information, collective action, and taxation for the purposes of public health).

The literature on the determinants of health outcomes in developing countries thus offers a set of factors this project attempts to account for in order to measure the effect of IPR on public health. To be sure, I will need to control for income and education, factors long associated with health status. To the extent they can be operationalized, controls for social determinants are also included in the analysis. Luckily, many of these factors will easily be controlled for by country fixed effects, since they do not change over time within a country, but others do change over time. In the analyses I report and the robustness checks I discuss, I have controlled for as many determinants of health outcomes as the large-N data will allow. The controls are discussed more fully in the following chapter.

2.4.2 Education

In the late 1980s and into the 1990s, a small body of research that focused on the economic benefits of education in the United States was linked with literature on economic development, allowing scholars to talk about education's impact on economic growth (Barro 1991; Lucas 1988; Mankiw, Romer, and Weil 1992). As a result, many scholars began to argue that investment in education should be a policy priority in the developing world (Becker 1995; Hanushek 1995; UNDP 1990; World Bank 2001). For all countries, improved education brings a litany of benefits to society, including literacy, numeracy, scientific knowledge, thinking skills, social skills, personal and community values, and a level of prestige (Glewwe 2002). Most, if not all of these benefits have clear economic effects, allowing for higher worker productivity and economic efficiency, and allowing developing countries to take advantage of their stock of human capital.

Drivers of educational outcomes in the developing world come from both the supply side and the demand side. The demand for education changes when households stop sending children to school because of cost/benefit calculations, economic constraints, perceptions of educational quality, gender issues, and accessibility of school facilities (Boissiere 2004). The supply side includes community and school factors that affect educational quality, including societal structure, community resources, school policies, educational resources, and school organization (Buchmann and Hannum 2001).

The Coleman Report in the United States and the Plowden Report in the United Kingdom together created controversy by suggesting, for the first time, that demand-side factors – specifically family socioeconomic status – were more important than supply-

side factors (Coleman and et. al. 1966; Peaker 1971). Conventional wisdom in the US and UK had been that school quality was the main driver of educational outcomes. These reports led to several articles examining determinants of education in developed and developing countries, with empirical support going both ways. Studying Uganda, Stephen Heyneman found that socioeconomic status was less important in Uganda than in the US in determining educational quality (Heyneman 1976). More recently, Deon Filmer and Lant Pritchett found support for the idea that household income is a good predictor of educational attainment across 35 developing countries (Filmer and Pritchett 1999).

In addition to socioeconomic status, important demand-side factors include family structure and size, and family decision-making processes (Buchmann and Hannum 2001). For developing countries, female-headed households generally enjoy higher levels of educational attainment, and counter-intuitively, large families and families with more siblings also experience better educational outcomes. These results are consistent across a range of developing countries, but the relationships are opposite those in developed countries, where smaller families and male-headed households experience better educational results (Buchmann and Hannum 2001). Family decision-making processes also seem to be important in the developing world, as some parents hold beliefs and preferences about childhood education that privilege male offspring over females.

On the supply-side, World Bank researchers have identified five principal contributors to effective education in developing countries: (1) curriculum, (2) learning materials, (3) instructional time, (4) classroom teaching, and (5) students' learning capacities (Boissiere 2004). Alternatively, Glewwe identifies just three key drivers of educational outcomes: the availability of textbooks, the use of educational radio, and the

reduction of class size (Glewwe 2002). Finally, in their review of the existing literature, Buchmann and Hannum conclude that material inputs such as textbooks, libraries, and teacher training have a big effect on educational outcomes, while more expensive inputs (such as science labs) and increasing teacher salary have lesser effects (Buchmann and Hannum 2001).

Many of these supply-side factors are difficult to measure. For a project like this, where the analysis is happening at the country level, many supply-side factors will be all but impossible to include as control variables. Curriculum and instructional time, for instance, vary at the individual school or classroom level, and country-level data will not be available. To some extent, educational spending can serve as a proxy, as discussed later. Despite this limitation, we can identify several country-level demand and supply-side determinants that are worth controlling for in order to isolate the impact of IPR on educational outcomes. These controls are discussed in greater detail in chapter four.

2.4.3 Income Inequality

Scholars have long studied the relationship between income inequality and economic development. The classical treatment of the relationship within the field of economics comes from Simon Kuznets, who suggested that inequality follows an inverse-U shaped relationship as GDP increases. As an economy develops, Kuznets argued, inequality would first increase and then decrease over time, the hypothetical 'Kuznets Curve' (Adelman and Morris 1973; Loehr and Powelson 1981). While other economists have disputed the nature of this relationship (see, for instance, Bruno, Ravallion, and

Squire 1996), there is general consensus that income inequality is affected by economic development and has profound implications for countries at all levels of development.

Both inflation and unemployment are associated with higher levels of income inequality (Birdsall 1998; E. Cardoso and Urani 1995), and several scholars argue that globalization and the spread of liberal economic policies also contribute to increased inequality in developing countries (Hurrell and Woods 1995; Reich 1992; Tonelson 2000). As the movement of goods and capital around the globe increases, there is an increased separation between those who are well positioned to gain from globalization and those whose status is undermined by the process. In particular, increased trade and the liberalization of financial markets lead to higher levels of inequality while governments are powerless to help because they need to retain their position in export and capital markets, leading to what some have called a "race to the bottom" (Mishra 1999; Page 1997). Whether or not this race to the bottom has been happening is the topic of much debate in the literature (Basinger and Hallerberg 2004; Davies and Vadlamannati 2013; Holzinger and Sommerer 2011; Konisky 2007; Mehmet and Tavakoli 2003).

Similarly, financial market liberalization privileges those with high incomes who have more to invest. At the same time, private businesses may find it necessary to trim wages and benefits to retain access to competitive global financial markets. All the while, financial openness allows footloose capital to avoid taxation, placing more of the burden of social programs on low-income groups (Galbraith 2000; Garrett 1996; Huber and Stephens 2001; Swank 1998). Many economists reject this scenario, arguing that economic integration and economic liberalism serve as powerful engines for growth that benefit all income groups: the proverbial "rising tide that lifts all boats" (Bhagwati 1997;

Burtless et al. 1998; Lawrence 1996). In fact, among a majority of economists, a consensus has formed in support of convergence theory: the idea that growth leads to a shrinking of inequality, both within and between countries (Baumol 1986; De Long 1988; Romer 1994; B. R. Scott 2001).

Even if neoliberal policies and economic globalization bring negative effects, there is always potential for redistribution to mitigate the impact on low-income and low-skilled workers (Pieterse 2002; Sen 1999). Thus, when discussing inequality, many scholars point to factors such as the strength of unions, political institutions and regime type, and participation in the democratic process. The presence and strength of unions and other labor organizations appears in many treatments of inequality, since these institutions are more likely to favor social spending that benefits low income groups (Freeman 1993; Glaeser 2005; Gustafsson and Johansson 1999). Likewise, political institutions may affect inequality in significant ways. In general, democracies foster an environment where social activists and peripheral groups can participate in the process and affect resource distribution (Bhagwati 1998). Proportional representation systems may allow the election of representatives that focus specifically on the needs of the poor, while majoritarian systems generally cater to the median voter, thus countries with proportional representation may experience less inequality than their majoritarian counterparts (Milesi-Ferretti, Perotti, and Rostagno 2002; Persson and Tabellini 2005). The ideology of parties in power also matters, as leftist parties typically consider distributive issues as important, although researchers caution that party ideology matters only in the short term (Huber and Stephens 2001; Swank 2002). Similarly, participation in national elections can influence inequality. Low turnout due to economic constraints or

a lack of mobilization often disadvantages low-income groups (Lijphart 1997; Mahler 2002).

Some scholars have also suggested that understanding inequality requires us to examine the reasons governments and societies invest in their children and the poor. Alberto Alesina and Edward Glaeser argue that ethnic heterogeneity leads to more redistribution and investment in education, which shrinks the gap between the rich and poor (Alesina and Glaeser 2005). In a similar argument, several scholars point to social cohesion and class relations as principal determinants of inequality (C. Muntaner and Lynch 1999; Navarro 1999; Scambler and Higgs 1999). Finally, several sociologists point to long-term structural and institutional changes resulting from industrialization as causes of inequality, such as the spread of education, the rise of democratic government, and the distribution of labor in various sectors. Several studies show that secondary school enrollment (the spread of education) and a higher percentage of labor in agriculture tend to decrease income inequality. Likewise, the rate of population growth tends to increase income inequality (Alderson and Nielsen 1999; Nielsen 1994).

As stated above, the literature provides a long list of potential causes of income inequality in the developing world. Chapter 5 attempts to control for many of these factors, although we simply do not have sufficient data on all of them. Luckily many of these factors, such as ethnic heterogeneity, change little over time within countries, allowing country fixed effects to capture their impact.

2.5 Linking IPR to Public Health, Education, and Income Inequality

Given the above discussion of the meaning and measurement of development, the current literature on the relationship between IPR and development, and the current literature on the determinants of public health, education, and income inequality, what remains is to bring these insights together into a cohesive theory about the impact of IPR on human development, and on these three social outcomes in particular. This is the theory I seek to describe and test.

2.5.1 Public Health and IPR

Perhaps the most direct and potentially harmful impact of IPR on human development involves public health outcomes. The key causal mechanism involves prices. Stronger protections of patents will increase the cost of essential medicines, as well as medical equipment and the technological infrastructure necessary for delivering healthcare. For societies that already struggle to afford public health initiatives, these price increases can be detrimental to medical access and an array of health outcomes.

A potential counter-argument would be that IPR will spur domestic innovation, which should provide for better healthcare. In fact the WHO's *Commission on Intellectual Property Rights, innovation and Public Health (CIPIH)* pointed out that strong IP protections should provide an incentive for innovation in developing countries, promote domestic and foreign investment in innovation, facilitate the transfer of health-related technology to the developing world, and improve the availability of medicines needed to combat diseases in poor countries (Satyanarayana and Srivastava 2007).

However, there has been little empirical evidence to suggest that this is the case. Most developing countries lack the capacity for innovation and the resources for research and development, while foreign firms tend to target research and development to the needs of rich societies. While some progress has been made developing the workforce and knowledge base for such innovation in middle income countries like China and India, the capacity for developing countries to create new health products is severely limited. As Satyanarayana and Srivastava note, "Many developing and nearly all least developed countries do not have the technological capability even to produce generics" (Satyanarayana and Srivastava 2007).

Even if strong IPR lead to some innovation, I argue that the same intellectual property protections that facilitate new innovations would prevent most citizens in the developing world from accessing those new and better resources by increasing prices as described above.

A second counter-argument, focusing on the issue of access to medicines, suggests that patents are less of a problem in the developing world than is poverty. Those making this argument note that more than 95% of essential drugs – as defined by the WHO – are not patented anywhere in the world, particularly in low-income countries (Noehrenberg 2006). Rather than patents being to blame for a lack of access to these drugs, the issue is a market breakdown. Patented or not, the drugs cost money and the infrastructure to deliver them costs money, and in least developed countries these costs become prohibitive (Attaran and Gillespie-White 2001; Noehrenberg 2006). In response to these arguments, opponents of stronger IPR writing in the access to medicines campaign note the connections between the authors of such articles and the

pharmaceutical industry and call into question the objectivity and motivation behind them. Whether stronger IPR raise the costs of drugs and/or effect access to medicines and overall health outcomes is indeed an empirical question, and one I seek to address with this project.

2.5.2 Education and IPR

Existing scholarship linking IPR and education in the developing world has come largely from activists and scholars working in the "Access to Knowledge" (A2K) movement (Chon 2005; Kapczynski 2007; Rens, Prabhala, and Kawooya 2006). As was the case with public health, the key causal mechanism at work involves prices. Unlike the health issue, however, the A2K movement is primarily concerned with copyright rather than patents. Protecting books, educational computer software, and other learning materials through copyright may potentially make the resources necessary for education more expensive.

Supporters of stronger IPR offer several counter-arguments. The first follows the same logic as above, suggesting that IPR will lead to domestic innovation and technological advancement. With stronger copyright protection, developing countries will have incentive to develop their own knowledge goods and educational resources, ultimately leading to better educational outcomes. As before, I argue that innovation remains unlikely in developing countries, which have been and continue to be net importers of knowledge goods.

Other IPR supporters point to exceptions and limitations that exist in the major intellectual property treaties and conventions, particularly Article 10(2) of the Berne Convention, Article 13 of the WTO's TRIPS agreement, and the 1996 WIPO Copyright Treaty (WTC) (Chon 2005; Kawooya 2007; Schonwetter et al. 2010). Each of these documents does indeed offer limitations and exceptions to copyright for situations that pass what has become known as the "three-step test." To qualify, "limitations and exceptions must be (1) applicable only in certain areas, (2) not in conflict with the normal exploitation of the work, and (3) not unreasonably prejudicial to the legitimate interests of the author/rights holder" (Schonwetter et al. 2010, 40).

While these exceptions for education exist, they have thus far been underutilized by developing countries or further restricted and/or removed by bilateral trade agreements. There are many reasons why developing countries have failed to use the limitations and exceptions fully, including TRIPS-Plus trade agreements, domestic laws that restrict a country's own ability to exercise the flexibilities, a lack of domestic capacity to replicate copyrighted material, rules that prevent parallel importation of copyrighted material, and in many cases a lack of resources to implement the flexibilities (Chon 2005; Nicholson 2006).

In other words, while exceptions to copyright exist for public goods such as education, and publishers in developing countries continue to offer initiatives such as donation, differential pricing, and publishing partnerships (Commission on Intellectual Property Rights 2002), copyright protections continue to be one major cause of a lack of access to knowledge goods and educational resources. The extent to which IPR affect

overall educational outcomes is therefore a major research question to be addressed in this project.

2.5.3 Income Inequality and IPR

The third and final social outcome of interest is income inequality within countries. The relationship between IPR and inequality is more complicated than IPR's relationship with health and education. Causal mechanisms operate both from an economic argument about the "winners" and "losers" of strong IP regimes, as well as indirectly through the other two social objectives: education and health.

From an economic standpoint, strengthening IPR may worsen income inequality by encouraging economic growth. A higher growth rate increases the rate of return on assets, thus increasing the income of asset-wealthy households relative to asset-poor households (Adams 2008; Chu 2009; Chu and Peng 2009). In other words, stronger IPR benefit property holders and those in society and abroad who have the capacity and resources for innovation and investment. The 'losers' in the equation are domestic entrepreneurs who count on imitation of existing products for their own economic success. The importance of imitation as an economic driver has been widely noted by opponents and supporters of IPR alike (Chen and Puttitanun 2005; Maskus 2000a, 2000b). In effect, stronger IPR redistribute wealth from the users of intellectual property – average citizens and low-tech businesses – to the owners and creators of intellectual property. To be sure, economic growth is a good thing for development. The argument

here is that IPR can improve economic growth while simultaneously worsening income inequality.

In addition to this economic logic, there is a potentially more powerful causal link involving education and health outcomes. As stronger IPR raise the cost of education, the education gap between the rich and poor will widen, while those with means can afford private education and more educational resources. As the education achievement gap grows, income and wealth inequality also increases.

Similarly, as stronger IPR increase the costs of medicines, medical technology, infrastructure, and medical access, the poor in society will suffer disproportionately. In developing countries, any illness in the family can lead to what Whitehead, Dahlgren, and Evans have called medical poverty traps (Whitehead, Dahlgren, and Evans 2001). A vicious cycle of poor nutrition, foregone education, and more illness results as the poor struggle to take care of sick family members, leading to reductions in family-level income. Meanwhile, those with financial resources can afford to take care of sick family members while maintaining their own educational and work lives, avoiding the medical poverty trap.

In conclusion, this chapter has attempted to provide the theoretical background for a hypothesized link between intellectual property rights and human development – particularly health, education, and inequality in the developing world. Examining the impact of IPR on human development will allow me to take a first cut at settling the debate in the literature of whether IPR are good or bad for developing countries. To the extent IPR are both helpful for economic development and harmful to human development, this analysis will also comment on that tradeoff, how developing country IP

policy can manage the tradeoff, and what policies can be implemented to exploit the benefits and mitigate the costs of stronger IP protections.

Chapter 3

The Impact of IPR on Health Outcomes

As mentioned in the previous chapter, public health outcomes are a critical component of human development. Scholars have examined the role that health plays both as an outcome of development, and as a critical component in the process of development. Even considering the traditionally narrow examination of development as GDP per capita growth, public health plays an important role. Healthy citizens are more productive workers than otherwise comparable but less healthy citizens. Good health also contributes to a robust labor force, and enables children to stay in school, thereby increasing overall societal education and boosting worker productivity (Bloom, Canning, and Jamison 2004; Prah Ruger, Jamison, and Bloom 2001). In other words, even if all we care about is economic development, public health is still an important consideration.

However, the effort to expand the definition and study of development beyond GDP per capita growth included a deepened focus on public health and education as key components of *human development*. The goal is to value health not simply for its indirect contribution to economic growth, but as Amartya Sen put it, as a "constituent component of development" (Sen 1999) – to value health as an end in itself. The Human Development Index introduced by the UN Development Program in 1990, which is discussed in detail below, includes measures of health and education alongside GDP as the three components of human development. Likewise, the World Bank has increasingly focused on health as a critical outcome of development. The 1993 World Development Report was subtitled "Investing in Health," and has been considered a watershed moment

in international health (Ruger 2005). This was the first World Bank report to focus exclusively on health, and its stated goal was to make the case to the broader development community that a greater investment in health was needed. Since 1993, the World Bank has only increased its focus on health, nutrition, and population (HNP) issues. Through its loans, credits, and grants, the World Bank has become the single largest external source of health financing in developing countries, with support for HNP programs growing from 5% of the Bank's portfolio in 1980 to 22% in 2003 (Ruger 2005).

This chapter explores the impact of intellectual property rights (IPR) on several important public health outcomes. The overarching goal is to empirically test the assertion by some NGOs, activists, and scholars that strengthening IPR is bad for public health, especially in developing countries. If these arguments are correct, we should see stronger levels of IPR correlated with worse health outcomes.

How, then, do IPR impact health outcomes? Activists and IPR critics point to a causal process that operates through prices. Stronger intellectual property rights are thought to increase the cost of health inputs, such as medical technology, medical supplies, and – most importantly – pharmaceuticals. Not only should higher prices increase healthcare costs to private individuals and governments, but in a world of limited resources, these higher prices should result in worse macro-level health outcomes in the population. In a perfect world, we would test the influence of IPR directly on prices of these various inputs. Unfortunately, we do not have large-N data on drug and medical prices, and therefore cannot test the impact of IPR on prices directly.

Instead, I test the influence of IPR on public health by examining a number of specific health outcomes for which extensive cross-sectional time series data is available. These health variables cover two key health indicators for a variety of demographic groups: life expectancy rates and mortality rates. If the activists and IPR skeptics are correct, we should see stronger levels of IPR associated with worse health outcomes.

Of course, economists and IPR supporters make the opposite argument: that stronger IPR are good for development and good for public health specifically. Stronger IPR increase the incentive to innovate and develop new and better medical resources and drugs, which should *improve* the macro-level health outcomes we are examining. At a minimum, they argue, stronger IPR should strengthen the economy in other sectors, providing increased GDP and national income which can then be used to improve society in myriad ways, including public health. In truth, both of these stories may be correct. Stronger IPR may be responsible for a stronger economy and increased health innovation, as well as increased prices for health inputs and drugs. By holding healthcare spending and GDP constant in the following analyses, we can think of this project as a test not only of whether there are positive or negative impacts of stronger IPR, but a test of which impact is stronger. If higher levels of IPR are associated with worse outcomes, we can conclude that IPR is bad for public health, and if higher levels of IPR are associated with better outcomes, we can conclude that IPR is, in fact, good for public health.

The chapter proceeds with a discussion of the variables and data used in the analysis, the methodology employed, and the results for each health outcome. The final section concludes with a discussion of the results.

3.1 Variables of Interest

3.1.1 Dependent Variables

I mentioned above that the dependent variables cover two key indicators of health: life expectancy rates and mortality rates.[7] I examine the impact of IPR on female, male, and total population life expectancy; as well as female, male, maternal, infant, child, and neonatal mortality rates. Full definitions and descriptive statistics for all the dependent variables are found in Table 3.1. The specific hypotheses for each set of variables are discussed below.

3.1.2 Intellectual Property Rights

The key explanatory variable is a measure of IPR strength. Evaluating IPR strength is a difficult task, but several measures currently exist (Ginarte and Park 1997; Mansfield 1994; Ostergard 2000, 2007; W. G. Park 2008; Rapp and Rozek 1990; Sherwood 1997). They all have shortcomings, but the index compiled by Ginarte and Park in 1997 and later extended by Walter Park in 2008 provides the best and most comprehensive index of patent strength available.

[7] Several other health outcomes were explored but are not included in this analysis. In particular, various HIV/AIDS statistics were considered. I examined the impact of IPR on the HIV prevalence rate, the number of children living with HIV, the number of adults and children living with HIV, the number of children orphaned by HIV, and AIDS estimated deaths. In no instance was the IPR variable statistically significant, suggesting that IPR and HIV/AIDS outcomes are not related. This may be the result of the overwhelming emphasis AIDS has received in foreign aid and private international public health budgets.

Table 3.1: Summary of Health-Related Dependent Variables

Health-Related Dependent Variable	Description	Mean	Standard Deviation	Min	Max
Female Life Expectancy	Female life expectancy at birth indicates the number of years a female newborn infant would live if prevailing patterns of mortality at the time of its birth were to stay the same throughout its life.	70.39	11.44	44.81	85.49
Male Life Expectancy	Male life expectancy at birth indicates the number of years a male newborn infant would live if prevailing patterns of mortality at the time of its birth were to stay the same throughout its life.	65.68	9.95	43.86	78.70
Population Life Expectancy	Life expectancy at birth indicates the number of years a newborn infant would live if prevailing patterns of mortality at the time of its birth were to stay the same throughout its life.	67.98	10.63	44.48	81.93
Female Adult Mortality	The rate, per 1,000 female adults, of a female dying between the ages of 15 and 60--that is, the probability of a 15-year-old dying before reaching age 60, if subject to current age-specific mortality rates between those ages.	158.68	127.71	43.38	571.31
Male Adult Mortality	The rate, per 1,000 male adults, of a male dying between the ages of 15 and 60--that is, the probability of a 15-year-old dying before reaching age 60, if subject to current age-specific mortality rates between those ages.	226.72	123.77	79.63	578.32
Maternal Mortality	Maternal mortality is the number of women who die during pregnancy and childbirth, per 100,000 live births.	214.23	285.29	2	1300
Infant Mortality	Infant mortality is the number of infants dying before reaching one year of age, per 1,000 live births in a given year.	35.55	33.64	2.8	121.7
Child Mortality	Under-five mortality is the probability per 1,000 that a newborn baby will die before reaching age five, if subject to current age-specific mortality rates.	53.19	58.49	3.6	266.9
Neonatal Mortality	Neonatal mortality is the number of neonates dying before reaching 28 days of age, per 1,000 live births in a given year.	17.92	14.5	1	55

[1] Descriptive statistics are reported for the cases included in the fixed effects model. They are similar to the descriptive statistics for cases in the OLS models.

Patent strength is determined by coding each of five elements of patent law in the specified country in the specified year. The authors consider (1) the extent of coverage, (2) membership in international patent agreements, (3) the absence of restrictions on patent rights, (4) the availability of enforcement mechanisms, and (5) the duration of protection. Each of the five elements is scored on a 0 to 1 scale and summed, so that each country's patent strength in a given year can range from 0 to 5. Higher values represent stronger levels of protection. In the analysis that follows, I examine the impact of the IPR index on each dependent variable, but I also disaggregate the index to examine the relative importance of each component of the index.[8]

3.1.3 Control Variables

In addition to the IPR variable, the health regressions include five control variables. Each controls for potential intervening variables that might correlate with both IPR and health outcomes. The most important control is for GNI (per capita, PPP), as richer countries are likely to have both higher levels of IPR and better health outcomes.[9] I have also included two variables that serve as proxies for broader concepts.

[8] Note that this variable measures only *patent* strength, saying nothing about copyright or trademark protections. This is not ideal; however there is good theoretical and empirical reason to believe countries with strong patent laws will also have strong copyright and trademark laws (Cavazos, Lippoldt, and Senft 2010; P. Walter G. Park and Lippoldt 2005; Reynolds 2003). Countries generally pass intellectual property legislation as a package, including similar protections for each type of intellectual property. Additionally, for health outcomes, we have good reason to believe patents will be the most important type of intellectual property protection.

[9] Health regressions use the purchasing power parity expression of wealth for two reasons. First, this is the most theoretically appropriate measure of income/wealth. Using the purchasing power parity (PPP) calculation of GNI allows for price differences to be taken into account across the panel of countries, as one PPP dollar is equivalent for a given country in purchasing power as one US dollar has in the US economy.

First, I include secondary school enrollment rates as a proxy for the stock of human capital. Human capital is a term economists use to describe a society's investment in education and training, so a more highly educated society is said to have a higher stock of human capital. Gary Becker popularized the term in 1964, leading to a long tradition of empirical work on human capital, and ultimately to Becker receiving the Nobel Prize in Economics. Human capital is featured prominently in the public health literature. Scholars have argued that education is linked directly to health outcomes as more highly educated individuals have better employment opportunities and higher wages (Cutler and Lleras-Muney 2010; M. Grossman and Kaestner 1997). As a result, societies with higher stocks of human capital experience better health outcomes. Recent work has extended the analysis beyond the education-income argument to suggest that more highly educated individuals are also more likely to *behave* differently vis-à-vis their health and the health of their family. More educated individuals have more and better information about their health and more health-related resources, and they may also be more likely to make good health-related decisions for themselves and their children (S. Desai and Alva 1998; Mosley and Chen 1984). There is also a body of research suggesting that more highly educated individuals are less likely to suffer from mental and emotional health issues than their less educated counterparts (M. Marmot 2005; Carles Muntaner et al. 2004; Y. Yu and Williams 1999). Human capital is also a common variable in research on international development, and secondary school enrollment rates are a common proxy (Barro 1991; Barro and Lee 1993, 2001; Baum and Lake 2003; Levine and Renelt 1992; Miles 2004). We also have good reason to

expect human capital to be correlated with IPR, as more educated societies usually generate more intellectual property worth protecting.

Second, I include the fertility rate as a proxy for gender attitudes.[10] This control is also common in the literature (Boissiere 2004; M. Marmot et al. 2008; M. Marmot and Wilkinson 1999). The literature has consistently found that countries with more egalitarian gender attitudes experience lower fertility rates (Kaufman 2000; Westoff and Higgins 2009). This is an important control because, for societies with less gender equality, negative impacts of IPR are likely to be felt hardest (or entirely) by women, as resources are spent first on men and children. This variable is most likely to be relevant when we seek to compare the impact of IPR on a particular outcome for men vs. women, or when we examine outcomes directly related to gender such as maternal mortality.

The fourth control is the polity score. In countries with more democratic forms of government, political pressure may force governments to pay more attention to health outcomes above and beyond government spending on health. Measures of political participation are also common determinants of health outcomes in the public health literature, which finds that more democratic governments experience better health outcomes even when controlling for health spending, health inputs, levels of wealth, and other common determinants (Franco, Álvarez-Dardet, and Ruiz 2004).

[10] To check robustness, each model was run with several other potential proxies for gender attitudes and female education. It is reasonable to assume that educated women might spend more time and effort on health outcomes for their families, so I want to be sure the educational level of women in society is properly controlled for. Other model specifications included: female percentage of the labor force, female secondary school enrollment, female tertiary school enrollment, and female total expected years of education. The inclusion of each variable did not meaningfully alter the relationship between IPR and each outcome.

The fifth and final control variable is per capita government spending on health. This is arguably the most important variable mediating between IPR and social outcomes. Richer countries are likely to spend more on healthcare, and additional government spending could compensate for any negative impacts of IPR on each health-related dependent variable.[11] Full definitions and descriptive statistics for all the independent variables are found in Table 3.2.

3.1.4 Data

The data used to test the relationship between IPR and health outcomes are from a variety of sources. The IPR variable is from Park (2008), which measures patent strength at five-year intervals from 1960-2005 for 122 countries. The polity variable comes from the Polity IV project. Finally, data for life expectancy rates, mortality rates, and the other four control variables come from the World Bank's World Development Indicators.

[11] To check robustness, each model was run with additional controls for the healthcare infrastructure, including the number of hospital beds per 1,000 people, the number of community health workers per 1,000 people, the number of nurses and midwives per 1,000 people, and the number of physicians per 1,000 people. The inclusion of each variable did not meaningfully alter the relationship between IPR and each outcome.

Additionally, each model was run with the Gini index as a control, since income inequality could theoretically impact the relationship between IPR and health outcomes. Other than severely limiting the number of observations because of missing Gini data, there was no meaningful impact on the IPR coefficient and its significance.

Additional robustness checks were done with controls for HIV prevalence, FDI, and the percentage of the population who work in agriculture. None of these controls affected the results.

Table 3.2: Summary of Health-Related Independent Variables

Health-Related Independent Variables	Description	Mean	Standard Deviation	Min	Max
Intellectual Property Rights Strength	Index of patent strength that ranges from 0-5, with higher values representing stronger patent protections.	3.20	1.04	0.20	4.88
Gross National Product	GNI per capita in purchasing power parity.	10594.10	10764.06	250	47950
Secondary School Enrollment Rate	The total enrollment in secondary education, regardless of age, expressed as a percentage of the population of official secondary education age. Variable can exceed 100% due to the inclusion of over-aged and under-aged students because of early or late school entrance and grade repetition.	71.04	35.03	5.35	161.74
Polity Score	Scale ranging from +10 (strongly democratic) to -10 (strongly autocratic). Modified version for use in time-series analyses.	5.20	5.93	-10	10
Fertility Rate	The number of children that would be born to a woman if she were to live to the end of her childbearing years and bear children in accordance with current age-specific fertility rates.	3.04	1.68	1.08	7.71
Health Spending	Total health expenditure per capita. It covers the provision of health services (preventive and curative), family planning activities, nutrition activities, and emergency aid designated for health but does not include provision of water and sanitation.	793.61	1244.99	2.47	6258.6

Descriptive statistics are reported for the cases included in the fixed effects model. They are similar to the descriptive statistics for cases in the OLS models.

3.2 Methods

This chapter examines the impact of IPR on health outcomes through regression analysis. In the sections that follow, I will be reporting two different types of regression models. Given that we have cross-sectional time series panel data, the most appropriate model would employ fixed effects estimators with Huber/White robust standard errors, clustered at the country level. These robust standard errors are consistent even when the disturbances are not identically distributed over the panels or there is serial correlation in the error term. Of the regression models available to examine panel data, a fixed effects model is preferable for both theoretical and empirical reasons. Given the diversity of countries in the analysis, we have good reason to expect country specific fixed effects. In other words, the impact of IPR on health is going to be different in the United States and in Kenya. If the country-specific effects do not change over time, we can use a fixed effects model to control for those country-specific factors. This theoretical argument is confirmed by postestimation tests. A Hausman test after each regression, which checks mathematically for country specific effects, strongly confirms the presence of fixed effects, suggesting that both pooled OLS and random effects models would produce inconsistent estimators.

Unfortunately, the nature of the data presents problems for the fixed effects model. Data on healthcare spending, which is a critical control variable, is only available from 1995 on. Therefore, while data on IPR and most of the other variables is available since 1960, the inclusion of healthcare spending limits the time dimension to 1995 – 2005. I considered dropping health spending as a control variable to increase the number

of time periods, but this approach is simply not theoretically tenable. Healthcare spending is a necessary and indispensable control, and I believe we can learn little from regression models that ignore it. Combined with the fact that the IPR variable is measured every 5 years, this data limitation shrinks the time dimension in the fixed effects models to just three points: 1995, 2000, and 2005. This is a problem for fixed effects estimators, which rely on variation within cases (countries) over time. There simply are not enough time periods to capture the impact of IPR on each dependent variable with this methodology. As a result, I also report single year cross-sectional OLS regression models for each variable. While not capturing variation over time, the OLS models do examine the relationship between IPR and the dependent variable across countries at each point in time, and provide insight into the direction and significance of the relationship between IPR and health outcomes.

In order to fully explore the impact of IPR on each health outcome, this analysis proceeds in four parts. In the first analysis, I run regressions on the full set of countries, both developed and developing. In the second analysis, I include interaction terms to examine whether the impact of IPR is different in developing countries than in developed countries. In assigning countries to a particular level of development, I follow the World Bank's procedure of divided them according to GNI per capita. The World Bank defines four groups: low income of $1,025 or less; lower middle income of $1,026 - $4,035; upper middle income of $4,036 - $12,475; and high income of $12,476 or more.

There is good reason to expect the impact of IPR on health to be different for developing countries than it is for developed ones. Developing countries may not have much of their own intellectual property to protect, thus relying more heavily on imported

technology and resources. As a result, stronger IPR may have a larger negative impact on developing countries. This is precisely the argument made by the "access to medicines" and "access to knowledge" campaigns discussed in the previous chapter.

The goal, then, is to determine whether the impact of IPR on each dependent variable is different for developing countries than it is for developed ones. Using the four point scale of development described above, I collapse this measure of development into a dichotomous variable, with low and lower middle income countries coded 0 (developing countries), and upper middle and high income countries coded 1 (developed countries). I then interact the development dummy variable with the IPR variable, and include in the regression the IRP variable, the development dummy variable, and the interaction term. We can interpret the coefficient of the IPR variable as the impact for countries identified as "developing" (coded 0 on the dummy variable). The coefficient of the interaction term is the *difference* in the impact for countries identified as "developed" (coded 1 on the dummy variable), such that the sum of the two coefficients is the total impact for developed countries. When the interaction term is statistically significant, we conclude that the impact is indeed different for the two groups. When the interaction term is not statistically significant, we conclude that the impact is the same for all countries.[12]

[12] Interpreting the coefficient for the dummy variable is less relevant, so I will not spend much time interpreting it in the following sections. In an OLS regression, the constant term is the intercept for countries coded 0 on the dummy variable, and the coefficient for the dummy variable is interpreted as the difference in the intercept for countries coded as 1. When statistically significant, this coefficient tells us that the intercept is indeed different for the two groups (just as the statistically significant coefficient of the interaction term tell us that the slope is different for the two groups). In a fixed effects regression, however, the constant and dummy variables have slightly different interpretations. The constant terms tells us the average fixed effect present in the model, while the coefficient of the dummy variable tells us the difference in the average fixed effect. These intercepts and average fixed effects are not directly relevant for the research question I am addressing, which is why I have left the interpretation out of the results discussion.

I also report but spend no time interpreting the R^2 statistics of these regressions. They have little theoretical interest, as health outcomes are severely overdetermined. My goal is not to account for all of the

In the third analysis, I disaggregate the IPR variable into its five components and test the impact of each component on the health outcomes. As I discussed above, the main explanatory variable captures five components of patent strength: (1) the extent of coverage, (2) membership in international patent agreements, (3) the absence of restrictions on patent rights, (4) the availability of enforcement mechanisms, and (5) the duration of protection. It may be informative to disaggregate this concept and to compare the impact of each of the five components on each health outcome. Perhaps one or more aspect of IPR is consistently more important than the others. Table 3.3, adapted from Park (2008), displays the method by which each of the five IP components were constructed.

In the fourth analysis, I lag the IPR variable five, ten, and fifteen years to see if IPR has a different impact on health after a period of time. The causal process we are assuming – whereby stronger IPR lead to increased prices for medical technology, supplies, and pharmaceuticals – resulting in worse macro-level public health outcomes, is admittedly a long causal chain. To go from intellectual property rights, to prices, to life expectancy, for instance, may take considerable time. For this reason, the fourth analysis lags the IPR variable and examines the impact of IPR lagged 5 years, 10 years, and 15 years on each dependent variable.

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variation in these dependent variables with my model, but instead to examine whether there is an effect from IPR on the outcomes.

Table 3.3: Components and scoring method of patent rights index. Replicated from Park (2008).

(1) Coverage	Available	Not Available
Patentability of pharmaceuticals	1/8	0
Patentability of chemicals	1/8	0
Patentability of food	1/8	0
Patentability of surgical products	1/8	0
Patentability of microorganisms	1/8	0
Patentability of utility models	1/8	0
Patentability of software	1/8	0
Patentability of plant and animal varieties	1/8	0
(2) Membership in international treaties	Signatory	Not signatory
Paris convention and revisions	1/5	0
Patent cooperation treaty	1/5	0
Protection of new varieties (UPOV)	1/5	0
Budapest treaty (microorganism deposits)	1/5	0
Trade-related intellectual property rights (TRIPS)	1/5	0
(3) Duration of protection	Full	Partial
	1	$0 < f < 1$
(4) Enforcement mechanisms	Available	Not Available
Preliminary (pre-trial) injunctions	1/3	0
Contributory infringement	1/3	0
Burden of proof reversals	1/3	0
(5) Restrictions on patent rights	Does not exist	Exists
Working requirements	1/3	0
Compulsory licensing	1/3	0
Recovation of patents	1/3	0

where f is the duration of protection as a *fraction* of 20 years from the date of application or 17 years from the date of grant (for grant-based patent systems). Overall score for patent rights index: sum of points under (1)-(5).

3.3 Life Expectancy Rates

3.3.1 Life Expectancy Full Panel Results

The World Bank has compiled life expectancy rates for men, women, and the full population. They define life expectancy for each group as: "Life expectancy at birth indicates the number of years a newborn infant would live if prevailing patterns of mortality at the time of its birth were to stay the same throughout its life" (World Bank n.d.).

The causal logic is described above, with prices of medical technology, supplies, and pharmaceuticals being the conduit through which IPR negatively impacts health outcomes. Stronger IPR will make healthcare inputs more expensive, leading to worse outcomes. As a result, I am testing the following hypothesis:

> H1: Countries with higher values for IPR will have lower life expectancies for men, women, and the full population.
> (IPR coefficients with a negative sign)

Some economists and IPR supporters make the opposite argument: that stronger IPR spur innovation and increase economic growth, giving a country more resources to use in order to improve their public health outcomes. In that way, this analysis can be seen as a test of which effect of IPR is stronger – the positive impact on innovation and the economy or the negative impact on medical prices.

Table 3.4 displays the results of the four regression models for population life expectancy. The IPR variable is insignificant in the fixed effects model, the 2000 OLS

model, and the 2005 OLS model. In the 1995 OLS model, however, we observe a significant negative relationship. A one-unit (20%) increase in IPR is associated with a 2.4 year decrease in life expectancy, which is a substantively significant result. If a country went from no IPR protection to full IPR protection (an admittedly dramatic shift), they would experience a decrease in population life expectancy of 12 years. In terms of control variables, the GNI and fertility rate are significant in the direction we would expect, while the other controls are not significant.

The results are almost identical for male life expectancy rates, as the models reported in Table 3.5 suggest. While the fixed effects model, the 2000 OLS model, and the 2005 OLS model show insignificant results, the 1995 OLS model suggests a significant and negative impact of IPR on male life expectancy of roughly the same magnitude. The same control variables are significant in this model as well. Interestingly, this result is not seen in female life expectancy rates. All four models for female life expectancy resulted in insignificant results on the IPR variable.

Table 3.4: Population Life Expectancy Rates

	Fixed Effects Model	OLS, 1995	OLS, 2000	OLS, 2005
IPR	-0.1820 (0.3954)	-2.4000* (1.1509)	-0.4955 (0.9490)	-0.4566 (0.9643)
GNI	0.00001 (0.00008)	0.0006** (0.0002)	0.0001 (0.0002)	0.0002 (0.0002)
Secondary Enrollment	0.0128 (0.0274)	0.0460† (0.0259)	0.0400 (0.0292)	0.0871* (0.0397)
Polity	-0.0206 (0.0896)	-0.0132 (0.1316)	0.0804 (0.1323)	0.0457 (0.1430)
Fertility Rate	0.5392 (1.5059)	-3.7683*** (0.4749)	-4.4412*** (0.4850)	-3.2229*** (0.5766)
Health Spending	0.0000 (0.0002)	0.0012 (0.0009)	0.0008 (0.0010)	-0.0004 (0.0009)
Constant	64.9981**** (6.4631)	78.6514*** (4.1409)	77.7376*** (4.0411)	70.5901*** (4.7831)
Year				
2000	1.1566** (0.4886)			
2005	2.6229** (0.9025)			
Observations	254	65	95	94
# Countries	106			
# Years	3			
R^2 (OLS)		0.8773	0.8397	0.7855
R^2 Overall	0.3265			
R^2 Within	0.3917			
R^2 Between	0.6321			

† Significant at 0.10 level
* Significant at 0.05 level
** Significant at 0.01 level
*** Significant at 0.001 level

Table 3.5: Male Life Expectancy Rates

	Fixed Effects Model	OLS, 1995	OLS, 2000	OLS, 2005
IPR	-0.2443 (0.3501)	-2.8263* (1.1181)	-0.7092 (0.9130)	-0.8993 (0.9880)
GNI	0.00002 (0.00008)	0.0007*** (0.0002)	0.0002 (0.0002)	0.0003 (0.0002)
Secondary Enrollment	0.0134 (0.0251)	0.0482† (0.0261)	0.0362 (0.0303)	0.0880* (0.0409)
Polity	-0.0207 (0.0846)	-0.0742 (0.1305)	0.0223 (0.1288)	0.0041 (0.1408)
Fertility Rate	0.7831 (1.3495)	-3.3452*** (0.4878)	-4.0977*** (0.4905)	-2.6939*** (0.6098)
Health Spending	0.0000 (0.0001)	-0.0013 (0.0009)	0.0008 (0.0010)	-0.0003 (0.0009)
Constant	61.8383*** (5.8603)	75.5850*** (4.1263)	75.2470*** (4.0220)	68.0420*** (4.9034)
Year				
2000	1.3614** (0.4569)			
2005	2.9219*** (0.8309)			
Observations	254	65	95	94
# Countries	106			
# Years	3			
R^2 (OLS)		0.8593	0.8192	0.7578
R^2 Overall	0.3950			
R^2 Within	0.4756			
R^2 Between	0.6579			

† Significant at 0.10 level
* Significant at 0.05 level
** Significant at 0.01 level
*** Significant at 0.001 level

Why, then, do we have a significant result in 1995 but not in 2000 or 2005? One potential explanation is that IPR simply stopped having an impact on population and male life expectancy. Perhaps as more countries reformed IPR in the late 1990s and early 2000s, factors other than IPR became more important predictors of life expectancy. Fully understanding this change will require further investigation. Regardless, the 1995 OLS model does offer some support for the hypothesis that stronger levels of IPR are associated (or have been associated in the past) with worse life expectancy rates.

3.3.2 Life Expectancy Results by Level of Development

Interestingly, there appears to be no difference between developed and developing countries. Every model run with development interaction variables yielded in insignificant results for the difference coefficient, suggesting that the impact of IPR on life expectancy is the same in all countries.

3.3.3 Life Expectancy Results for Disaggregated IPR

We can examine the impact of each of the five components of the IPR measure on life expectancy rates separately. Tables 3.6, 3.7, and 3.8 present the results to make the tables easier to read and interpret, I report only the IPR coefficients for each model. The models each have the same number of observations as the combined IPR models, and the significance and direction of the control variables are the same as reported above.

Table 3.6: Disaggregated IPR's Effect on Population Life Expectancy

Dependent Variable	Combined IPR	Duration	Coverage	Enforcement	Absence of Restrictions	Treaty Membership
Fixed Effects Model	-0.1820 (0.3954)	1.9021 (1.2736)	-0.9538 (1.2510)	-0.7608 (0.9013)	-0.1707 (1.1600)	1.0161 (1.1734)
OLS, 1995	-2.4000* (1.1509)	1.5033 (2.0082)	-5.8584† (3.0680)	-1.4964 (1.8053)	0.0489 (1.7510)	-6.7429*** (1.9790)
OLS, 2000	-0.4955 (0.9490)	-1.0502 (3.3836)	-2.6728 (2.8336)	1.9268 (1.6608)	1.1083 (1.6255)	-7.7550** (2.8655)
OLS, 2005	-0.4566 (0.9643)	-1.7979 (4.9987)	-0.9771 (2.7823)	1.9813 (2.0960)	1.2028 (1.8909)	-7.4586** (2.9669)

† Significant at 0.10 level
* Significant at 0.05 level
** Significant at 0.01 level
*** Significant at 0.001 level

Table 3.7: Disaggregated IPR's Effect on Male Life Expectancy

Dependent Variable	Combined IPR	Duration	Coverage	Enforcement	Absence of Restrictions	Treaty Membership
Fixed Effects Model	-0.2443 (0.3501)	1.8513† (1.1132)	-1.0645 (1.1152)	-0.8378 (0.8020)	-0.0665 (1.0881)	0.7310 (1.0633)
OLS, 1995	-2.8263* (1.1181)	1.0644 (2.0402)	-7.0529* (3.1131)	-1.9569 (1.9179)	0.9849 (1.8912)	-7.8601*** (1.9179)
OLS, 2000	-0.7092 (0.9130)	-1.7291 (3.6207)	-3.1083 (2.7081)	1.5939 (1.6683)	1.3569 (1.6354)	-8.6667** (2.7429)
OLS, 2005	-0.8993 (0.9880)	-3.2889 (5.2490)	-1.9972 (2.8180)	1.3834 (2.0757)	0.8725 (1.8763)	-8.0561** (2.9448)

† Significant at 0.10 level
* Significant at 0.05 level
** Significant at 0.01 level
*** Significant at 0.001 level

Table 3.8: Disaggregated IPR's Effect on Female Life Expectancy

Dependent Variable	Combined IPR	Duration	Coverage	Enforcement	Absence of Restrictions	Treaty Membership
Fixed Effects Model	-0.1165 (0.4518)	1.9553 (1.4593)	-0.8376 (1.4123)	-0.6799 (1.0159)	-0.2800 (1.2499)	1.3155 (1.3178)
OLS, 1995	-1.9523 (1.2135)	1.9642 (2.0644)	-4.6041 (3.1035)	-1.0129 (1.7820)	-0.9340 (1.7461)	-5.5698* (2.1680)
OLS, 2000	-0.2710 (1.0125)	-0.3374 (3.2129)	-2.2154 (3.0557)	2.2763 (1.7145)	0.8472 (1.6977)	-6.7977* (3.0775)
OLS, 2005	0.0083 (0.9663)	-0.2323 (4.8095)	0.0940 (2.8364)	2.6090 (2.1788)	1.5496 (2.0012)	-6.8313* (3.0825)

† Significant at 0.10 level
* Significant at 0.05 level
** Significant at 0.01 level
*** Significant at 0.001 level

Looking at all three tables it is clear that only one component of IPR appears to be important: treaty membership. Not only is this component significant in the 1995 OLS models, but it is significant in all three OLS models for all three dependent variables. The magnitude of the impact of treaty membership on life expectancy is also significant, with a one-unit increase in treaty membership resulting in a 5-8 year decrease in life expectancy, depending on the dependent variable and model specification. A one-unit increase in treaty membership represents a country being a signatory on all five major patent treaties rather than being a signatory on none of them. Put another way, countries who have signed on to all five treaties have life expectancy rates 5-8 years lower than countries who have signed on to none of them. In reality, however, very few countries have not signed any of these treaties (only 4 countries in 1995, 2 countries in 2000, and 1 country in 2005). That said, there is significant variation in the treaty membership variable. For example, in 2005, 31 countries had signed all five treaties, 11 countries had signed four, 28 countries had signed three, 20 countries had signed two, and three countries had signed one. These models suggest that, while the other components of IPR are less important, treaty membership and the patent requirements each treaty imposes on countries appear to have a significant and negative impact on life expectancy.

3.3.4 Life Expectancy Results With Lagged IPR

There is good reason to believe that it might take time for IPR to have an impact on a macro-level measure of health such as life expectancy rates. Rather than examining only the contemporary levels of IPR, I lagged the IPR variable five, ten, and fifteen years

and included the lagged IPR variable as the key explanatory factor. Table 3.9 reports the results. Again I report only the IPR coefficients to make the table easy to read. The number of observations and the results for the control variables are roughly identical to the contemporary IPR models reported above. Additionally, I am only reporting the results for the 2000 OLS model. The fixed effects models showed no significant results, which is likely a result of the methodological limitations discussed above. The 1995 and 2005 OLS models show basically the same results as the 2000 OLS model, so reporting all of them would be redundant.

Table 3.9: Lagged IPR's Impact on Population, Male, and Female Life Expectancy

	Contemporary IP	IP Lagged 5 Years	IP Lagged 10 Years	IP Lagged 15 Years
Population Life Expectancy	-0.4955 (0.9490)	-1.7396† (0.9749)	-2.5853* (1.1057)	-3.0534* (1.2411)
Male Life Expectancy	-0.7092 (0.9130)	-2.0299* (0.9778)	-2.5351* (1.0775)	-2.9797* (1.2069)
Female Life Expectancy	-0.2710 (1.1012)	-1.4348 (1.0006)	-2.6380* (1.1485)	-3.1307* (1.2927)

† Significant at 0.10 level
* Significant at 0.05 level
** Significant at 0.01 level
*** Significant at 0.001 level

For all three life expectancy measures, 10- and 15-year lagged IPR have significant and negative impacts on life expectancy. The magnitude of the effect is similar to the original combined-IP model, with a one-unit (20%) increase in lagged IPR leading to a 2-3 year

reduction in life expectancy. This is true for men, women, and the full population. These results add additional support for the hypothesis that stronger levels of IPR are associated with worse life expectancy rates. As before, I included development interaction terms in the model to see if the results were the same for developed and developing countries, and the results suggested that there was no difference for countries at different levels of development.

Taken together, the full panel 1995 OLS models, the disaggregated IPR OLS models, and the lagged IPR model all provide evidence in support of the stated hypothesis. Higher levels of intellectual property protection do appear to be related to worse life expectancy rates for men, women, and the total population. If IPR also improve life expectancy through innovation or economic growth, that positive impact is overcome by the negative impact of IPR observed in these regressions.

3.4 Mortality Rates

3.4.1 Mortality Rates Full Panel Results

The mortality rate is another important measure of public health, and we can examine the impact of IPR on mortality rates for various demographics. The World Bank has compiled mortality rates for adult men and women, mothers giving birth, infants, children under five, and newborns (neonates). Each of the mortality rates is defined slightly differently. These definitions appear in Table 3.1 above, but are repeated here:

Table 3.10: Mortality Rate Definitions

Mortality Rate	Description
Female Adult Mortality	The rate, per 1,000 female adults, of a female dying between the ages of 15 and 60--that is, the probability of a 15-year-old dying before reaching age 60, if subject to current age-specific mortality rates between those ages.
Male Adult Mortality	The rate, per 1,000 male adults, of a male dying between the ages of 15 and 60--that is, the probability of a 15-year-old dying before reaching age 60, if subject to current age-specific mortality rates between those ages.
Maternal Mortality	Maternal mortality is the number of women who die during pregnancy and childbirth, per 100,000 live births.
Infant Mortality	Infant mortality is the number of infants dying before reaching one year of age, per 1,000 live births in a given year.
Child Mortality	Under-five mortality is the probability per 1,000 that a newborn baby will die before reaching age five, if subject to current age-specific mortality rates.
Neonatal Mortality	Neonatal mortality is the number of neonates dying before reaching 28 days of age, per 1,000 live births in a given year.

Once again, the causal mechanism involves prices. If drugs, medical technology, and healthcare resources are more expensive for countries with stronger IPR, then fewer individuals will have access and more may die in a given year. As a result, I test the following hypothesis:

> H2: Countries with higher values for IPR will have higher mortality rates. (IPR coefficients with a positive sign)

Once again, this analysis can be seen as a test of which effect of IPR is stronger: a positive impact on innovation and the economy suggested by economists and IPR supporters, or a negative impact on medical prices.

Interestingly, in the full panel fixed effects and OLS models, the IPR variable was insignificant in every regression except maternal mortality. Table 3.11 reports the results for maternal mortality. While IPR is insignificant in the fixed effects model and the OLS models for 2000 and 2005, the 1995 model shows a positive and statistically significant result. A one-unit increase in IPR is associated with an increase in maternal mortality of 84.6272 maternal deaths per 100,000 live births. For the average country with a maternal

mortality rate of 214.23, this 20% increase in IPR is associated with a 39.5% increase in maternal mortality. In terms of control variables, the secondary school enrollment rate was negatively correlated and statistically significant and the fertility rate was positive and statistically significant. Both of these variables operate as we would expect.

Luckily, maternal mortality is relatively rare in the world: an average rate of 214.23 per 100,000 live births is only a maternal mortality rate of 2.1%. However, given the rarity of the event, increasing maternal mortality by 39.5% with a 20% increase in IPR is dramatic in terms of substantive significance. It would be helpful to know exactly how that process works – what medical costs result from increased IPR that play such a large role in increasing maternal mortality? Unfortunately, I cannot answer this question based on the aggregate data available. It is also interesting to note that this effect is not seen in the 2000 and 2005 OLS models.

Note that the 1995 OLS model includes only 65 countries while the other two OLS models include 94 and 95. This is a result of data limitations in 1995. To make sure the difference in significance for IPR was not merely a result of the different samples, I ran the 2000 and 2005 OLS models with only the countries present in the 1995 model and the results were still insignificant. This suggests that the impact of IPR on maternal mortality observed in 1995 was not present in the following years for the same set of countries.[13] There is therefore some evidence that – at least in 1995 – stronger IPR was associated with much higher maternal mortality rates.

[13] In fact, the sample size for the 1995 OLS model is smaller than the sample size for the 2000 and 2005 OLS models in every regression presented in this chapter. While the numbers fluctuate slightly due to various missing data, the 1995 regressions all had about 65 countries while the 2000 and 2005 regressions all had about 95 countries. To make sure differences between the years was not merely a result of different sample sizes and constellations of countries, I ran every 2000 and 2005 regression with the set of countries present in the 1995 OLS model for that variable. In none of the cases was the difference between 1995 and the later years a result of the different sample sizes.

Table 3.11: Maternal Mortality Rates

	Fixed Effects Model	OLS, 1995	OLS, 2000	OLS, 2005
IPR	19.7755 (14.2198)	84.6272* (38.7311)	20.3270 (27.7167)	-4.7780 (23.1178)
GNI	0.0116* (0.0046)	-0.0129† (0.0068)	0.0003 (0.0040)	-0.0026 (0.0035)
Secondary Enrollment	0.5378 (0.6781)	-2.3330* (1.0592)	-1.7043† (0.9669)	-2.8974** (1.0264)
Polity	2.5065 (2.7992)	1.7934 (4.2081)	-1.5868 (3.3584 ()	0.8815 (3.0763)
Fertility Rate	7.0497 (39.2908)	130.7599*** (17.6769)	134.8908*** (19.0753)	84.7017*** (16.6287)
Health Spending	-0.0083 (0.0081)	0.0591† (0.0302)	0.0042 (0.0310)	0.0269 (0.0207)
Constant	29.6996 (148.1363)	-199.5523 (139.4230)	-130.0167 (123.1419)	176.0981 (118.9326)
Year				
2000	-62.0958* (27.0086)			
2005	-127.8175** (45.8424)			
Observations	254	65	95	94
# Countries	106			
# Years	3			
R^2 (OLS)		0.8360	0.8021	0.7910
R^2 Overall	0.3592			
R^2 Within	0.3699			
R^2 Between	0.3782			

† Significant at 0.10 level
* Significant at 0.05 level
** Significant at 0.01 level
*** Significant at 0.001 level

3.4.2 Mortality Rate Results by Level of Development

Including development interaction terms allows us to examine the impact of IPR in developing vs. developed nations. As before, the IPR variable was statistically insignificant for male, female, infant, child, and neonatal mortality. However, for maternal mortality the interaction model reveals an interesting outcome. Table 3.12 shows that, for developing countries, IPR does not have a statistically significant impact on maternal mortality. The second IPR coefficient, which tells us the *difference* in impact for developed countries, is positive, large, and approaches traditional levels of statistical significance (p-value = 0.072). This result, along with the fact that IPR is statistically significant in the full panel model, suggests that IPR does not have an impact on maternal mortality in developing countries but does have a positive and significant impact on maternal mortality in developed countries.

In other words, for richer countries strong IPR is associated with higher rates of maternal mortality. However, in poorer countries this effect is not present. I began this analysis with the assumption that any negative effect of IPR on health would be worse in developing countries – that strong IPR would be more harmful to public health in poor countries. This result offers some evidence that this is not the case. It is in the developed world where IPR has a negative impact on maternal mortality. Why might that be the case? Perhaps in the developing world maternal mortality is more a function of other factors: proximity to a hospital, the availability of doctors, cultural norms around childbirth, healthcare infrastructure, etc. In the developing world, perhaps these factors dwarf any impact of IPR on maternal mortality. However, in the developed world, where

these issues may be less important, we can see an impact of IPR on maternal mortality. This hypothesis is logical, but requires more research to determine if it is accurate.

Table 3.12: Difference in Impact of IPR on Maternal Mortality For Developing and Developed Countries

	Maternal Mortality (OLS, 1995)
IPR for Developing Countries	54.3363 (47.6352)
Difference in IPR Effect for Developed Countries	98.5041† (53.7591)
Development Dummy	-130.6408 (151.9102)
GNI	-0.0254** (0.0092)
Secondary Enrollment	-2.7742** (1.0382)
Polity	1.8294 (3.9062)
Fertility Rate	121.4012*** (17.5785)
Health Spending	0.0711* (0.0711)
Constant	-54.1956 (154.6895)
Observations	64
R^2	0.8530

† Significant at 0.10 level
* Significant at 0.05 level
** Significant at 0.01 level
*** Significant at 0.001 level

3.4.3 Mortality Rate Results for Disaggregated IPR

Disaggregating the IPR variable gives some additional insight on the impact of IPR on mortality. Tables 3.13 – 3.18 display the results, reporting only the IPR coefficients for each model. While only maternal mortality was affected by the combined IPR variable, we see significant results in nearly every mortality rate when considering the disaggregated IPR components. Looking at all six mortality rates, it becomes clear that the most important component of IPR – when it comes to mortality – is treaty membership. Treaty membership is significant (or nearing traditional significance in the case of female mortality), in at least one model specification for each mortality rate.

For maternal mortality, which is on a different scale than the others, a one-unit increase in treaty membership is associated with an increase in maternal mortality of 241.0359 maternal deaths per 100,000 live births in 1995, and 138.8640 maternal deaths per 100,000 live births in 2005.

Table 3.13: Disaggregated IPR's Effect on Maternal Mortality

Dependent Variable	Combined IPR	Duration	Coverage	Enforcement	Absence of Restrictions	Treaty Membership
Fixed Effects Model	19.7755 (14.2198)	-60.1890 (44.1257)	70.7637† (39.6712)	36.0286 (24.4034)	-44.8512 (43.7688)	42.8250 (39.0209)
OLS, 1995	84.6272* (38.7311)	-11.5996 (73.4538)	162.9095† (97.0007)	107.4540 (70.6113)	26.1438 (52.6013)	241.0359*** (70.3449)
OLS, 2000	20.3269 (27.7167)	52.9868 (84.5401)	87.2606 (81.7696)	-34.3364 (55.9596)	5.6506 (58.1944)	138.8640* (60.6851)
OLS, 2005	-4.7780 (23.1178)	32.2447 (82.6892)	-13.4011 (75.1989)	-64.5448 (51.1367)	-7.5057 (47.2603)	86.7808 (54.1256)

† Significant at 0.10 level
* Significant at 0.05 level
** Significant at 0.01 level
*** Significant at 0.001 level

Table 3.14: Disaggregated IPR's Effect on Male Mortality

Dependent Variable	Combined IPR	Duration	Coverage	Enforcement	Absence of Restrictions	Treaty Membership
Fixed Effects Model	2.6886 (4.4762)	23.1727* (10.7293)	-4.8579 (10.3467)	1.9885 (5.3431)	3.7731 (11.4275)	-2.4278 (10.5374)
OLS, 2000	20.2038 (14.0970)	36.3899 (56.0133)	54.9286 (40.0231)	-5.2404 (28.7941)	-2.8896 (28.2854)	135.0786** (47.5951)
OLS, 2005	20.3692 (15.7885)	78.7747 (84.7589)	43.8217 (44.3333)	-7.1973 (35.4380)	-20.7800 (30.8025)	139.0465* (53.5029)

† Significant at 0.10 level
* Significant at 0.05 level
** Significant at 0.01 level
*** Significant at 0.001 level

Table 3.15: Disaggregated IPR's Effect on Female Mortality

Dependent Variable	Combined IPR	Duration	Coverage	Enforcement	Absence of Restrictions	Treaty Membership
Fixed Effects Model	3.1408 (5.0845)	23.2717 (15.8822)	-7.2289 (9.2613)	2.3272 (5.0060)	7.0143 (11.3834)	-3.9912 (10.2989)
OLS, 2000	13.7118 (13.8279)	4.2112 (42.3863)	41.5253 (38.6794)	-5.5761 (26.4060)	7.5778 (25.8914)	89.7295† (49.1803)
OLS, 2005	-0.0941 (14.1747)	13.8667 (74.6371)	-5.0054 (38.3349)	-28.4895 (33.6512)	-32.6224 (28.7278)	94.9247† (50.5218)

† Significant at 0.10 level
* Significant at 0.05 level
** Significant at 0.01 level
*** Significant at 0.001 level

Table 3.16: Disaggregated IPR's Effect on Infant Mortality

Dependent Variable	Combined IPR	Duration	Coverage	Enforcement	Absence of Restrictions	Treaty Membership
Fixed Effects Model	0.7883 (1.3014)	-4.3987 (2.7093)	1.8648 (2.9703)	2.9523 (1.9925)	0.9277 (3.0720)	-3.8823 (5.5609)
OLS, 1995	5.2351 (3.8403)	-7.4919 (10.0021)	13.0969 (9.4669)	7.4667 (5.4466)	-0.1610 (5.5350)	15.8966* (7.0592)
OLS, 2000	-1.9374 (3.0001)	-8.7489 (11.1516)	-0.1802 (9.3063)	-6.2879 (5.3609)	-6.4838 (5.5721)	13.5644† (7.7371)
OLS, 2005	-0.5205 (2.1291)	-1.4809 (11.0718)	-2.2399 (6.5801)	-7.0678 (4.8796)	-0.9626 (4.7750)	12.3264* (5.8075)

† Significant at 0.10 level
* Significant at 0.05 level
** Significant at 0.01 level
*** Significant at 0.001 level

Table 3.17: Disaggregated IPR's Effect on Child Mortality

Dependent Variable	Combined IPR	Duration	Coverage	Enforcement	Absence of Restrictions	Treaty Membership
Fixed Effects Model	1.7457 (2.2771)	-5.7699 (4.8115)	8.4205 (5.2108)	4.9410 (3.5191)	-4.2370 (6.4622)	-1.9349 (6.1352)
OLS, 1995	14.4335† (7.5521)	5.3426 (18.3901)	40.1137* (18.1282)	17.2046† (9.8334)	-4.7096 (9.0079)	48.6946*** (12.8958)
OLS, 2000	-0.8123 (5.2767)	-0.8807 (18.9194)	14.8808 (16.1034)	-13.0349 (8.7766)	-15.4199† (9.2557)	34.8376** (12.2607)
OLS, 2005	0.7043 (3.9240)	-2.3426 (20.7157)	2.5601 (11.0493)	-12.5636 (8.6203)	1.0441 (8.6579)	25.6889* (9.9799)

† Significant at 0.10 level
* Significant at 0.05 level
** Significant at 0.01 level
*** Significant at 0.001 level

Table 3.18: Disaggregated IPR's Effect on Neonatal Mortality

Dependent Variable	Combined IPR	Duration	Coverage	Enforcement	Absence of Restrictions	Treaty Membership
Fixed Effects Model	-0.1015 (0.3869)	-0.3241 (1.0203)	-0.6314 (1.1720)	0.3268 (0.7095)	1.2116 (1.1018)	-2.8021** (1.0695)
OLS, 1995	0.5723 (1.8974)	-4.7029 (3.9384)	3.1644 (4.6834)	1.4356 (2.5712)	2.7075 (3.8341)	1.3389 (3.8029)
OLS, 2000	-1.8299 (1.3989)	-4.6430 (4.6395)	-3.6971 (4.6585)	-3.3559 (2.7574)	-3.3231 (2.8708)	2.5068 (3.9949)
OLS, 2005	-1.6289 (1.1168)	-6.7726 (4.5699)	-3.8484 (3.4180)	-3.7665 (2.7026)	-1.7988 (2.5690)	2.0558 (2.8355)

† Significant at 0.10 level
* Significant at 0.05 level
** Significant at 0.01 level
*** Significant at 0.001 level

As discussed above regarding life expectancy rates, a one-unit increase in treaty membership is dramatic, representing a change from signing none of the five global patent treaties to signing all five of them. However, even a smaller change in treaty membership is associated with fairly large increases in maternal mortality, given the rarity of this kind of death. None of the other components of IPR are significant, although patent coverage approaches traditional levels of significance in the fixed effects and 1995 OLS models (p-values of 0.077 and 0.098 respectively). If we accept these higher p-values, the results suggest that countries who allow patents on more product categories experience higher maternal mortality rates. Of eight product categories listed in Table 3, pharmaceuticals and surgical products are the most likely to have a connection to maternal mortality. Regardless, a one-unit increase in patent coverage – which represents a move from covering none of these products to covering all of them – is associated with an increase in maternal mortality of 70.7637 deaths per 100,000 live births in the fixed effects model and 162.9095 deaths per 100,000 live births in the 1995 OLS model. It is worth repeating that this one-unit increase in coverage is dramatic, and both of these results fail to meet traditional measures of statistical significance.

Male, female, infant, and child mortality rates are all measured as a number of deaths per 1,000 individuals in the category. Treaty membership appears to have a positive and significant relationship with each of these mortality rates. For female mortality, treaty membership comes close to meeting traditional levels of significance in the 2000 and 2005 OLS models (p-values of 0.071 and 0.064 respectively). If we accept these p-values, the results suggest that a one-unit increase in treaty membership results in an increase in female mortality of roughly 89-95 deaths per 1,000 adult females. For an

average country with an annual female mortality rate of 158.68, this is a 56-60% increase. Even for much smaller changes in treaty membership, this is a substantively significant result. For instance, a country that signs just one additional treaty is associated with a 10% higher female mortality rate.

The impact is even more dramatic for male mortality, where we find a larger positive and significant impact, with a one-unit increase in treaty membership associated with an increase in male mortality of roughly 135-139 deaths per 1,000 adult males. The the average country with a male mortality rate of 226.72, this is a 60-61% increase. These results are both statistically significant (p-vales of 0.006 and 0.011 respectively), and substantively significant. In the fixed effects model for male mortality, the duration of patent coverage is also significant, with a one-unit increase in duration associated with an increase of 23.1727 in male mortality. This one-unit increase in patent coverage is a move from no patents at all to the full standard 20 years of coverage, which is a fairly dramatic increase. That said, even much smaller increases in patent duration are associated with meaningful increases in male mortality.

Results for infant and child mortality are equally compelling. A one-unit increase in treaty membership is associated with increases in infant mortality of 15.8966 in 1995, 13.5644 in 2000 (p-value = 0.083), and 12.3264 in 2005. Since infant mortality is less common, with the average country experiencing only 35.55 infant deaths per 1,000 live births a year, these impacts of treaty membership are very large. For children, a one-unit increase in treaty membership is associated with an increase in mortality rates of 48.6946 in 1995, 34.8376 in 2000, and 25.6889 in 2005. Child mortality is also fairly uncommon, with an average mortality rate of 53.19. Thus, these changes in mortality are large by

comparison, and highly statistically significant. Interestingly, patent coverage is again significant for the 1995 OLS model of child mortality, with a one-unit increase in coverage associated with a very large increase in child mortality of 40.1137. This result is not present in the 2000 and 2005 models.

The fixed effects model for neonatal mortality offers somewhat different results. Treaty membership is statistically significant; however, signing additional treaties is associated with *reductions* in neonatal mortality. A one-unit increase in treaty membership leads to a reduction in neonatal mortality of 2.8021. Neonatal deaths are exceedingly rare, with the average country experiencing only 17.92 newborn deaths per 1,000 live births. While small, this negative coefficient for treaty membership represents a significant reduction in neonatal mortality. We do not observe this relationship in the OLS models, and no other IPR components are significant for neonatal mortality. This is a challenging result to explain. One potential explanations is that, in signing additional patent treaties and strengthening IPR as a result, countries are either generating innovation related to newborn heath or receiving access to some product or technology not available without strong patent protections that impacts newborn health. It is also possible that the economic argument in favor of IPR, whereby stronger IPR leads to economic growth, provides additional resources that make their way into the healthcare system to improve newborn mortality rates.

We can draw a few conclusions from the regression results for these six mortality rates. First, while there is occasional evidence that patent duration and coverage might matter, the more compelling evidence is for treaty membership having a significant and positive effect on female, male, maternal, infant, and child mortality rates. Countries who

are signatories on more of the five global patent treaties are associated with significantly worse mortality rates. These results support the hypothesis above, and offer some evidence to support the claims of IPR skeptics who believe stronger IPR will damage health outcomes in countries at various levels of development. This result is not true for neonatal mortality, for which the fixed effects model suggests a significant but negative relationship.

Second, the magnitude of the effect of treaty membership for mothers, infants, and children appears to have diminished over time. For these three mortality rates, the largest statistically significant impact appears in the 1995 OLS model. The size of the coefficient for each mortality rate decreases in the 2000 OLS model, and decreases again in the 2005 OLS model (dropping from significance for maternal mortality). We cannot know from these regressions the exact reason for this change over time. However, we do know that over time all of these mortality rates have been decreasing across the globe. With some notable exceptions, most countries have experienced progressively better mortality statistics year over year since 1960 when the World Bank began collecting them. At the same time, more and more countries have signed on to the five global patent treaties over time. As a result, in 2005 most countries included in the regression had higher treaty membership values and lower mortality rates than they did 1995. It seems to be the case that, as mortality rates have improved, the importance of treaty membership has been overtaken by other factors. This trend is not present for male and female mortality, where the magnitude of the impact of treaty membership on mortality is slightly larger in 2005 than it was in 2000.

3.4.4 Mortality Rate Results With Lagged IPR

Table 3.19 presents the results for all six mortality rates when we lag the IPR variable five, ten, and fifteen years. As before, the table reports only the IPR coefficients for the 2000 OLS model. The patterns observed here were roughly the same in the 1995 and 2005 OLS models. With the exception of the neonatal mortality rate, for which the results are insignificant across all four models, the impact of lagged IPR on mortality is similar for each demographic. Using contemporary IPR values from 2000, the results are insignificant for all mortality rates. When lagged five, ten, and fifteen years, the IPR variable becomes statistically and substantively significant, and positively correlated with mortality. With a 5-year lag, male, female, and maternal mortality become significant, and with a 10-year lag child and infant mortality also become significant. For each mortality rate, the size of the coefficient is similar to the magnitude of the impact observed in previous models. Interesting the size of the coefficient increases the more we lag the IPR variable, such that the impact of IPR lagged fifteen years is very large; slightly smaller at ten years; and smaller again at five years. These results suggest that it may indeed take some time for intellectual property rights to have an effect on health outcomes, and mortality rates specifically. These results, along with the previous mortality rate results, offer some compelling evidence in support of the hypothesis that strong IPR are bad for mortality.

Table 3.19: Lagged IPR's Impact on Mortality Rates

	Contemporary IP	IP Lagged 5 Years	IP Lagged 10 Years	IP Lagged 15 Years
Male Mortality	20.2038 (14.0970)	38.6868* (14.9749)	37.2367* (18.4544)	44.0244* (20.4474)
Female Mortality	13.7118 (13.8279)	24.3880† (13.1963)	37.6335* (18.2826)	43.0575* (20.2400)
Maternal Mortality	20.3269 (27.7167)	56.1942* (26.7554)	94.8303*** (24.7653)	103.9674*** (29.8101)
Under-5 Mortality	-0.8123 (5.2767)	5.5713 (4.9600)	10.7447* (4.3717)	12.0364* (5.2197)
Infant Mortality	-1.9374 (3.0001)	1.4855 (2.8030)	5.6476* (2.5870)	6.5344* (3.0165)
Neonatal Mortality	-1.8299 (1.3989)	-0.9804 (1.3137)	1.6824 (1.0699)	1.9446 (1.2483)

† Significant at 0.10 level
* Significant at 0.05 level
** Significant at 0.01 level
*** Significant at 0.001 level

3.5 Discussion & Conclusion

I will conclude with a few general comments. First, the evidence presented here largely confirms the hypotheses being tested, suggesting that stronger IPR are associated with worse life expectancy and mortality outcomes. IPR was negatively correlated with life expectancy rates in the 1995 OLS models, and when we lag the IPR variable we see even larger negative impacts of IPR on life expectancy. Similarly, IPR was negatively correlated with maternal mortality in the 1995 OLS model, a result that was statistically significant and large in magnitude, but only true

only for developed countries. When lagged five, ten, and fifteen years, the magnitude of the negative impact of IPR on maternal mortality was even larger.

The second general outcome of these analyses has to do with developing versus developed nations. IPR skeptics in general, and especially those in the access to medicines campaign, have argued that IPR are bad for public health especially in developing countries. The results presented here do not support that argument. For the health outcomes where we observe a significant negative relationship, there is either no difference between countries at different levels of development, or the negative effect of IPR is present only for middle income and rich countries. I suggested one possible explanation above, which bears repeating here. It may be the case that in poor countries that are already struggling with public health infrastructure and resources, health outcomes are determined by other factors. Only in middle income and rich countries, where public health outcomes are quite good, can we observe a negative impact from IPR on the outcomes. Perhaps these countries have overcome the traditional barriers to public health delivery, and at the upper levels of life expectancy and mortality some small negative effects of IPR can be observed. This explanation is presently just conjecture, and a complete explanation of this result will require additional research.

A third general conclusion involves the disaggregated IPR components. It is clear from these results that not all aspects of IPR have an impact on health outcomes. The treaty membership component is consistently the most important factor. Countries who have signed on to more of the five global patent treaties are associated with worse male, female, and population life expectancy rates. Likewise,

countries who have signed on to more treaties are associated with worse maternal, infant, and child mortality rates. Very interestingly, the magnitude of the negative impact of IPR on these mortality rates diminishes over time, with smaller coefficients in 2000, and even smaller coefficients in 2005.

The fourth and final conclusion involves lagging the IPR variable. Across all of these health outcomes, we observe at least some statistically significant negative impact of lagged IPR. This is the most dramatic evidence in support of the stated hypotheses, and in support of the critics of IPR. With good reason to expect that the process of strengthening IPR may take some time to affect these outcomes, the regression results suggest that this is exactly what is happening. IPR levels from five, ten, or fifteen years prior are negatively correlated with nearly all the health outcomes.

It is important, before moving on, to return to a point I made in the introductory chapter: the reform of IPR and the relationship between IPR and health outcomes all occurs within a political context. It would be useful to control for the reasons behind IPR reform and the institutional aspects of IPR implementation in each country in the panel. While that data does not exist in large-N form, its development would be a key contribution for future research. It may be the case that stronger IPR have even larger negative impacts on health outcomes in countries that fully implement and enforce these protections and far weaker impacts in countries that don't, but such distinction is concealed by the large-N nature of this analysis.

The next chapter explores the relationship between IPR and educational outcomes to see if the trends observed in this chapter continue, or if the relationship between IPR and education functions differently.

Chapter 4

The Impact of IPR on Education Outcomes

Along with public health, education has been widely viewed as a critical component of human development. Its inclusion in the UNDP's human development index, as well as a growing literature on the role of education in the development process, is evidence of the importance scholars and development experts place in education. Education is a catalyst for economic growth and the reduction of poverty, and education is closely tied to public health, strong communities, and quality of life (Armstrong 2010).

As I discuss in the theory chapter, there is a young but growing literature in political science regarding the relationship between of intellectual property rights and education. Both IPR supporters and skeptics have suggested that there is a link between educational outcomes and the availability of learning resources – both physical and digital – such as textbooks, computer software, and reference materials. Some supporters of strong IPR and extensive copyright protection offer the utilitarian perspective that says stronger protections give authors the necessary incentive to invest in the creation and dissemination of learning materials, benefiting the educational system and the public at large. Other proponents of stronger IPR make the argument that IPR has an indirect impact on education, through its positive impact on economic growth. This is a similar argument to the one discussed in the previous chapter on health outcomes. Stronger IPR generate economic growth, increasing national income which can be put to use in the educational sector improving educational attainment and other outcomes (Armstrong 2010; Idris 2003).

IPR critics, on the other hand, argue that stronger intellectual property rights will present problems for education, especially in the developing world. This "access to knowledge" campaign and research agenda points to the fact that in the developing world there is little native creation of learning materials, and most textbooks and other educational resources are imported from the developed world. The most important impact of copyright in these countries involves not the generation and dissemination of learning materials, but access to and the price of those materials. In this view, stronger IPR will increase the costs of textbooks, educational software, and reference materials. This will make learning material less accessible and more expensive, increasing the cost of sending children to school and keeping them in school through graduation (Boyle 2004).

This chapter examines the impact of intellectual property rights on several important education outcomes. As was the case in the previous chapter, the goal is to empirically test the assertion by some NGOs, activists, and scholars that strengthening IPR is bad for access to education and knowledge, especially in developing countries. As a result, the hypotheses are structured in this direction. However, since IPR supporters make the opposite argument, these analyses are also a test of which impact on education is stronger: a negative impact through increased prices, or a positive impact either directly through the development of new and cheaper resources or indirectly through economic growth. We must also be careful interpreting these results, as there is a potential argument for reverse causality. Rather than stronger IPR having an impact on educational outcomes, it is possible that better educational outcomes create incentives for countries to strengthen IPR as their citizens become intellectual property creators rather

than purely users. I discuss this idea more in the sections that follow and in the discussion at the end of the chapter.

Ideally, we would examine the impact of IPR, especially copyright, on the prices of textbooks and educational material directly. Unfortunately, large-N data does not exist on these price levels. Instead, I examine the impact of IPR on macro-level education outcomes by running regressions on several education-related dependent variables, including enrollment rates at the primary, secondary, and tertiary level, school-life expectancy rates, and school completion rates. A second limitation involves the distinction between public and private education systems, and whether individual citizens have to pay for their children's education. Countries vary widely in the percentage of students who attend public schools at each level of education, and in the average annual cost of school attendance. Some countries provide textbooks, educational software, and other learning material for free, while families in other countries are required to buy these materials. Unfortunately, large-N data on differences in the cost of attending school is not available and cannot be included directly in the statistical analysis. There are likely important intervening factors, and collecting this data would be a fruitful extension of the analysis in this project.

The health chapter used a measure of patent strength as the IPR variable, which was the most appropriate measure for health outcomes. In this chapter, however, I use an index of copyright strength instead. Copyright has a much stronger theoretical link to educational materials and outcomes, which are largely authored works rather than industrial products and designs.

The chapter proceeds with a discussion of the variables and data used in the analysis, the methodology employed, and the results for each education outcome. The final section concludes with a discussion of the results.

4.1 Variables of Interest

4.1.1 Dependent Variables

I examine the relationship between IPR and three sets of educational outcomes for various levels of education: enrollments, school life expectancy, and completion rates. Data on each outcome comes from the World Bank's Education Statistics database. The general theory being tested is that stronger IPR will make sending children to school, and keeping them in school through completion, more expensive for families, and will therefore result in worse education outcomes. I discuss each dependent variable in more detail and the specific hypotheses being tested in the sections that follow. Full definitions and descriptive statistics for all the dependent variables are found in Table 4.1.[14]

[14] One important education outcome that is notably missing from this list is literacy. Literacy is a critical outcome for all countries, especially developing countries. Unfortunately, large-N literacy data is incomplete and not extensive. When regressions were run on literacy statistics of many forms (adult, female, child, etc.), there were too few available observations to have confidence in the regression results. This was true for both fixed effects panel regressions and single-year OLS regressions. Literacy remains an essential education outcome, of course, but exploring the relationship between IPR and literacy will have to be done through case study and comparative methods rather than large-N statistical methods for now.

Table 4.1: Summary of Education-Related Dependent Variables

Variable	Description	Obs.	Mean	Standard Deviation	Min	Max
Primary School Enrollment Rate	The total enrollment in primary education expressed as a percentage of the population of official primary education age. Variable can exceed 100% due to the inclusion of over-aged and under-aged students because of early or late school entrance and grade repetition.	918	98.84	20.58	12.5	167.04
Secondary School Enrollment Rate	The total enrollment in secondary education expressed as a percentage of the population of official secondary education age. Variable can exceed 100% due to the inclusion of over-aged and under-aged students because of early or late school entrance and grade repetition.	734	69.4	33.88	1.11	158.27
Tertiary School Enrollment Rate	The total enrollment in tertiary education (ISCED 5 and 6) expressed as a percentage of the population of the five-year age group following on from secondary school leaving. Variable can exceed 100% due to the inclusion of over-aged and under-aged students because of early or late school entrance and grade repetition.	639	30.9	25.8	0.09	103.56

Table 4.1, Continued: Summary of Education-Related Dependent Variables

Variable	Description	Obs.	Mean	Standard Deviation	Min	Max
School Life Expectancy	The total number of years of schooling which a child of a certain age can expect to receive in the future, assuming that the probability of his or her being enrolled in school at any particular age is equal to the current enrollment ratio for that age.	840	10.07	2.82	0.83	16.41
Primary School Completion Rate	The total number of new entrants in the last grade of primary education, regardless of age, expressed as percentage of the total population of the theoretical entrance age to the last grade of primary. Variable can exceed 100% due to over-aged and under-aged children who enter primary school late/early and/or repeat grades.	671	78.99	25.74	5.56	117.44
Secondary School Completion Rate	The total number of new entrants in the last grade of secondary education, regardless of age, expressed as percentage of the total population of the theoretical entrance age to the last grade of secondary. Variable can exceed 100% due to over-aged and under-aged children who enter primary school late/early and/or repeat grades.	491	58.38	32.01	0.65	104.45

Descriptive statistics restricted to cases in the regression, i.e. are nonmissing on all included variables.

4.1.2 Intellectual Property Rights

The key explanatory variable is a measure of copyright strength developed by Tad Reynolds, and later updated by Walter Park (W. G. Park 2005; Reynolds 2003). Copyright strength is determined by coding each of four elements of copyright protection in each country for the specified year: (1) the duration of copyright protection for various product categories, (2) restrictions on unauthorized use of copyrighted material, (3) the availability of enforcement mechanisms, and (4) membership in copyright agreements and treaties. Each of the four elements is scored on a 0 to 1 scale and summed, so that each country's patent strength in a given year can range from 0 to 4. Higher values represent stronger levels of protection. This index is compiled annually, from 1965 – 2010 for 122 countries at all levels of development. In the analysis that follows, I examine the impact of the copyright index on each dependent variable, but I also disaggregate the index to examine the relative importance of each component of the index.

4.1.3 Control Variables

In addition to the copyright variable, the education regressions include five control variables. Each controls for potential intervening variables that might correlate with both IPR and educational outcomes. GDP, the polity score, and fertility rates are familiar controls from the previous chapter, but they have

theoretical importance for education outcomes as well.[15] Richer countries are likely to have both stronger copyright and better education outcomes. Additionally, richer countries are likely to have better educational outcomes regardless of the level of intellectual property protection. Likewise, the policy score is relevant as countries with more democratic forms of government are more responsive to public opinion, which generally favors education programs and may force governments to pay more attention to educational outcomes above and beyond simple government spending on education.

There is good reason to believe that when education is more expensive for families the impact on outcomes will be worse for young girls than young boys, especially in the developing world. Scholarly research, as well as work by the UN Children's Fund, the World Bank, and NGOs, has routinely observed that when circumstances restrict access to education, families tend to education boys more than girls (Bellamy 2004; M. A. Lewis and Lockheed 2006; Tembon and Fort 2008; Unterhalter and Oommen 2009). We want to compare the impact of IPR on education outcomes for men vs. women, so in order to isolate the role copyright plays it is important to control for gender attitudes in society. As before, I use the fertility rate as a proxy for gender attitudes, a practice well supported in the development literature (Boissiere 2004; M. Marmot et al. 2008; M. Marmot and Wilkinson 1999). All three of these variables also appear regularly in the literature on education outcomes (Davison 1993; J. Scott 2004).

[15] This chapter uses GDP rather than GNI for two reasons: first, using GDP increases the number of observations because GNI is missing for several cases that would otherwise be included. Second, GDP is itself more often statistically significant than GNI. Each regression was checked for robustness by using GNI instead, and there was no meaningful difference in the impact of IPR on each outcome.

Additional controls for educational expenditure and pupil-teacher ratios are included. More government spending on education could mitigate any negative impact of IPR, as the cost to families is reduced or subsidized by government spending. Likewise, when countries have more favorable pupil-teacher ratios, they may be able to work with fewer books and educational materials, reducing the importance of the cost of these items. The education literature suggests that these variables are important determinants of education in general, and their potential relationship with IPR make them worthy controls to include (Card and Krueger 1996; Case and Deaton 1999; Fowler and Walberg 1991). The polity variable comes from the Polity IV project, the education spending and pupil-teacher ratio variables comes from the World Bank's Education Statistics database, and the GDP and fertility rate data come from the World Bank's World Development Indicators. Table 4.2 includes full definitions and descriptive statistics for the independent variables.

Table 4.2: Summary of Education-Related Independent Variables

Variable	Description	Obs.	Mean	Standard Deviation	Min	Max
Copyright Strength	Index of copyright strength that ranges from 0-4, with higher values representing stronger patent protections.	918	2.04	1.04	0	3.89
Educational Expenditure (% GDP)	The total public expenditure on education expressed as a percentage of the Gross Domestic Product (GDP) in a given year. Public expenditure on education includes government spending on educational institutions (both public and private), education administration, and transfers/subsidies for private entities (students/households and other privates entities).	918	4.54	2.79	0.83	49.52
Gross Domestic Product (GDP)	GDP per capita in purchasing power parity.	918	7795.31	11657.55	78.28	59664.67
Polity Score	Scale ranging from +10 (strongly democratic) to -10 (strongly autocratic). Modified version for use in time-series analyses.	918	4.23	6.65	-10	10
Fertility Rate	The number of children that would be born to a woman if she were to live to the end of her childbearing years and bear children in accordance with current age-specific fertility rates.	918	3.45	1.96	1.08	8.29
Pupil-Teacher Ratio	The number of pupils enrolled divided by the number of school teachers.	918	29.79	14.41	9.55	88.92

Descriptive statistics restricted to cases in the regression, i.e. are nonmissing on all included variables.

4.2 Methods

This chapter employs similar methods as those used in the previous chapter on health outcomes. I examine the impact of copyright on each education outcome through fixed effects regressions with Huber/White robust standard errors, clustered at the country level. These robust standard errors are consistent even when the disturbances are not identically distributed over the panels or there is serial correlation in the error term. Of the regression models available to examine panel data, a fixed effects model is preferable for both theoretical and empirical reasons. Given the diversity of countries in the analysis, we have good reason to expect country specific fixed effects. This theoretical argument is confirmed by postestimation tests. A Hausman test after each regression, which checks mathematically for country specific effects, strongly confirms the presence of fixed effects, suggesting that both pooled OLS and random effects models would produce inconsistent estimators.

Unlike the previous analysis of health outcomes, however, these education regressions have significantly more observations. The copyright index is measured annually from 1965 – 2010, and data for government spending on education is available since 1970. The reader will recall that, in Chapter 3, we had patent data every five years and health spending data only since 1990. As a result, the fixed effects regressions presented here include data from 1970 – 2005 and have more observations, more within-country variation, and significantly more leverage. Notwithstanding this fact, I also ran single-year OLS regressions for each dependent variable. Missing data in some years restricted the number of countries in the OLS models, and each OLS returned

insignificant results for the copyright variable. As a result, I do not report the OLS models.[16]

As was the case with health outcomes, we have reason to believe that the impact of IPR on education might be different at different levels of development. To test whether or not this is true, I ran each model with interaction terms as described in Chapter 3. Interestingly, the level of development only mattered for one set of outcomes: tertiary enrollment rates. That difference is discussed in the relevant section below, but for every other outcome there was no difference in the impact of IPR for developed and developing countries.

I then disaggregate the copyright variable into its four components and test the impact of each component on the education outcomes. As I discussed above, the main explanatory variable captures four components of copyright strength: (1) the duration of copyright protection, (2) restrictions on unauthorized use of copyrighted material, (3) the availability of enforcement mechanisms, and (4) membership in copyright agreements and treaties. It may be informative to disaggregate this concept and to compare the impact of each of the four components on each education outcome. Perhaps one or more aspect of copyright is consistently more important than the others. Table 4.3 displays the method by which each of the copyright index is constructed.

[16] I also do not include the year dummy variables in the regression tables. Since there were many years in each model, it is impractical to report their coefficients in each table. Time fixed effects dummy variables were included in every model; some year dummies were significant and some were not, but none are reported directly.

Table 4.3: Components and Scoring Method for Copyright Variable

(1) Duration of Coverage	Calculation	Explanation
General Works	$0 < f < 70$	Calculated as a percentage of 70 years after the author's death, which is the international standard
Performances	$0 < f < 70$	Calculated as a percentage of 70 years after the author's death, which is the international standard
Sound Recordings	$0 < f < 70$	Calculated as a percentage of 70 years after the author's death, which is the international standard
Films	$0 < f < 70$	Calculated as a percentage of 70 years after the author's death, which is the international standard
Broadcasts	$0 < f < 70$	Calculated as a percentage of 70 years after the author's death, which is the international standard
Computer Programs	0, 1	Coded as 1 if covered, 0 if not covered
(2) Restrictions on Unauthorized Use	**Calculation**	**Explanation**
Private Use Allowances Without Payment (Fair Use)	0, 0.5, 1	Coded 1 if all use requires compensation, 0.5 if limited fair use allowed, 0 if extensive fair use allowed
Availability of Collective Licensing Schemes	0, 1	Coded 1 if collective licensing schemes are available, 0 if not
Compulsory Translation Licenses	0, 1	Coded 1 if no compulsory translation licenses are allowed, 0 if they are
(3) Enforcement Mechanisms	**Calculation**	**Explanation**
Criminal Provisions in the Copyright Law	0, 1	Coded 1 if criminial provisions exist in the law, 0 if only civil penalties are allowed
Preliminary Injunctions	0, 1	Coded 1 if preliminary injunctions are allowed, 0 if not
Seizure / Destruction of Infringing Goods	0, 1	Coded 1 if seizure and/or destruction of infiringing goods is allowed, 0 if not
Prohibition of Circumvention Devices	0, 1	Coded 1 if the law bans copyright circumvention devices, 0 if not
(4) Membership in Copyright Agreements	**Calculation**	**Explanation**
Berne	0, 1	Coded 1 if a signatory, 0 if not
ucc52	0, 2	Coded 1 if a signatory, 0 if not
Rome	0, 3	Coded 1 if a signatory, 0 if not
Geneva	0, 4	Coded 1 if a signatory, 0 if not
ucc71	0, 5	Coded 1 if a signatory, 0 if not
Brussels	0, 6	Coded 1 if a signatory, 0 if not
Wipocopy	0, 7	Coded 1 if a signatory, 0 if not
Wipoperf	0, 8	Coded 1 if a signatory, 0 if not
Trips	0, 9	Coded 1 if a signatory, 0 if not

where f is the duration of protection as a *percentage* of 70 years from the author's death. Each of the four components is an average of the scores for the included items. The overall copyright variable is the sum of the component scores. Thus, each component can take on values from 0-1 while the overall copyright variable can take on values from 0-4.

Finally, I lag the copyright variable five, ten, and fifteen years to see if copyright has a different impact on education after a period of time. The causal process we are assuming – whereby stronger copyright protections increase the costs of learning materials, which in turn increases the cost of sending children to school and keeping them in school through graduation – is admittedly a long causal chain. For this reason, the fourth analysis lags the copyright variable and examines the impact of copyright lagged 5 years, 10 years, and 15 years on each dependent variable.

4.3 Enrollment Rates

4.3.1 Primary, Secondary, and Tertiary School Enrollment Rates

The theory in question is that stronger IPR make it harder for people across the world, but especially in developing countries, to access knowledge and education. Stronger IPR, especially copyright protections, make textbooks, educational software, and other learning material more expensive. Absent help from the government, a more expensive education will lead to fewer children enrolled in school. The enrollment rate is the percentage of the primary, secondary, and tertiary school age population who are enrolled in school for that year. When increased costs force families to keep children at home, we also expect that impact to be larger for girls than for boys. Therefore, we are testing the following hypotheses:

H1: Countries with higher values for the copyright index will have lower primary, secondary, and tertiary enrollment rates.
(IPR coefficients with a negative sign)

H2: The magnitude of the negative impact on enrollment rates will be larger for the female population than for the male population.

As mentioned above, IPR supporters make the opposite argument, that stronger copyright protection will generate native development of educational materials and may in fact drive prices down. Additionally, increased economic growth that results from stronger IPR will make more money available for governments to invest in education and other factors that may affect educational outcomes. If we observe a positive significant impact of IPR on enrollments, we may have evidence to support this opposing view. However, since there is a logical argument that causality may run in the opposite direction, a positive significant impact may be the result of reverse causality, where countries with more educated populations are generating more intellectual property and, as a result, strengthen their IPR laws.

Tables 4.4, 4.5, and 4.6 present the results of regressions on primary, secondary, and tertiary enrollment rates. For primary enrollment, copyright strength appears to have a significant negative relationship with overall enrollment rates. A one-unit increase in the copyright score, which is a 25% increase in protection, is associated with a decrease in total primary school enrollment of 5.6537%. This impact is smaller for males, where a one unit increase in copyright is associated with a 3.6191% decline in enrollment, and it is larger for females, where a one unit increase in copyright corresponds to a 6.3008% decrease in enrollment. This evidence is strong support for the hypotheses presented

above. Stronger IPR do appear to be related to worse enrollment rates for men and women, with a larger impact on female enrollment.

Table 4.4: Primary School Enrollment Rates

	Total Primary School Enrollment (%)	Female Primary School Enrollment (%)	Male Primary School Enrollment (%)
Copyright	-5.6537***	-6.3008***	-3.6191*
	(1.4643)	(1.4492)	(1.4858)
Education Spending	2.4327*	2.0684*	2.5939**
	(0.9821)	(0.9437)	(0.9935)
GDP	-0.0003**	-0.0003**	-0.0003†
	(0.0001)	(0.0001)	(0.0001)
Polity	0.0299	0.1506	0.1289
	(0.1887)	(0.1977)	(0.1758)
Fertility Rate	-3.1637	-5.9016**	-1.6020
	(1.9834)	(1.9046)	(2.2534)
Pupil-Teacher Ratio	0.7398***	0.6771**	0.7815***
	(0.2018)	(0.2096)	(0.1998)
Constant	72.8018***	86.9513***	65.5554***
	(11.2631)	(11.2679)	(11.9382)
Observations	918	908	908
# Countries	108	107	107
# Years	16	16	16
R^2 Overall	0.0085	0.0826	0.0057
R^2 Within	0.5972	0.6411	0.5367
R^2 Between	0.0721	0.0025	0.0694

† Significant at 0.10 level
* Significant at 0.05 level
** Significant at 0.01 level
*** Significant at 0.001

Table 4.5: Secondary School Enrollment Rates

	Total Secondary School Enrollment (%)	Female Secondary School Enrollment (%)	Male Secondary School Enrollment (%)
Copyright	2.6843 (1.6251)	3.1448† (1.8974)	3.3805* (1.4153)
Education Spending	0.6394 (0.4302)	1.0384† (0.5775)	0.5707 (0.5093)
GDP	-0.0001 (0.0002)	-0.0001 (0.0002)	-0.0000 (0.0001)
Polity	-0.2078 (0.1945)	-0.2588 (0.2196)	-0.1384 (0.1931)
Fertility Rate	-5.7525** (2.0081)	-6.6968** (2.2881)	-4.5244* (1.8859)
Pupil-Teacher Ratio	0.2225 (0.1796)	0.1606 (0.2079)	0.3286† (0.1678)
Constant	53.0706*** (11.9376)	53.9547*** (13.7174)	48.1573*** (10.9418)
Observations	734	718	718
# Countries	106	105	105
# Years	16	16	16
R^2 Overall	0.5927	0.6377	0.5305
R^2 Within	0.7406	0.7156	0.7422
R^2 Between	0.6003	0.6450	0.512

† Significant at 0.10 level
* Significant at 0.05 level
** Significant at 0.01 level
*** Significant at 0.001

Table 4.6: Tertiary School Enrollment Rates

	Total Tertiary School Enrollment (%)	Female Tertiary School Enrollment (%)	Male Tertiary School Enrollment (%)
Copyright	5.3175**	5.2143*	6.5779**
	(1.9713)	(2.0057)	(2.4543)
Education Spending	0.8827	0.7903	0.9642
	(0.5425)	(0.5709)	(0.6112)
GDP	0.0007***	0.0007***	0.0005**
	(0.0002)	(0.0002)	(0.0002)
Polity	0.2041	0.0953	0.3043
	(0.2514)	(0.2030)	(0.3641)
Fertility Rate	2.1588	3.4957	0.8860
	(1.8470)	(2.3214)	(1.6615)
Pupil-Teacher Ratio	-0.5103*	-0.4775*	-0.6536*
	(0.2456)	(0.2026)	(0.3144)
Constant	-2.0270	-11.2351	10.0757
	(12.2541)	(15.2998)	(11.5020)
Observations	639	589	589
# Countries	104	101	101
# Years	16	16	16
R^2 Overall	0.6135	0.5535	0.5854
R^2 Within	0.7438	0.7699	0.7221
R^2 Between	0.5849	0.4772	0.5780

† Significant at 0.10 level
* Significant at 0.05 level
** Significant at 0.01 level
*** Significant at 0.001

In terms of control variables, education spending and the pupil-teacher ratio both have significant positive relationships with enrollment, while GDP/capita has a significant negative relationship. It is almost certainly the case that we are observing reverse causality for these variables. When enrollments are higher, governments must spend more money on education and classes will face larger student-teacher ratios. When enrollments are lower, young people are not in school and the population has less education overall, which leads to lower productivity and lower GDP. Making a causal argument in the other direction is much more tenuous. Additionally, the fertility rate is significant only for female primary school enrollment. This relationship could potentially be explained through a causal argument in either direction. On the one hand, lower enrollments leave young women out of school, which may give them an increased opportunity to become pregnant at a young age, increasing the number of children young women have in their lives and society's overall fertility rate. On the other hand, it might be the case that societies that have higher fertility rates also have less progressive gender attitudes, and as a result they do not prioritize formal education of young women, leading to lower enrollment rates. In fact, it may be the case that both of these processes are true. These control variable results are both interesting and worthy of further exploration. The purpose of including these variables is not to understand their individual relationships with enrollment rates, but rather to isolate the impact of copyright protection on enrollments.

For secondary and tertiary enrollment rates, we get significantly different results. At both the secondary and tertiary levels, copyright strength is significantly and positively related to enrollment. While the copyright variable is not significant in the

regression model for total secondary school enrollment, it is significant for male secondary school enrollment and approaches traditional levels of significance for female secondary school enrollment (p-vale = 0.10). A one-unit increase in copyright strength is associated with a 3.3805% increase in male secondary school enrollment and a 3.1448% increase in female secondary school enrollment (if we accept this p-value). Only the fertility rate control is significant for secondary school enrollment, and the direction and function of this variable are similar to what we observed for primary school enrollment.

The magnitude of the positive relationship between copyright and enrollments is even larger at the tertiary level. A one-unit increase in copyright strength is associated with a 5.3175% increase in total tertiary school enrollment, a 5.2143% increase in female tertiary school enrollment, and a 6.5779% increase in male tertiary school enrollment. For the control variables, the fertility rate is no longer significant, but GDP is positively related to enrollment and the pupil-teacher ratio (at the secondary school level) is negatively related to enrollment. The GDP relationship is easy to understand, as increases in GDP provide both the incentive and ability to attend university and other post-graduate programs. The negative relationship between secondary school pupil-teacher ratios and tertiary enrollments is more difficult to explain. It may be that secondary school pupil-teacher ratios are indicating lower quality educational systems, or educational systems with fewer resources in general. Countries with weak or overtaxed educational systems are likely to matriculate fewer individuals into university and post-graduate programs. This is just one potential explanation, and fully understanding this result would require follow up research.

Clearly, this evidence does not support the two hypotheses being tested, and in fact offers significant evidence that a relationship exists in the opposite direction. There are a few ways we might interpret the results for secondary and tertiary enrollment rates. This positive significant relationship could be the result of stronger copyright increasing the incentives for domestic authors to create new and better learning resources, which theoretically could be available at lower costs than imported books, software, and reference material. Alternatively, stronger IPR (copyright and other IPR) may be generating economic growth. Stronger growth might create additional public and private resources that drive down the cost of education, and stronger growth might increase the need for and incentive to pursue secondary and tertiary education. Finally, the observed relationship may be the result of reverse causality, where higher enrollments are driving government decisions about IPR and copyright law. When more of the population is enrolled in secondary and especially tertiary education, countries may be generating more human capital and creating more intellectual property and authored works, increasing the incentive for governments to protect intellectual property. Rather than copyright driving enrollments, higher enrollments may be leading to stronger copyright protections. I discuss this reverse causality argument in more detail in the discussion section below.

4.3.2 Enrollment Rates by Level of Development

By including interaction terms for the level of development, a methodology described in detail in the previous chapter, we can determine if the relationship between copyright and enrollment rates is different for developed countries than for developing

ones. For primary and secondary enrollment the results suggest there is no difference based on the level of development. Both developing and developed countries experience a negative relationship between copyright and primary enrollment and a positive relationship between copyright and secondary enrollment. There was, however, a difference for tertiary enrollment rates. Table 4.7 reports the results for tertiary enrollment. The first copyright coefficient reports the relationship between copyright and enrollment in developing countries, while the second copyright coefficient reports the *difference* in the relationship for developed countries. The total impact of copyright on enrollment in developed countries is the *sum* of the two coefficients. According to these results, copyright has a significant positive effect on enrollments for both developing and developed countries, but magnitude of the impact is much larger in the developed world. In developing countries, a one unit increase in copyright corresponds to a 3.3216% increase in total tertiary enrollment, a 2.9889% increase in female tertiary enrollment, and a 4.4261% increase in male tertiary enrollment. In developed countries, the size of the impact is two to three times as large: a 10.091% increase overall, a 9.493% increase for women, and a 10.7339% increase for men. The significance, direction, and magnitude of the coefficients for the control variables are the same as reported above for tertiary enrollment.

Table 4.7: Tertiary School Enrollment at Different Levels of Development

	Total Tertiary School Enrollment (%)	Female Tertiary School Enrollment (%)	Male Tertiary School Enrollment (%)
Copyright for Developing Countries	3.3216* (1.6471)	2.9889† (1.7575)	4.4261* (2.1332)
Difference in Effect of Copyright for Developed Countries	6.7694** (2.5734)	6.5041* (2.8537)	6.3078** (2.3360)
Development Dummy	-9.0413 (6.1617)	-8.2395 (7.0526)	-8.0896 (5.9675)
Education Spending	0.6929 (0.4384)	0.6398 (0.4693)	0.8202 (0.5105)
GDP	0.0005** (0.0002)	0.0006*** (0.0002)	0.0004* (0.0002)
Polity	0.2128 (0.2159)	0.1305 (0.1686)	0.3388 (0.3260)
Fertility Rate	0.8749 (1.7507)	2.0979 (2.1645)	-0.4621 (1.5281)
Pupil-Teacher Ratio	-0.4134* (0.2054)	-0.3762* (0.1746)	-0.5567* (0.2642)
Constant	2.9747 (11.2717)	-6.4576 (14.5707)	14.7163 (10.2632)
Observations	639	589	589
# Countries	104	101	101
# Years	16	16	16
R^2 Overall	0.6999	0.6572	0.6603
R^2 Within	0.7767	0.7936	0.7577
R^2 Between	0.6966	0.6385	0.6763

† Significant at 0.10 level
* Significant at 0.05 level
** Significant at 0.01 level
*** Significant at 0.001 level

Whether this positive relationship between tertiary enrollments is the result of domestic innovation, increased economic growth, or reverse causality, the relationship is apparently much stronger in the developed world. This could be a function of more sophisticated educational systems, higher levels of domestic innovation, and more developed intellectual property-related industries in the developed world, although the exact causal link is unclear from these results.

4.3.3 Disaggregated Copyright Scores and Enrollment Rates

We can examine the impact of each of the four components of the copyright measure on enrollment rates separately. Table 4.8 presents these results. To make the tables easier to read, I report only the copyright coefficients for each model. The models each have the same number of observations as the combined IPR models above, and the significance and direction of the control variables are the same as reported above. The first column reports the coefficient for the combined copyright variable. The next four columns display the results for each component of copyright.

An important caveat is needed here. Recall that the combined variable was constructed by adding the four component parts. Each of the four components is on a scale from 0 to 1, with 0 indicating no protection of that component and 1 indicating complete protection. The combined variable can take on values between 0 and 5, while each component part can take on values between 0 and 1.

Table 4.8: Disagregated Copyright on Enrollments

Dependent Variable	Combined Copyright	Duration	Restrictions	Enforcement	Membership
Total Primary School Enrollment	-5.6537*** (1.4643)	-13.3230** (4.4324)	-13.6356** (4.4011)	-8.4745** (3.2174)	-8.3178 (5.1369)
Female Primary School Enrollment	-6.3008*** (1.4492)	-14.5497** (4.8632)	-14.4066*** (4.1426)	-9.2503** (3.4258)	-9.7093 (6.3182)
Male Primary School Enrollment	-3.6191* (1.4858)	-8.9423* (4.3963)	-8.4232* (4.1122)	-5.8857† (3.2331)	-3.1626 (5.2403)
Total Secondary School Enrollment	2.6843 (1.6251)	6.8778 (5.3076)	5.0271 (4.2817)	1.0599 (3.6428)	10.8322† (5.5852)
Female Secondary School Enrollment	3.1448† (1.8974)	7.7180 (6.0030)	7.7005† (4.6249)	1.2583 (4.2534)	9.1673 (6.2388)
Male Secondary School Enrollment	3.3805* (1.4153)	7.6512 (4.9848)	5.6184 (4.4712)	1.9247 (3.3085)	13.5151** (4.8862)
Total Tertiary School Enrollment	3.3216* (1.6471)	10.4929* (4.9130)	8.0729 (5.1885)	8.0439* (4.0101)	16.6845* (6.6633)
Female Tertiary School Enrollment	2.9889† (1.7575)	11.4169† (5.8772)	6.2525 (4.9062)	7.0168 (4.6911)	19.2345** (7.2570)
Male Tertiary School Enrollment	4.4261* (2.1332)	13.1164* (6.3517)	11.0378† (6.2765)	8.2860* (4.0440)	21.3851** (6.6938)

† Significant at 0.10 level
* Significant at 0.05 level
** Significant at 0.01 level
*** Significant at 0.001 level

When we are examining regression coefficients we can compare directly across the four components of copyright that are on the same scale, but we must be careful comparing the impact of any single component to the combined variable, as these will be on different scales. While a one-unit increase in the combined copyright value is a 25% increase in protection, a one-unit increase in one of the component parts is a 100% increase.

For primary school enrollment, only treaty membership is insignificant. Copyright duration, restrictions on unauthorized use, and enforcement mechanisms are all

statistically significant and negative, with a one-unit (100%) increase in each component corresponding to a roughly 5.9% - 14.5% decrease in enrollments. In terms of magnitude, duration and restrictions have relatively equal impacts on enrollment, while enforcement has a smaller impact. As is the case with the combined copyright measure, stronger protections decrease enrollment more for women than for men. We can conclude from these results that duration and usage appear to have large impacts on enrollments, enforcement a meaningful but smaller impact, and treaty membership alone no impact.

The results for secondary and tertiary enrollment are different. At the secondary school level, the positive relationship between copyright and male enrollment is explained entirely by treaty membership, which is the only component that is statistically significant. Treaty membership's impact is also quite large, with a one-unit (100%) increase in treaty membership corresponding to a 13.5151% increase in male secondary school enrollment. At the tertiary level, duration, enforcement, and treaty membership are each significant for total enrollment and male enrollment, while only duration and treaty membership are significant for female enrollment. In terms of magnitude, treaty membership has the largest impact, with a one-unit (100%) increase in membership corresponding to an increase in total enrollment of 16.6845%, in female enrollment of 19.2345%, and in male enrollment of 21.3851%. The size of the coefficient is smaller for duration, where a one-unit increase is related to enrollment increases between 10.5% – 13.1%. The relationship between tertiary enrollment and enforcement is smaller still, with a one-unit increase in enforcement related to an 8.0439% increase in total tertiary enrollment and 8.2860% increase in male tertiary enrollment.

What general conclusions can we draw from these disaggregated copyright results? First, these results confirm the finding from the combined copyright variable that the relationship between copyright and enrollments functions differently at the primary level than it does at the secondary and tertiary level. For primary school, copyright and its components are negatively related to enrollments, offering evidence in support of the hypothesis that stronger copyright protections drive up the cost of school and decrease primary school enrollment. At the secondary and tertiary level, there appears to be a relationship in the opposite direction, with stronger protections associated with higher enrollments. This is true for the copyright components as well as the aggregate copyright measure.

The second general conclusion is that each of the four components of copyright matter for some enrollments and not others. Treaty membership does not seem to be significant in the negative relationship between primary school enrollment and copyright, but it is highly significant with large impacts in the positive relationship between secondary and tertiary enrollment and copyright. Meanwhile, although restrictions on unauthorized use is significant for primary school enrollments, it is not significant for secondary and tertiary enrollments. Apparently, each of these four components matters, but does not matter consistently across all enrollment measures.

4.3.4 Lagged Copyright and Enrollment Rates

As was the case in the previous chapter, we might expect it to take time for IPR to have an impact on a macro-level measures of education. Rather than examining only

contemporary copyright levels, I lagged the copyright variable five, ten, and fifteen years and included the lagged variable as the key explanatory factor in each regression. Table 4.9 reports the results for primary, secondary, and tertiary enrollment rates. Again I report only the copyright coefficients to make the table easy to read. The number of observations and the results for the control variables are roughly identical to the contemporary models reported above.

When lagged five and ten years, copyright strength appears to have similar impacts on enrollments as contemporary copyright strength. The direction, significance, and magnitude of lagged copyright is almost identical for primary and secondary enrollment rates. Tertiary enrollment is the one place we see some slight differences. Five and ten year lagged copyright are significantly and positively related to tertiary enrollments, but the level of significance is stronger and the magnitude of the impact is larger. While a one-unit increase in contemporary copyright strength is associated with a 3.3% - 4.4% increase in tertiary enrollment, significant at the 0.05 level, five and ten year lagged copyright is associated with a 6.1% - 7.2% increase in tertiary enrollment, significant at the 0.001 level. Interestingly, copyright lagged fifteen years is not significant at all for primary and secondary enrollment, and is less significant with smaller coefficients for tertiary enrollment.

Table 4.9: Lagged Copyright on Enrollments

Dependent Variable	Contemporary Copyright	Copyright Lagged 5 Years	Copyright Lagged 10 Years	Copyright Lagged 15 Years
Total Primary School Enrollment	-5.6537***	-5.4346***	-4.5572***	-1.1726
	(1.4643)	(1.3095)	(1.3007)	(1.2611)
Female Primary School Enrollment	-6.3008***	-5.8056***	-4.6070***	-0.5352
	(1.4492)	(1.2249)	(1.2792)	(1.2252)
Male Primary School Enrollment	-3.6191*	-3.7860**	-3.7710**	-0.9080
	(1.4858)	(1.3130)	(1.2892)	(1.2193)
Total Secondary School Enrollment	2.6843	2.8545†	2.2761	1.2434
	(1.6251)	(1.6371)	(1.4706)	(1.5362)
Female Secondary School Enrollment	3.1448†	3.8466†	3.1505†	1.8374
	(1.8974)	(1.9788)	(1.8016)	(1.7343)
Male Secondary School Enrollment	3.3805*	2.7874†	2.0255	0.5590
	(1.4153)	(1.4554)	(1.3530)	(1.4129)
Total Tertiary School Enrollment	3.3216*	6.1294**	6.1883***	3.2046*
	(1.6471)	(1.8945)	(1.8912)	(1.3160)
Female Tertiary School Enrollment	2.9889†	6.1834***	6.3705***	3.7018**
	(1.7575)	(1.7862)	(1.7733)	(1.2620)
Male Tertiary School Enrollment	4.4261*	6.4440**	7.2159**	4.5265**
	(2.1332)	(2.2283)	(2.2328)	(1.4867)

† Significant at 0.10 level
* Significant at 0.05 level
** Significant at 0.01 level
*** Significant at 0.001 level

These results suggest that, for the most part, lagging the copyright variable does not produce significantly different relationships between copyright and enrollment. If anything, after some time copyright may have slightly larger impacts on tertiary enrollment (or vice-versa, depending on the direction of causality).

4.4 School Life Expectancy

4.4.1 Total, Female, and Male School Life Expectancy

The World Bank tracks another educational benchmark called school life expectancy, which is the total number of years of schooling a child of a certain age can expect to receive in the future, including primary and lower secondary levels of education. If stronger copyright protections make textbooks and other educational resources more expensive, preventing access to education for young people, we would expect school life expectancy rates to decline. As before, we might expect this negative impact on school life expectancy to be worse for young girls. Thus, we are testing the following hypotheses:

H3: Countries with higher values for the copyright index will have lower school life expectancy rates.
(IPR coefficients with a negative sign)

H4: The magnitude of the negative impact on school life expectancy will be larger for the female population than for the male population.

As before, we must consider the counter argument from IPR supporters that stronger copyright protection will increase economic growth, making more money available for governments to invest in education. If we observe a positive significant impact of copyright on school life expectancy, we may have evidence to support this opposing view. Reverse causality is also still a possibility, so a positive significant impact may be

the result of countries with more educated populations generating more intellectual property and, as a result, strengthening their IPR laws.

Table 4.10 presents the results for total, female, and male school life expectancy. Copyright appears to have a significant negative impact on school life expectancy for the total population, for females, and for males. A one-unit (25%) increase in copyright strength is associated with a decrease in school life expectancy of 0.4176 years for the full population, 0.4242 years for the female population, and 0.2610 years for the male population. Countries represented in the regression model had minimum school life expectancy values close to zero and maximum values of 16.41 years, with an average school life expectancy of 10.07 years. For the average country, a decrease in school life expectancy of nearly half a year is a 5% overall decrease resulting from a 25% increase in copyright protection. This is a substantively significant result. For the control variables, education spending is positively related, and fertility rates are negatively related to school life expectancy, which is similar to the results observed for enrollment rates discussed above. This evidence supports the hypotheses being tested: stronger copyright protections appear to be related to lower school life expectancy rates, and the magnitude of that negative impact is considerably larger for females than males. I mentioned above, but will repeat here, that this result holds for countries at all levels of development. There is no difference in the impact of copyright on school life expectancy for developed vs. developing nations.

Table 4.10: School Life Expectancy Rates

	Total School Life Expectancy	Female School Life Expectancy	Male School Life Expectancy
Copyright	-0.4176***	-0.4242**	-0.2610*
	(0.1268)	(0.1452)	(0.1199)
Education Spending	0.2091*	0.2296**	0.2419**
	(0.0821)	(0.0768)	(0.0854)
GDP	-0.00002	-0.00002	-0.00002
	(0.00001)	(0.00002)	(0.00002)
Polity	-0.0044	0.0037	0.0089
	(0.0168)	(0.0183)	(0.0158)
Fertility Rate	-0.3510*	-0.5505**	-0.2025
	(0.1522)	(0.1740)	(0.1641)
Pupil-Teacher Ratio	0.0201	0.1377	0.0272†
	(0.0156)	(0.0163)	(0.0158)
Constant	7.7988***	8.5080***	7.0066***
	(0.9491)	(1.0380)	(0.9283)
Observations	840	804	804
# Countries	106	105	105
# Years	16	16	16
R^2 Overall	0.1251	0.3139	0.0565
R^2 Within	0.7274	0.7501	0.6934
R^2 Between	0.0498	0.2369	0.0027

† Significant at 0.10 level
* Significant at 0.05 level
** Significant at 0.01 level
*** Significant at 0.001

4.4.2 Disaggregated Copyright Scores and School Life Expectancy

Table 4.11 presents the results for disaggregated copyright components. Among the four components of copyright protection, the most consistently relevant factor is the availability of restrictions on unauthorized use. This component is statistically significant or close to traditional levels of significance for total, male, and female school life expectancy (p-value = 0.07 for female school life expectancy). Countries who have all three restrictions experience school life expectancy rates 1.0939 years shorter for the total population, 0.8833 years shorter for females, and 0.7442 years shorter for males than countries that have none of the three restrictions. In the regression model for total school life expectancy, the duration of coverage component and the enforcement component are also significant (p-value = 0.078 for enforcement). A one-unit (100%) increase in duration is associated with a 0.8891 year decrease in total school life expectancy, while a one-unit (100%) increase in enforcement is associated with a 0.5132 year decrease in school life expectancy (assuming we accept this p-value). Finally, membership in copyright treaties is very close to traditional levels of significance (p-value = 0.056), but only for female school life expectancy. From these results we can conclude that each of the four components appears to matter to some degree, and the restrictions components is the most consistently important, with the largest coefficients.

Table 4.11: Disagregated Copyright on School Life Expectancy

Dependent Variable	Combined Copyright	Duration	Restrictions	Enforcement	Membership
Total School Life Expectancy	-0.4176*** (0.1268)	-0.8891* (0.4204)	-1.0939** (0.3888)	-0.5132† (0.2882)	-0.7274 (0.4485)
Female School Life Expectancy	-0.4242** (0.1452)	-0.7707 (0.4892)	-0.8833* (0.4037)	-0.5146 (0.3184)	-1.0929† (0.5664)
Male School Life Expectancy	-0.2610* (0.1199)	-0.4782 (0.3836)	-0.7442† (0.4067)	-0.3333 (0.2861)	-0.3033 (0.4362)

† Significant at 0.10 level
* Significant at 0.05 level
** Significant at 0.01 level
*** Significant at 0.001 level

4.4.3 Lagged Copyright and School Life Expectancy

Once again we can lag the copyright variable to see if the impact of copyright on school life expectancy is different after a period of time. Table 4.12 presents these results, which are similar to the lagged copyright results for school enrollment rates. Lagged five and ten years, copyright has roughly the same effect on school life expectancy rates as contemporary copyright levels. This result is true for the total population, for males, and for females. We do not learn much new about the relationship between copyright and school life expectancy from these results, but there is no evidence that contradicts the hypotheses in question. Copyright protection appears to have a significant negative impact on school life expectancy rates for male and female students, with a one-unit increase in copyright strength corresponding to a 0.29 – 0.38 year reduction in school life expectancy.

Table 4.12: Lagged Copyright on School Life Expectancy

Dependent Variable	Contemporary Copyright	Copyright Lagged 5 Years	Copyright Lagged 10 Years	Copyright Lagged 15 Years
Total School Life Expectancy	-0.4176*** (0.1268)	-0.3841** (0.1198)	-0.3468** (0.1283)	-0.1695 (0.1182)
Female School Life Expectancy	-0.4242** (0.1452)	-0.3327* (0.1337)	-0.2908* (0.1381)	-0.1070 (0.1226)
Male School Life Expectancy	-0.2610* (0.1199)	-0.2954** (0.1124)	-0.3099* (0.1225)	-0.2097† (0.1072)

† Significant at 0.10 level
* Significant at 0.05 level
** Significant at 0.01 level
*** Significant at 0.001 level

4.5 School Completion Rates

4.5.1 Primary and Secondary School Completion Rates

If stronger copyright protections make sending kids to school more expensive, we might expect fewer students to complete each level of their education. World Bank data is available on primary and secondary school completion rates for male and female students, as well as the total student population. I test the following hypotheses:

H3: Countries with higher values for the copyright index will have lower primary and secondary school completion rates.
(IPR coefficients with a negative sign)

H4: The magnitude of the negative impact on school completion rates will be larger for the female population than for the male population.

Given the counterargument from IPR supporters that stronger IPR will lead to growth and ultimately better education outcomes – and the potential for reverse causality – this is also a test of which effect of copyright is stronger: the positive impact on education through growth or the negative impact on education through prices.

Tables 4.13 and 4.14 present the results for primary and secondary school completion rates. At the primary level, we observe a significant negative relationship between copyright strength and completion rates. A one-unit (25%) increase in copyright strength is associated with a 2.6881% decrease in total primary school completion and a 4.0008% decrease in female primary school completion, and a 2.1064% decrease in male primary school completion (p-value = 0.095). Controls for education spending and the fertility rate are significant and function in the direction we would expect, with increases in spending improving completion rates while higher fertility rates are associated with lower completion rates, especially for women. As was the case with primary school enrollment rates, higher GDP is significantly associated with lower completion rates, which may be the result of reverse causality as societies with lower completion rates have a less educated society and lower worker productivity.

Table 4.13: Primary School Completion Rates

	Total Primary School Completion Rate	Female Primary School Completion Rate	Male Primary School Completion Rate
Copyright	-2.6681* (1.1846)	-4.0008** (1.4185)	-2.1064† (1.2496)
Education Spending	2.4569*** (0.6493)	2.1465** (0.7061)	2.7447*** (0.7105)
GDP	-0.00035*** (0.00009)	-0.00031** (0.0001)	-0.00025* (0.00010)
Polity	0.0284 (0.1991)	-0.0951 (0.2348)	-0.0349 (0.2118)
Fertility Rate	-3.6489** (1.3357)	-6.3917*** (1.6179)	-2.9235† (1.6612)
Pupil-Teacher Ratio	0.1249 (0.1158)	0.1156 (0.1329)	0.2057 (0.1262)
Constant	56.1416*** (7.9687)	68.6977*** (10.6937)	53.9844*** (9.2738)
Observations	671	628	628
# Countries	94	89	89
# Years	15	15	15
R^2 Overall	0.2405	0.4225	0.1086
R^2 Within	0.6510	0.6653	0.5508
R^2 Between	0.1422	0.3571	0.0234

† Significant at 0.10 level
* Significant at 0.05 level
** Significant at 0.01 level
*** Significant at 0.001

Table 4.14: Secondary School Completion Rates

	Total Secondary School Completion Rate	Female Secondary School Completion Rate	Male Secondary School Completion Rate
Copyright	0.2654 (1.4921)	-0.8593 (1.7479)	0.8635 (1.2447)
Education Spending	0.6925 (0.7079)	0.8971 (0.6976)	1.0697 (0.6874)
GDP	0.00002 (0.00001)	-0.00002 (0.0001)	-0.00003 (0.0001)
Polity	-0.3869 (0.2461)	-0.5558* (0.2725)	-0.6507* (0.2725)
Fertility Rate	-4.4580* (2.0507)	-4.6349† (2.7214)	-2.6011 (2.6791)
Pupil-Teacher Ratio	-0.1264 (0.1505)	-0.1817 (0.1626)	-0.1146 (0.1601)
Constant	51.7791** (15.9793)	62.4161*** (17.7044)	52.5281** (16.4366)
Observations	491	458	458
# Countries	86	82	82
# Years	14	14	14
R^2 Overall	0.6065	0.5544	0.3576
R^2 Within	0.6491	0.6468	0.5972
R^2 Between	0.6737	0.6216	0.3949

† Significant at 0.10 level
* Significant at 0.05 level
** Significant at 0.01 level
*** Significant at 0.001

These results offer strong support for the hypotheses being tested. Stronger copyright protection appears to have a significant and negative impact on primary school completion. Interestingly, none of these results hold for secondary school completion rates. Copyright strength, as well as nearly all the control variables, appears to have no impact on or relationship with secondary school completion.

4.5.2 Disaggregated Copyright and School Completion Rates

Table 4.15 presents the results for disaggregated copyright components. For secondary school completion, none of the components is statistically significant, which mirrors the results for the combined copyright variable. For primary school completion, the negative relationship observed for the combined measure is explained by two of the four components: duration of protection and restrictions against unauthorized use. The magnitude of the impact of the restrictions component is slightly larger than the impact of the duration variable, although both are quite large, with a one-unit (100%) increase in each component associated with a 6.7% - 12.5% decrease in primary school completion. For both components, as was the case for the combined copyright measure, the negative impact is slightly larger for female students than for male students. We can conclude that duration and restrictions are both important determinants of primary school completion rates, while the presence of enforcement mechanisms and membership in copyright treaties are not.

Table 4.15: Disagregated Copyright on Completion Rates

Dependent Variable	Combined Copyright	Duration	Restrictions	Enforcement	Membership
Total Primary School Completion Rate	-2.6681* (1.1846)	-7.5427† (4.0544)	-10.1510** (3.4779)	-2.8966 (2.7440)	1.9763 (5.0569)
Female Primary School Completion Rate	-4.0008** (1.4185)	-9.7095† (4.9495)	-12.4623** (3.8346)	-4.8047 (3.1878)	-1.8046 (5.9387)
Male Primary School Completion Rate	-2.1064† (1.2496)	-8.5059* (4.2185)	-6.7455† (3.8541)	-1.7943 (2.9180)	1.6370 (5.2097)
Total Secondary School Completion Rate	0.2654 (1.4921)	0.1773 (4.8932)	-2.5355 (4.3262)	1.1130 (3.5799)	3.5059 (4.9306)
Female Secondary School Completion Rate	-0.8593 (1.7479)	-4.7259 (5.4333)	-5.0610 (4.1166)	0.6505 (4.1625)	1.3485 (5.2777)
Male Secondary School Completion Rate	0.8635 (1.2447)	-1.2771 (5.0577)	-0.2103 (4.4900)	0.8148 (3.4664)	8.2619† (4.2879)

† Significant at 0.10 level
* Significant at 0.05 level
** Significant at 0.01 level
*** Significant at 0.001 level

4.5.3 Lagged Copyright Scores and School Completion Rates

The results for lagged copyright strength are presented in Table 4.16 and follow the patterns observed for the lagged measure in the previous analyses. At five, ten and fifteen years lagged, copyright continues to have a significant negative relationship with primary school completion rates. The five-year lag coefficients are more statistically significant and slightly larger than the contemporary copyright coefficients, although the size of the coefficients at ten and fifteen years prior are slightly smaller. These results suggest that copyright levels from five years ago may have a slightly larger impact on primary school completion, and that the impact of copyright on completion rates may diminish slightly over time. At five and ten years lagged, copyright continues to have a

larger negative impact on female primary school completion rate than male rates. All of these results continue to support the hypotheses being tested, that countries with stronger copyright protections should experience worse primary school completion rates, and that this negative impact should be larger for female students than male students.

Table 4.16: Lagged Copyright on Completion Rates

Dependent Variable	Contemporary Copyright	Copyright Lagged 5 Years	Copyright Lagged 10 Years	Copyright Lagged 15 Years
Total Primary School Completion Rate	-2.6681* (1.1846)	-3.6096** (1.1750)	-2.8914* (1.3194)	-2.3356† (1.2203)
Female Primary School Completion Rate	-4.0008** (1.4185)	-5.1888*** (1.1806)	-4.0733** (1.4128)	-2.5662* (1.2896)
Male Primary School Completion Rate	-2.1064† (1.2496)	-3.6885** (1.2321)	-2.7545† (1.4592)	-2.2388† (1.2897)
Total Secondary School Completion Rate	0.2654 (1.4921)	0.8088 (1.5447)	-0.5154 (1.3316)	-1.1114 (1.3419)
Female Secondary School Completion Rate	-0.8593 (1.7479)	-0.4681 (1.6156)	-0.3373 (1.4091)	-0.2034 (1.3474)
Male Secondary School Completion Rate	0.8635 (1.2447)	0.9906 (1.4608)	0.6283 (1.2789)	0.8718 (1.4349)

† Significant at 0.10 level
* Significant at 0.05 level
** Significant at 0.01 level
*** Significant at 0.001 level

At the secondary level, the lagged copyright models follow the results found in the contemporary copyright models: there does not appear to be any relationship – positive or negative – between copyright protections and secondary school completion rates.

4.5 Discussion & Conclusion

I will conclude with a few general comments. When it comes to education outcomes both IPR skeptics and IPR supporters may find evidence presented here to support their viewpoint. Stronger copyright protections are associated with worse education outcomes at the primary school level; the evidence is mixed at the secondary level; and the relationship operates in the other direction at the tertiary level. The fixed effect regressions demonstrate a significant, negative relationship between copyright strength and primary school enrollment rates, school-life expectancy (for primary through lower secondary school), and primary school completion rates. Each of these relationships is true for males, females, and the total student population, and the magnitude of the impact of copyright on each education outcome was larger for females than for males. Unlike the results for secondary and tertiary enrollment, there is no reverse causality argument to be made, so these results are fairly compelling evidence in support of the hypotheses being test and the argument that stronger copyright protections are a barrier to access to education.

On the other hand, the results are quite different for secondary and tertiary education, where we find statistically significant but positive relationships between copyright strength and enrollment rates. For tertiary enrollment, we have evidence that the impact of copyright is different at different levels of development. There is a statistically significant positive relationship for all countries, but a much larger impact for developed countries.

As discussed above, there are three potential explanations for this positive relationship. First, stronger copyright (and other IPR) may be stimulating domestic creation of educational materials, making those materials cheaper. Alternatively, stronger copyright (and other IPR) may be stimulating overall economic growth. This may have two beneficial effects on enrollments, increasing public and private resources and student/family financial conditions that allow students to stay enrolled, while at the same time increasing the economic incentive to attend secondary and tertiary programs. Finally, we may be observing reverse causality with enrollment rates driving copyright protection. When more students are enrolled in secondary and tertiary education, society is developing more human capital and higher capacity for developing intellectual property and authored works. This increases the incentive for governments to protect intellectual property as citizens shift from importers of intellectual property to creators of intellectual property. All three of these explanations make logical sense.

Here it is helpful to return to the political and institutional factors that play into the relationship between IPR and human outcomes. One argument *against* reverse causality has to do with the process by which countries have been reforming IPR law in the recent past. For most of the developing world, changes to IPR protections have come not endogenously through economic growth and the growth of knowledge industries, but through joining the WTO and bilateral and multilateral political pressure from the richer and more powerful economies of the world. Sifting through these three explanations, and determining the causal process by which secondary and tertiary enrollments are related to copyright strength, is one of the

most promising opportunities for future research beyond this dissertation. The case study in Chapter 6 explores these institutional factors in more detail.

One of the most surprising findings from these analyses involves the impact of copyright at different levels of development. I began the analysis with the assumption found in the access to knowledge literature that the negative impact of copyright on education would be worse in the developing world. The evidence presented here does not support that conclusion. Tertiary enrollment rates – where we find a positive relationship – is the one and only model in which the impact is different at different levels of development. The statistically significant negative relationship observed for primary school enrollment rates, school-life expectancy rates, and primary school completion rates is the same in developing and developed states. Understanding why there is not a larger difference between countries at different levels of development is another promising direction for follow-up research.

We can draw fewer concrete conclusions from the models with disaggregated and lagged copyright measures. These results do not contradict the combined copyright model results: we still observe significant and negative relationships for primary enrollments, school life expectancy, and primary completion rates as well as positive relationships for secondary and tertiary enrollment rates. The four components of copyright – duration of protection, restrictions on unauthorized use, the availability of enforcement mechanisms, and membership in treaties – each appears to be important for some outcomes and not others. Treaty membership clearly matters more for the positive impact on secondary and tertiary enrollment

rates, and this component is not significant in the models that result in a negative impact on education outcomes. The other three components sometimes matter and sometimes do not. The lagged copyright analyses offer similarly vague results. At no point does the direction of the relationship change when the copyright variable is lagged (something that did happen in the previous chapter). For the most part, copyright strength lagged five and ten years remains statistically significant and in the same direction as contemporary copyright strength.

In conclusion, these analysis offer support to IPR skeptics when we consider primary school outcomes, but offer support to IPR supporters when we consider secondary and tertiary school outcomes. While not conclusive, these results offer good suggestive evidence that copyright presents a barrier to education for young students, but not for older students. At some point later in the educational process, copyright protection and education are mutually reinforcing rather than at odds with one another, although the exact nature of that causal link remains to be investigated further.

Chapter 5

The Impact of IPR on Inequality

Income inequality is the third and final aspect of human development this project will examine. As was the case in the previous two chapters, the goal is to empirically test the assertion by some NGOs, activists, and scholars that strengthening IPR is bad for human development, especially in developing countries. This chapter begins with a discussion of the theoretical link between IPR and inequality, followed by a discussion of the variables and data used in the analysis, the methodology employed, and the outcome of the analysis. The final section concludes with a discussion of the results.

The theoretical relationship between IPR and inequality is more complicated than IPR's relationship with health and education. Causal mechanisms operate both from an economic argument about the "winners" and "losers" of strong IP regimes, as well as indirectly through the other two social objectives: education and health.

From an economic standpoint, strengthening IPR may worsen income inequality by encouraging economic growth. A higher growth rate increases the rate of return on assets, thus increasing the income of asset-wealthy households relative to asset-poor households (Adams 2008; Chu 2009; Chu and Peng 2009). In other words, stronger IPR benefit property holders and those in society who have the capacity and resources for innovation and investment. The 'losers' in the equation are domestic entrepreneurs who count on imitation of existing products for their own economic success, along with farmers, the working poor, and others who do not depend on IP-related products and services. The importance of imitation as an economic driver has been widely noted by

opponents and supporters of IPR alike (Chen and Puttitanun 2005; Maskus 2000a, 2000b). In effect, stronger IPR redistribute wealth from the users of intellectual property to the owners and creators of intellectual property. To be sure, economic growth is a good thing for development. The argument here is a familiar one many scholars make regarding globalization in general: that IPR can spur economic growth while simultaneously worsening income inequality.

In addition to this economic logic, there is a second causal link involving education and health outcomes. If stronger IPR raise the cost of education, the education gap between the rich and poor will widen, while those with means can afford private education and more educational resources. As the education achievement gap grows, income and wealth inequality also increases. In this way, stronger IPR reinforces existing inequality within societies.

Similarly, if stronger IPR increase the costs of medicines, medical technology, infrastructure, and medical access, the poor in society will suffer disproportionately. In developing countries, any illness in the family can lead to what Whitehead, Dahlgren, and Evans have called medical poverty traps (Whitehead, Dahlgren, and Evans 2001). A vicious cycle of poor nutrition, foregone education, and additional illness emerges. The poor struggle to take care of sick family members, leading to reductions in family-level income. Meanwhile, those with financial resources can afford to take care of sick family members while maintaining their own educational and work lives, avoiding the medical poverty trap. Operating through one or more of these causal processes, stronger IPR thus result in worsened income inequality.

5.1 Variables of Interest

5.1.1 Dependent Variables

I examine the impact of IPR on two measures of income inequality: the Gini index and the Palma ratio. The Gini index, also known as the Gini coefficient or Gini ratio, is a widely used and widely criticized statistic. The Gini index attempts to measure the extent to which the distribution of income in a society deviates from a perfectly equal distribution. It does this by plotting the cumulative percentages of income received against the cumulative number of individuals along a Lorenz curve. The Gini index reports the area between the Lorenz curve and a 45 degree line representing perfect equality. The Gini index is the area between the line and curve expressed as a percentage of the maximum area under the line. The resulting Gini index can therefore vary from zero to 100, with a value of zero representing perfect equality, and a value of 100 representing perfect inequality (World Bank n.d.). Thus, larger Gini values represent more unequal distributions. In the data used here, the actual range of the Gini index is from 21.20 to 65.45. The Gini index has been the subject of a considerable amount of criticism (for some examples, see Davidson 2009; Deltas 2003; Demuynck 2012; Maio 2007; Pyatt 1976). Notwithstanding that fact, it remains the most widely used measure of income inequality. Data on the Gini index comes from the World Bank Development Indicators.

In addition to the Gini index, I examine the impact of IPR on a second measure of inequality called the Palma ratio. The Palma ratio is a fairly new inequality statistic,

developed by Alex Cobham and Andy Sumner based on the work of economist Gabriel Palma (Cobham and Sumner 2013). Palma's research discovered that, for most countries, the share of national income held by the middle 50% of the population – those households between the fifth and ninth decile – is remarkably stable across time and countries (Palma 2006, 2011). The income share of the middle 50% almost always represents about half of gross national income, while the other half is split between the richest 10% and the poorest 40% of society. Countries differ greatly on the share of these two groups. The Palma ratio is calculated as the ratio of the income share of the top 10% to that of the bottom 40%. Like the Gini index, higher values for the Palma ratio represent higher income inequality. In the regressions examined in this chapter, the Palma ratio ranges from 0.6437 to 3.4559.

The Palma ratio addresses two of the biggest issues with the Gini index identified by critics: its over-sensitivity to changes in the middle of the income distribution for a given country, and its insensitivity to changes at the top and bottom of the income distribution. Cobham and Sumner argue that the Palma ratio is an excellent alternative to the Gini index, and is preferable to other common income ratios used in the literature (i.e. the 20:20 ratio which compares the income share of the top 20% to that of the bottom 20%). We would expect the Gini index and the Palma ratio to be highly correlated, and they are. The Pearson correlation coefficient is 0.8688.

I constructed to Palma ratio using data from the World Bank Development Indicators. The World Bank collects data on the income share of each decile and quintile for countries across time. It is simple enough to create the ratio by dividing the income share held by the top decile by the income share held by the bottom two quintiles for each

country in each year. One important note is required regarding the construction of the Palma ratio. Recall that for the patent index, we have values every five years from 1960 – 2005. World Bank data on income share by decile and quintile is somewhat spotty, and was missing for certain years in which patent data was available. I filled in those missing years for the Palma ratio following the procedure Cobham and Sumner established, by using the Palma ratio values from one or two time years before or after the relevant year (Cobham and Sumner 2013). For example, if the income data was missing for a country in 1985, but was available for that country in 1984 or 1986, I assume the same value for 1985. We have good reason to believe that the income share of the top 10% and bottom 40% do not change rapidly, so this is a reasonable step to take and allows for sufficient observations to conduct large-N analysis. Table 5.1 includes definitions and descriptive statistics for these measures of inequality.

Table 5.1: Summary of Income Inequality Measures

	Description	Obs.	Mean	Standard Deviation	Min	Max
Gini Index	Gini index measures the extent to which the distribution of income or consumption expenditure among individuals or households within an economy deviates from a perfectly equal distribution. A Gini index of 0 represents perfect equality, while an index of 100 implies perfect inequality.	861	38.04	10.08	21.20	60.45
Palma Ratio	The Palma ratio is the ratio of the share of income held by the top 10% of households to the share of the income held by the bottom 40% of households. It was developed by Cobham and Sumner (2013) and is based on the work of Chilean economist Gabriel Palma.	485	1.41	0.5	0.64	3.46

5.1.2 Intellectual Property Rights

In Chapter 3 and Chapter 4, we used two separate IPR variables: an index of patent strength and an index of copyright strength. Patents are more relevant for health outcomes while copyright is more relevant for education outcomes. Both types of IPR may be relevant for income inequality, so this chapter uses both IPR variables and examines each index's impact on the two dependent variables discussed above. The IPR indices should be familiar to the reader, but the index of patent rights is compiled by Juan Ginarte and Walter Park and later extended through 2005 by Walter Park (Ginarte and Park 1997; W. G. Park 2008). A country's patent strength in a given year can range from 0 to 5, with higher values representing stronger levels of protection. The patent index includes 122 countries measured every five years from 1960 – 2005. The copyright index was developed by Tad Reynolds and later updated by Walter Park (W. G. Park 2005; Reynolds 2003). A country's copyright strength in a given year can range from 0 to 4, with higher values representing stronger levels of protection. The copyright index includes the same 122 countries measured annually from 1965 – 2010. The two indices are clearly related, and we would expect countries with strong patent protections to have strong copyright protections as well. The Pearson correlation coefficient of 0.6742 confirms that the two are correlated, but not perfectly so.

5.1.3 Control Variables

In addition to the IPR variable, each inequality regression includes six control variables. GDP and the polity score are familiar controls from the previous chapters and may be relevant for this investigation as well. GDP is correlated with both inequality and IPR strength, so we want to make sure we are not merely observing the impact of wealth on inequality. Likewise, the polity score is correlated with both inequality and IPR strength, so it is important to control for regime type. We also need several economic controls. Inflation, unemployment, and the volume of trade are key economic indicators that have been associated with inequality and may intervene in the relationship between IPR and inequality. Both inflation and unemployment are associated with higher levels of income inequality (Birdsall 1998; E. Cardoso and Urani 1995). The relationship between inflation and inequality is debated in the literature, although there is some agreement that higher inflation generally worsens inequality (Albanesi 2007; Al-Marhubi 1997; R. M. Desai, Olofsgard, and Yousef 2005; Jin 2009; Walsh and Yu 2012). There are various ways in which inflation hurts poor households more than the rich. The mechanisms for avoiding the costs of rising inflation – such as shifting future purchases to the present, investing in consumption goods and inflation-adjusted tools rather than cash assets, and using bargaining power to increase one's wages – are usually available to the rich at much higher rates than the poor. The relationship between unemployment and inequality is also well established in the literature, with general agreement that higher unemployment is a major cause of income inequality (Björklund 1991; Cysne 2004; Simkins 2000). The wealthy receive a higher

percentage of their income as investment income rather than wage income, and as a result, unemployment has a larger negative effect on poorer households. The volume of trade is also potentially related to inequality. The literature has come full circle on this issue, with the original Heckscher-Ohlin analysis suggesting that trade is a central driver of income inequality, as the rich benefit more from trade than the poor. Economic analysis in the 1990s demonstrated that this logic did not always hold, especially in low-income countries. In recent years, the economic literature has produced a number of new studies on the relationship between trade and inequality which suggest that the two may be positively correlated after all (for a review of this literature, see Harrison, McLaren, and McMillan 2011).

The causal process discussed above involves stronger IPR leading to economic growth, which further exacerbates income inequality. In order to isolate the impact of IPR it is important to include control variables for unemployment, inflation, and trade volume. One additional control proved important: the percentage of the population working in agriculture. Highly agrarian economies generally experience more inequality and less economic development, which may impact the relationship between IPR and inequality. Table 5.2 includes full definitions and descriptive statistics for all of the independent variables.

Government redistributive policies / social welfare spending is one important intervening variable that is difficult to include in the large-N analysis. Countries that have more egalitarian redistributive policies are likely to have less income inequality at all levels of IPR protection and at all levels of development. However, large-N data on social welfare spending and redistributive policies are not available for the

full panel of countries. Only the OECD collects social spending data, and that data is only available for 34 OECD member countries since 1980. When I include social spending in the following models, it decreases the number of observations in each model drastically. Social welfare spending is itself not statistically significant in any model specification for income inequality, and it is difficult to determine whether changes to the significance and magnitude of any of the other independent variables is the result of controlling for redistribution or simply an artifact of the limited sample and time frame. As a result, I report the full panel models without social spending controls. With redistribution / social welfare spending poorly controlled, these results are limited. Collecting such data on the full panel over time would be one fruitful extension of the project. We would expect redistribution to mitigate negative impacts of IPR on income inequality, so for the models below that show a significant negative impact of IPR on inequality, it is likely that these models *underestimate* the negative effect rather than overestimating it.

Table 5.2: Summary of Inequality-Related Independent Variables

	Description	Obs.	Mean	Standard Deviation	Min	Max
Patent Index	Index of patent strength that ranges from 0-5, with higher values representing stronger patent protections.	190	3.36	1.09	0.92	4.88
Copyright Index	Index of copyright strength that ranges from 0-4, with higher values representing stronger patent protections.	861	2.45	0.74	0	3.89
Gross Domestic Product (GDP)	GDP per capita in purchasing power parity.	861	12239.75	12048.01	182.22	72959.77
Inflation	Inflation as measured by the consumer price index reflects the annual percentage change in the cost to the average consumer of acquiring a basket of goods and services that may be fixed or changed at specified intervals, such as yearly.	861	26.57	162.86	-9.63	2947.73
Unemployment	The share of the labor force that is without work but available for and seeking employment.	861	8.14	4.43	1.10	26.70
Polity Score	Scale ranging from +10 (strongly democratic) to -10 (strongly autocratic). Modified version for use in time-series analyses.	861	7.61	4.36	-9	10
Trade Volume	The sum of exports and imports of goods and services measured as a share of gross domestic product.	861	75.02	53.37	13.75	412.16
% Employed in Agriculture	Percentage of population employed in agriculture.	861	14.73	15.67	0	88.80

Descriptive statistics restricted to cases in the regression, i.e. are nonmissing on all included variables.

5.2 Methods

The methodology of this chapter is the same as in the previous chapters on health and education outcomes. I examine the relationship between IPR and income inequality using fixed effects estimators with Huber/White robust standard errors, clustered at the country level. I ran single-year OLS models as well, but the results were insignificant for the IPR variables. Data limitations in given years, especially for the Gini coefficient, reduced the number of observations in the OLS models as well, further weakening the value of these regressions. As a result, I only report the fixed effects results.

For income inequality, as with health and education outcomes, we have reason to believe that the impact of IPR on education might be different at different levels of development. To test whether or not this is true, I ran each model with interaction terms as described in Chapter 3. In the third set of analyses, I disaggregate both the patent index and the copyright index into their components and evaluate the impact of each component on the Gini index and Palma ratio. Tables 5.3 and 5.4 display the method by which each index is constructed, information discussed in the previous chapters but repeated here. Finally, I lag the copyright variable five, ten, and fifteen years to see if IPR has a different impact on inequality after a period of time.[17]

[17] As was the case in the previous chapter, I do not include the year dummy variables in the regression tables. Since there were many years in each model, it is impractical to report their coefficients in each table. Time fixed effects dummy variables were included in every model; some year dummies were significant and some were not, but none are reported directly.

Table 5.3: Components and scoring method of patent rights index. Replicated from Park (2008).

(1) Coverage	Available	Not Available
Patentability of pharmaceuticals	1/8	0
Patentability of chemicals	1/8	0
Patentability of food	1/8	0
Patentability of surgical products	1/8	0
Patentability of microorganisms	1/8	0
Patentability of utility models	1/8	0
Patentability of software	1/8	0
Patentability of plant and animal varieties	1/8	0
(2) Membership in international treaties	Signatory	Not signatory
Paris convention and revisions	1/5	0
Patent cooperation treaty	1/5	0
Protection of new varieties (UPOV)	1/5	0
Budapest treaty (microorganism deposits)	1/5	0
Trade-related intellectual property rights (TRIPS)	1/5	0
(3) Duration of protection	Full	Partial
	1	$0 < f < 1$
(4) Enforcement mechanisms	Available	Not Available
Preliminary (pre-trial) injunctions	1/3	0
Contributory infringement	1/3	0
Burden of proof reversals	1/3	0
(5) Restrictions on patent rights	Does not exist	Exists
Working requirements	1/3	0
Compulsory licensing	1/3	0
Recovation of patents	1/3	0

where f is the duration of protection as a *fraction* of 20 years from the date of application or 17 years from the date of grant (for grant-based patent systems). Overall score for patent rights index: sum of points under (1)-(5).

Table 5.4: Components and Scoring Method for Copyright Variable

(1) Duration of Coverage	Calculation	Explanation
General Works	$0 < f < 70$	Calculated as a percentage of 70 years after the author's death, which is the international standard
Performances	$0 < f < 70$	Calculated as a percentage of 70 years after the author's death, which is the international standard
Sound Recordings	$0 < f < 70$	Calculated as a percentage of 70 years after the author's death, which is the international standard
Films	$0 < f < 70$	Calculated as a percentage of 70 years after the author's death, which is the international standard
Broadcasts	$0 < f < 70$	Calculated as a percentage of 70 years after the author's death, which is the international standard
Computer Programs	0, 1	Coded as 1 if covered, 0 if not covered
(2) Restrictions on Unauthorized Use	**Calculation**	**Explanation**
Private Use Allowances Without Payment (Fair Use)	0, 0.5, 1	Coded 1 if all use requires compensation, 0.5 if limited fair use allowed, 0 if extensive fair use allowed
Availability of Collective Licensing Schemes	0, 1	Coded 1 if collective licensing schemes are available, 0 if not
Compulsory Translation Licenses	0, 1	Coded 1 if no compulsory translation licenses are allowed, 0 if they are
(3) Enforcement Mechanisms	**Calculation**	**Explanation**
Criminal Provisions in the Copyright Law	0, 1	Coded 1 if criminial provisions exist in the law, 0 if only civil penalties are allowed
Preliminary Injunctions	0, 1	Coded 1 if preliminary injunctions are allowed, 0 if not
Seizure / Destruction of Infringing Goods	0, 1	Coded 1 if seizure and/or destruction of infiringing goods is allowed, 0 if not
Prohibition of Circumvention Devices	0, 1	Coded 1 if the law bans copyright circumvention devices, 0 if not
(4) Membership in Copyright Agreements	**Calculation**	**Explanation**
Berne	0, 1	Coded 1 if a signatory, 0 if not
ucc52	0, 2	Coded 1 if a signatory, 0 if not
Rome	0, 3	Coded 1 if a signatory, 0 if not
Geneva	0, 4	Coded 1 if a signatory, 0 if not
ucc71	0, 5	Coded 1 if a signatory, 0 if not
Brussels	0, 6	Coded 1 if a signatory, 0 if not
Wipocopy	0, 7	Coded 1 if a signatory, 0 if not
Wipoperf	0, 8	Coded 1 if a signatory, 0 if not
Trips	0, 9	Coded 1 if a signatory, 0 if not

where f is the duration of protection as a *percentage* of 70 years from the author's death. Each of the four components is an average of the scores for the included items. The overall copyright variable is the sum of the component scores. Thus, each component can take on values from 0-1 while the overall copyright variable can take on values from 0-4.

5.3 Results

In each analysis below, I examine the impact of the patent index and the copyright index on each measure of income inequality. Based on the mechanism described above whereby stronger IPR protections lead to higher levels of income inequality, I am testing the following hypothesis:

> H1: Countries with higher values for IPR (patents and copyright) will have higher (more unequal) values for the Gini index and the Palma ratio. (IPR coefficients with a positive sign)

5.3.1 Gini Index and Palma Ratio for All Countries

Table 5.5 presents the regression results for the patent index. Patent strength appears to have a significant positive impact on the Gini index. A one-unit (20%) increase in patent strength is associated with an increase in the Gini index of 1.8478. For the average country with a Gini index value of 38.04, this is a 4.9% increase in the Gini index, which is a substantial increase in income inequality. Larger increases in IPR protection would obviously result in even larger increases in inequality. The only control variable that is significant in this model is the percentage of the population who work in agriculture. The positive coefficient suggests that countries with higher percentages of agricultural workers have higher levels of inequality, which matches our expectations for this variable. Interestingly, the patent index is insignificant for the Palma ratio, suggesting that there is no relationship. This could be the result of missing data, as the

total number of observations in the Palma model is smaller, and the Palma model only includes 44 countries while the Gini index model includes 63. Alternatively, this could be the result of the Palma ratio capturing a different aspect of inequality. Fully understanding why the patent index affects the Gini index but not the Palma ratio will require follow-up research. From these results we can conclude that patents appear to be significantly and positively associated with at least one measure of income inequality.

Table 5.5: Impact of Patents on Inequality

	Gini Index	Palma Ratio
Patent Index	1.8478* (0.8319)	0.0126 (0.0616)
GDP	-0.00006 (0.00006)	0.00003† (0.00002)
Inflation	0.0004 (0.0008)	0.00011** (0.00004)
Unemployment	-0.0622 (0.0884)	-0.0094 (0.0113)
Polity	0.0063 (0.1716)	0.0071 (0.0014)
Trade	0.0139 (0.0279)	-0.00009 (0.0014)
Population in Agriculture	0.1937* (0.0755)	0.0090** (0.0032)
Constant	27.7262*** (4.5281)	1.2002*** (0.1772)
Observations	190	144
# Countries	63	49
# Years	6	6
R^2 Overall	0.0179	0.0020
R^2 Within	0.3126	0.2814
R^2 Between	0.0117	0.0244

† Significant at 0.10 level
* Significant at 0.05 level
** Significant at 0.01 level
*** Significant at 0.001 level

Table 5.6 presents the regression results for the copyright index. In both models the copyright measure is statistically insignificant, suggesting that there is no relationship between copyright strength and the Gini index or the Palma ratio. Several control variables are significant, including GDP and the percentage of the population in agriculture in both models, and inflation in the Palma ratio model. Oddly, the GDP variable changes direction and is negatively associated with the Gini index but positively associated with the Palma ratio. This suggests that countries with higher GDP/capita levels have more equal distributions of income as measured by the Gini index, but less equal distributions of income as measured by the Palma ratio. Exploring this outcome in more detail is beyond the scope of this project, but this is an interesting result and one that might tell us something about the relative merits of measuring inequality with the Gini index vs. the Palma ratio. Both inflation and the percentage of the population in agriculture are positively correlated with inequality, which is the expected direction for each variable. While the control variable results are interesting, the insignificant result for the copyright variable suggests that there is no observable impact of copyright strength on inequality across the countries in the sample. These models do have significantly more observations that the patent index models above, since the copyright index has annual data rather than 5-year data.

Table 5.6: Impact of Copyright on Inequality

	Gini Index	Palma Ratio
Copyright Index	0.6604 (0.5402)	0.0288 (0.0307)
GDP	-0.00018*** (0.00004)	0.00002** (0.000007)
Inflation	0.0006 (0.0008)	0.00015*** (0.00003)
Unemployment	0.0455 (0.0566)	0.0018 (0.0068)
Polity	-0.0706 (0.0870)	0.0057 (0.0058)
Trade	-0.0188 (0.0120)	0.0004 (0.0008)
Population in Agriculture	0.1273* (0.0538)	0.0065** (0.0022)
Constant	34.8710*** (2.1712)	1.2261*** (0.1195)
Observations	861	485
# Countries	75	55
# Years	27	26
R^2 Overall	0.2169	0.0001
R^2 Within	0.1664	0.2141
R^2 Between	0.2252	0.0002

† Significant at 0.10 level
* Significant at 0.05 level
** Significant at 0.01 level
*** Significant at 0.001 level

5.3.2 Gini Index and Palma Ratio Results at Different Levels of Development

By including development interaction terms we can determine if the results observed in the previous models hold at all levels of development. For the patent index, there is no difference between countries that are developing and those that are developed. The positive significant relationship between patent strength and the Gini index, and the absence of any relationship between patent strength and the Palma ratio, appear to be consistent for all countries. That is not the case for copyright. While the absence of a relationship between copyright strength and the Palma ratio holds for all countries, there is a difference for copyright's impact on the Gini index. Table 5.7 presents the results of the interaction model of copyright strength on the Gini index. The first copyright variable, which reports the impact of copyright on the Gini index for developing countries, suggests that there is a positive and statistically significant relationship in the developing world. A one-unit (25%) increase in copyright strength corresponds to an increase in the Gini index of 1.3424, which is a 3.5% increase in inequality for the average country in the sample. The second copyright coefficient reports the *difference* in impact of copyright on the Gini index for developed countries. Since it is statistically significant, we conclude that there is in fact a difference in developed countries. The difference coefficient is negative and about the same magnitude as the positive coefficient for developing countries. The total impact of copyright on the Gini index in developed countries is the sum of the two coefficients: -0.3406.

Table 5.7: Impact of Copyright on Gini Index at Different Levels of Development

	Gini Index
Copyright for Developing Countries	1.3424* (0.6839)
Difference in Effect of Copyright for Developed Countries	-1.683* (0.6901)
Development Dummy	4.3101* (1.6204)
GDP	-0.0001*** (0.00003)
Inflation	0.0006 (0.0008)
Unemployment	0.0621 (0.0588)
Polity	-0.1147 (0.0916)
Trade	-0.0163 (0.0129)
Population in Agriculture	0.1292* (0.0524)
Constant	32.6613*** (2.4777)
Observations	861
# Countries	75
# Years	27
R^2 Overall	0.2022
R^2 Within	0.1794
R^2 Between	0.2117

† Significant at 0.10 level
* Significant at 0.05 level
** Significant at 0.01 level
*** Significant at 0.001 level

This suggests that there is a significant positive impact in developing countries and a very small but significant negative impact in developed countries, which helps explain why the copyright coefficient was insignificant in the full panel model above. When considering all countries, there appears to be no relationship because the small negative impact in developed countries offsets the slightly larger positive impact in developing countries. In terms of control variables, GDP has a significant negative impact on the Gini index, and the percentage of the population in agriculture has a significant positive impact on agriculture, which are similar results as those observed above. From this model we can conclude that in developing countries stronger copyright does appear to be related to higher levels of inequality, but in developed countries this is not the case.

5.3.3 Disaggregated IPR and the Gini Index and Palma Ratio

Table 5.8 presents the results for the disaggregated components of the patent index. To make the tables easy to read, I report only the copyright coefficients for each model. Both models have the same number of observations as the combined patent model above, and the direction and significance of the control variables are the same as before. The first column reports the coefficient for the combined patent index, and the next five columns display the results for each component of patent protection.

Table 5.8: Disagregated Patents on Inequality

Dependent Variable	Combined Patents	Duration	Coverage	Enforcement	Loss	Membership
Gini Index	1.8478*	2.9804	7.3161**	2.9886*	0.5348	1.5947
	(0.8319)	(3.4942)	(2.6152)	(1.2277)	(2.1625)	(2.1230)
Palma Ratio	0.0126	0.1131	0.1070	-0.0572	0.0011	0.0559
	(0.0616)	(0.1620)	(0.1960)	(0.0864)	(0.2234)	(0.1298)

† Significant at 0.10 level
* Significant at 0.05 level
** Significant at 0.01 level
*** Significant at 0.001 level

I will offer the same caveat as in the previous chapters: Each of the four components is on a scale from 0 to 1, with 0 indicating no protection of that component and 1 indicating complete protection. The combined variable is the sum of the five components and can take on values between 0 and 5. When we are examining regression coefficients we can compare directly across the five components of patent protection that are on the same scale, but we must be careful comparing the impact of any single component to the combined variable, as these will be on different scales. While a one-unit increase in the combined patent index is a 20% increase in protection, a one-unit increase in one of the component parts is a 100% increase.

The significant positive relationship observed between the patent index and the Gini index appears to be explained through just two components: the extent of coverage for various product categories and the availability of enforcement mechanisms. Between the two, the coverage variable has a larger positive impact and is more statistically significant. A one-unit (100%) increase in the coverage variable corresponds to an increase in the Gini index of 7.3161. This is a very large increase in the Gini index, but a one-unit increase in the coverage variable is also a very large increase. A one-unit increase in coverage represents a move from offering patents on no products to offering patents on all eight categories of products. Even when countries cover just one or two additional product categories, however, this change is related to a meaningful increase in inequality. For enforcement, a one-unit increase in enforcement – which represents a move from having none of the three enforcement mechanisms to having all three of them – is associated with an increase in the Gini index of 2.9886. This is a smaller but still substantive change in inequality. The other three components do not appear to be

significant factors for the Gini index, and none of the five components appears to have a relationship with the Palma ratio.

Table 5.9 presents the results for the disaggregated components of the copyright index. Since the copyright variable was insignificant when considering all countries, I ran the disaggregated component model of copyright only for developing countries where we have observed a relationship between copyright and the Gini index. The table reports the results of that limited model. For the sake of readability, I only report the copyright coefficients, but it is important to note that these models have 329 observations that cover a period of 18 years across 50 countries coded as developing countries. The significance and direction of the control variables was the same as those reported in the full panel models above. The same caveat about interpreting the results is true here as well: the components are on 0-1 scale while the combined measure is on a 0-4 scale.

Table 5.9: Disagregated Copyright on Inequality (Only for Develping Countries)

Dependent Variable	Combined Copyright	Duration	Usage	Enforcement	Membership
Gini Index	1.3424* (0.6839)	3.1217 (2.2062)	2.9479 (1.9452)	4.2958* (2.1418)	11.9156*** (2.8108)
Palma Ratio	0.0288 (0.0307)	-0.0100 (0.0761)	0.0812 (0.1153)	0.0419 (0.0970)	0.1799 (0.1691)

† Significant at 0.10 level
* Significant at 0.05 level
** Significant at 0.01 level
*** Significant at 0.001 level

The significant positive relationship we observed for developing countries is explained through two components. Enforcement, which was significant in the disaggregated patent model, is significant for copyright as well.[18] A one-unit increase in enforcement – which represents a move from having no enforcement mechanisms to having all four copyright enforcement tools – is associated with an increase in the Gini index of 4.2958. The second significant variable is membership in the copyright treaties, whose coefficient is highly significant and large in magnitude. A one-unit increase in treaty membership – which represents signing all nine related treaties – is associated with an increase in the Gini index of 11.9156. Therefore, countries that sign just one or two additional treaties experience significantly higher levels of inequality as measured by the Gini index. The duration of patent coverage and the availability of restrictions on unauthorized use are not significant, and do not appear to have an impact on the Gini index. None of the copyright components appear to be related to the Palma ratio.

These disaggregated models offer a few general conclusions. Enforcement mechanisms appear to be important for both patents and copyright, as countries with more enforcement mechanisms experience higher levels of income inequality. Furthermore, patent coverage and copyright treaty membership each has a large impact on inequality. Countries that offer patents on more product categories, and those who sign on to more copyright treaties, experience significantly higher inequality levels. The other components are not relevant. There are no components that offer contradictory

[18] Note, importantly, that the enforcement mechanisms in the copyright index are *not* the same as the enforcement mechanisms in the patent index. The patent index considers three patent-specific enforcement tools, and the copyright index considers four copyright-specific enforcement tools. The two components are only correlated with one another with a Pearson correlation coefficient of 0.4721. In other words, countries may well have robust enforcement mechanisms for patents and few enforcement mechanisms for copyright, or vice versa.

evidence or significant relationships in the opposite direction. Finally, none of these components have a relationship with the Palma ratio. Combining this result with the insignificant results in the combined IPR models, we can conclude that there appears to be no relationship between any part of IPR and the Palma ratio.

5.3.4 Lagged IPR and the Gini Index and Palma Ratio

As was the case in the previous chapters, we might expect it to take time for IPR to have an impact on income inequality. Rather than examining only contemporary patent and copyright levels, I lagged the IPR indices five, ten, and fifteen years and included the lagged variable as the key explanatory factor in each regression. Table 5.10 reports the results for the lagged patent index. Again I report only the copyright coefficients to make the table easy to read. The number of observations and the results for the control variables are roughly identical to the contemporary models. Patents are not related to the Palma ratio at any point, but the lagged regressions on the Gini index offer interesting results. At five years lagged, the patent index coefficient is positive and approaches traditional levels of significance (p-value = 0.09). At ten years lagged, the coefficient is positive and significant, with about the same magnitude of effect as contemporary patent strength. At fifteen years lagged, however, the direction of the relationship flips. Rather than being positively related, patent strength has a significant negative relationship with the Gini index. This result may just be anomalous, but if not this suggests that after a longer period of time, the economic benefits of patent protection may in fact improve income inequality. These models suggest that there is a short term increase in inequality

but a long term decrease. In addition, the magnitude of the negative effect of 15-year-lagged patent scores is larger than any of the positive impacts in the short term.

Table 5.10: Lagged Patents on Inequality

Dependent Variable	Contemporary Patents	Patents Lagged 5 Years	Patents Lagged 10 Years	Patents Lagged 15 Years
Gini Index	1.8478* (0.8319)	0.9913† (0.5764)	1.6307* (0.7611)	-2.2774* (0.9433)
Palma Ratio	0.0126 (0.0616)	-0.0415 (0.3627)	-0.0973 (0.0921)	0.0003 (0.2521)

† Significant at 0.10 level
* Significant at 0.05 level
** Significant at 0.01 level
*** Significant at 0.001 level

We do not find a similar result for lagged copyright protection. Table 5.11 presents those results, and I again only include the copyright coefficients. As before, the results for the Palma ratio are insignificant in every model specification. When considering the full panel of countries, the results are insignificant for the Gini index as well, so the table presents the results for the restricted sample of developing countries. The number of observations, years, and countries are the same as discussed in the previous section for the developing country sample, and the direction and significance of the control variables is the same as the full panel model.

Table 5.11: Lagged Copyright on Inequality (Only for Develping Countries)

Dependent Variable	Contemporary Copyright	Copyright Lagged 5 Years	Coyright Lagged 10 Years	Copyright Lagged 15 Years
Gini Index	1.3424* (0.6839)	1.7250* (0.6890)	1.6807 (1.1484)	0.2718 (1.5845)
Palma Ratio	0.0288 (0.0307)	-0.0028 (0.0369)	0.0162 (0.0318)	0.0056 (0.0313)

† Significant at 0.10 level
* Significant at 0.05 level
** Significant at 0.01 level
*** Significant at 0.001 level

For lagged copyright strength, we find a slightly larger and significant effect of copyright on the Gini index when lagged five years, but no significant relationship when lagged ten and fifteen years. Unlike lagged patents, there is no apparent negative relationship with lagged copyright. This could be the result of the limited sample, or a result of different long term impacts of patents and copyright on economic growth.

The lagged models presented here both confirm and contradict the positive significant relationship observed between patents and the Gini index in all countries, and between copyright and the Gini index in developing countries.

5.4 Discussion & Conclusion

I will conclude this analysis with four general comments. First, even though the Gini index and the Palma ratio are theoretically linked and empirically correlated (r = 0.8688), the results are markedly different for the two dependent variables.

While we consistently find a significant relationship between IPR and the Gini index, we find no relationship at all between IPR and the Palma ratio. There are several possible interpretations of this result. Since data on the income share held by each decile and quintile is less complete than Gini index data, the Palma models have fewer observations on fewer countries. The difference in results could be due to these data limitations. Alternatively, it could be the case that – while correlated – the Gini index and Palma ratio are measuring fundamentally different things.

Determining which measure is a more accurate operationalization of income inequality is a debate worth having in the literature, but for now these results could be suggesting that these measures of inequality are fundamentally different in various ways. Finally, perhaps the difference in results suggests that when IPR affects income inequality, it does that by affecting incomes in the middle 50% of households. Recall that the Palma ratio ignores the middle 50% and measures the ratio of the top 10% to the bottom 40%. Meanwhile, the Gini index methodology tends to overemphasize the middle 50%. By finding significant relationships between IPR and the Gini index but not the Palma ratio, these analyses could suggest that changes in inequality are taking place in the middle of the income distribution. Follow-up research may be able to evaluate these interpretations in order to determine the most likely explanation for why the results are so different for the Gini index and Palma ratio.

The second conclusion involves relationships at different levels of development. As was the case with health and education outcomes, I began this analysis with the assumption, found in the IPR literature, that undesirable effects of

IPR would be worse in the developing world. These analyses offer only weak evidence to support that assumption. For patents, there is no difference in the impact of patent strength on income inequality in developing vs. developed countries. The positive significant relationship observed in the full panel model holds for countries at all levels of development. Copyright, on the other hand, appears to be related to the Gini index only for developing countries. In the developing world, stronger copyright protections are associated with worse income inequality. In the developed world, however, there is no relationship between the two.

Third, these analyses suggest that not all aspects of patent and copyright protection are relevant for income inequality. For patents, only the number of categories covered by patents and the availability of enforcement mechanisms are significant determinants of inequality. The duration of those patents, the presence of restrictions on patents, and membership in patent treaties have no effect on inequality. Similarly for copyright, only membership in copyright treaties and the availability of enforcement mechanisms are significant. There is no relationship between inequality and copyright coverage or restrictions on unauthorized use. While these indices examine different enforcement mechanisms for patents and copyright, the presence of some enforcement mechanism is the only consistently relevant aspect of IPR when it comes to income inequality. This is logical, as countries that have strong IPR protections but no ability to enforce those protections are unlikely to experience large IP-related effects.

Finally, the lagged patent model offers some interesting results worthy of future investigation. The fact that, when lagged 15 years, patents appear to *improve*

rather than worsen income inequality is an unexpected outcome. Assuming this result is not merely a product of data limitations or spurious correlations, it suggests that there may be a different short term and long term effect of patents. If patents do worsen income inequality in the short term, but in the long term improve inequality even more, IPR critics who suggest that stronger IPR will be bad for inequality may be overstating their case. To be sure, these results are far from conclusive, and the absence of controls for redistribution / social welfare spending is a major limitation. As noted above, this missing variable may result in an underestimation of the negative consequences of IPR on inequality.

Chapter 6

IPR Reform in the Kingdom of Jordan

The purpose of this chapter is to supplement the large-N analysis in the preceding chapters with a case study of IPR reform in a single country. The statistical analyses suggest a general relationship between IPR and health, education, and income inequality. I want to complicate this story by suggesting that political and institutional factors intervene in the relationship. At several points in the previous three chapters I suggest that the regression results point to potential endogeneity problems. In other words, we observe relationships between IPR and particular health, education or inequality outcomes that can be plausibly explained by causal processes operating in either direction. Are these outcomes harmed or improved because IPR was strengthened, or do countries strengthen IPR in response to changes in health and education outcomes? The possibility of reverse causality or simultaneity (causality operating in both directions) confounds the proper interpretation of the statistical results.

In this chapter, I argue that the *process* of IPR reform, the *political* motivations behind strengthening of IPR, and the *institutional* agencies responsible for the reform and enforcement of IPR partially determine the impact of IPR on outcomes. This case study is an initial test of this argument. Of course, we cannot fully test this theory with a single case study, and follow up research will be necessary to fully understand how institutional and political factors matter.

There are three reasons why the Hashemite Kingdom of Jordan (hereafter, "Jordan") makes for an excellent test case. First, Jordan reformed its intellectual property

law between 1997 and 2001. It was one of the first countries in the Middle East to adopt strong IP protections, and it made these reforms within a relatively short period of time. The condensed timeline makes it easier to examine the impact of IPR reform. Second, Jordan is a middle-income developing country. Many of those writing in the "access to medicines" and "access to knowledge" campaigns argue that strong IPR will have the largest negative impact on developing countries. Choosing a developing country for the test case allows for a "most likely" scenario, and avoids one potential line of criticism from IPR skeptics. Furthermore, one might argue that the least developed countries of the world have so little intellectual property to protect that any strengthening of IPR could only benefit foreign firms. As a middle income country Jordan has economic activity and knowledge economy to theoretically benefit from strong IPR. Finally, Jordan's decision to strengthen its IPR law could have been endogenous or exogenous. The reforms came at a time when Jordan was making other economic reforms, as discussed below, which were intended to stimulate economic growth and local industries. The choice to strengthen IPR could have been an economic decision meant to increase local innovation and foreign direct investment. At the same time, however, Jordan was in the process of joining the WTO and signing bilateral free trade agreements with the US and EU. The choice to strengthen IPR could equally have been a political decision acquiescing to the demands of powerful developed states. By examining the process of IPR reform in Jordan, we can determine whether the impetus for IPR reform was, in fact, exogenous or endogenous.

The chapter proceeds in six parts. First, I begin with background information on Jordan, its history and economy, the Jordanian legal system, and the history of IPR

protection in Jordan. In the next section I discuss the process of IPR reform, the decision-making process of the Jordanian leadership, and the pressure put on Jordan by the US and other powerful states to adopt strong IP protections. In the third section, I discuss the institutional framework for IPR regulation and enforcement in Jordan. The fourth section examines the impact of IPR reform on health, while the fifth section examines the impact on education, and the sixth section discusses inequality. The seventh section returns to the argument presented above, and concludes with a discussion of IPR in Jordan and what we can learn from this case study.

6.1 Jordanian Political and Economic History, Legal System, and IPR

6.1.1 Background on Jordan

When the Ottoman Empire collapsed following World War I, the League of Nations gave the British a mandate to govern much of the Middle East, including the region that is modern day Jordan. In the 1920s, the British separated from Palestine a semi-autonomous region they called Transjordan, and in 1946 the area gained its independence and formed the Hashemite Kingdom of Jordan. Jordan lost the West Bank of the Jordan River to Israel in 1967 during the Six-Day War, but maintained a claim on the land until officially relinquishing it in 1988.

In 1921 the British established the monarchy in Jordan, led by King Abdullah I until he was assassinated in 1951. The king was briefly followed by his son, King Talal, who abdicated a year later. From 1952 until his death in 1999, Talal's son King Hussein

ruled Jordan, and since 1999 the country has been led by Hussein's son King Abdullah II. Following independence, Jordan established itself as a constitutional monarchy, with a bicameral legislature and Prime Minister as head of government. The King remains a powerful figure in Jordan, with the authority to sign, execute and veto all laws; appoint the Prime Minister and Senate; dismiss judges; dissolve parliament at any time; and rule by decree when Parliament is dissolved (Robins 2004).

6.1.2 The Jordanian Economy

Jordan is a small country of just 89,342 square kilometers, of which only 2.41% is arable land. Agriculture is therefore concentrated in the Jordan River valley. Jordan has few natural resources other than phosphate and potash, which can be turned into a fertilizer, giving the country virtually no oil revenue and insufficient water resources. Additionally, Jordan has little heavy industry. The Jordanian economy thus relies heavily on foreign assistance and remittances from workers abroad, along with tourism and service industries (Ramachandran 2004).

While Jordan has one of the smallest economies in the Middle East, the country performed fairly well from the end of the war in 1967 through the mid-1980s. Jordan's GDP grew by an average of 11.6% during the 1970s, representing one of the highest growth rates in the region (Al-Khaldi 2008). This growth was partially the result of Jordan becoming the world's third largest exporter of phosphates (Dandan 2011). Additionally, Jordan received billions of dollars of foreign aid and foreign remittances. Remittances constitute, on average, 20% of Jordan's annual GDP (Ramachandran 2004).

Finally, Jordan positioned itself as a transit hub for exports and imports flowing between Western Europe and the Middle East, generating significant foreign direct investment (Dandan 2011).

This economic success was somewhat short-lived, however. Jordanians working abroad had been drawn to the oil industry in nearby countries, and as a result the level of foreign remittances was sensitive to the global price of oil. As oil prices declined in the mid-1980s Jordan experienced significant economic decline, resulting in a collapse in the value of the currency and increasing government and external debt. During the1990s, Jordan benefited from additional aid inflows, including support from the World Bank. Additionally, many Jordanians returned home following the 1991 Gulf crisis and War. During this period, Jordan again experienced a period of relatively strong economic activity and growth rates returned to 2-3% per annum (Al-Khaldi 2008; Ramachandran 2004).

When King Abdullah II came to power in 1999, he began a process of economic reform that included reducing barriers to trade, privatizing state-owned industries, and financial sector reforms. He also ushered Jordan into the World Trade Organization and signed new free trade agreements with the US and EU. Jordan experienced GDP growth of 8% from 2004-2008, although that growth has slowed following the global financial crisis to an average of 2.6% for 2010-2013 (World Bank n.d.).

6.1.3 The Jordanian Legal System

Jordan's legal system is a product of Ottoman, French, British, and Islamic influence. The Ottoman government blended the French Commercial and Penal Code with the Hanafi School of Islamic law to create a new secular legal system in the later part of the 19th century (Coulson 1964; Lippman, McConville, and Yerushalmi 1988; Nesheiwat 2012). Unlike common law systems of the United Kingdom and the United States – in which most law is uncodified and relies heavily on precedent and prior decisions to shape the legal system – civil law systems like Jordan's depend on comprehensive, continuously updated legal codes that aim to specify all aspects of the law, its interpretation, and the appropriate penalties for violating the law (Dainow 1966). Some elements of common law have been incorporated into the Jordanian legal system under British rule, especially in the Jordanian Commercial Code (Nesheiwat 2012). The result is a unique civil law system with some elements of British common law.

Jordanian laws fall under one of four branches: the constitution, the criminal code, the civil code, or the commercial code. Intellectual property rights have their roots in the civil code, which enumerates three types of "rights" belonging to the individual: personal, material, and incorporeal. Intellectual property rights are explicitly listed as examples of incorporeal rights, or rights exercised over intangible or nonmaterial things (Nesheiwat 2012).

6.1.4 Intellectual Property Rights in Jordan

The legal protection of intellectual property in Jordan dates back at least 125 years. The Ottoman Patent and Trade Mark Law was implemented in 1887, and the Ottoman Copyright Law in 1910. There is some evidence that intellectual property protections are even older, perhaps dating to a time before the emergence of Islam in the region (El-Said 2006). Laws were updated in the 1920s under British rule, and again in the 1950s as part of the transition to independence.

Patents and trademarks had been enforced through the Ottoman Patent and Trade Mark Law. The Ottoman law was based on principles in the Paris Convention, to which the Ottoman Empire was a signatory. When the Ottoman Empire collapsed and Jordan was placed under the British Mandate, changes to the legal system included an update to patent and trademark regulations. These changes included trademark legislation in 1930, updated in 1938 and again after independence in 1952. This legislation was accompanied by the 1953 Goods Merchandise Law that remains in force today. The Ottoman patent law was also updated under the British Mandate in 1924 and after independence in 1953. These trademark and patent laws remained in effect until 1999, when Jordan began its modern overhaul of intellectual property laws (El-Said 2006).

Similarly, copyright protections date back to Ottoman rule. However, while a number of Arab states revised copyright law following the end of the Ottoman Empire, Jordan did not. The Ottoman Copyright Law remained in effect until the 1990s, when a new Jordanian law replaced it. Jordan's copyright law underwent another set of revisions during the overall IP reform process, which went into effect in 2004.

6.2 The Process of IPR Reform in Jordan

Between 1999 and 2004, Jordan passed eleven IPR-related new laws and amendments to existing laws (Jaafari 2012; Olwan 2013a). As I mentioned in the introduction, this change came at a time when King Abdullah II ascended to the throne and began making an array of economic changes and reforms, all of which were intended to strength the economy and generate growth. This process included financial sector reform and privatization of state-owned enterprises, as well as structural changes to the economy and trade sector. At the same time, the King led the charge for Jordan to join the World Trade Organization and increase trade and economic cooperation between Jordan and the United States.

6.2.1 Jordanian Accession to the WTO

On April 11, 2000, Jordan became the 136th member of the World Trade Organization. Its official membership came after more than two years of negotiations, which involved considerable legal and economic reforms by the Jordanian leadership. As part of any WTO Accession protocol, Jordan had to negotiate with existing WTO members, especially powerful leaders like the United States. In order to join the WTO, Jordan was required to reform its intellectual property laws to come into compliance with the TRIPS agreement. The process began in 1997, when Jordan signed a Trade and Investment Framework Agreement (TIFA) and a Bilateral Investment Agreement (BIT) with the United States (El-Said 2006). In the following two years, Jordan passed several

new patent, trademark and industrial design laws, including (1) *Patent Law No. 32 of 1999,* (2) *Trademark Law No. 34 of 1999,* (3) *Industrial Design Law No. 24 of 2000,* (4) *Plant Varieties Law No. 24 of 2000,* (5) *Geographical Indication Law No. 8 of 2000,* (5) *Unfair Competition and Trade Secret Law No. 15 of 2000,* and (6) *The Protection of Layout-Designs and Integrated Circuit Law No 10 of 2000* (Olwan 2013a).

In terms of copyright, the 1992 Copyright law was updated to reflect TRIPS requirements in 1998, again in 1999, and finally in 2005. Additionally, Jordan joined the Berne Convention for the Protection of Literary Works ("Berne Convention") in 1999, the WIPO Copyright Treaty and the WIPO Performances and Phonograms Treaty in 2004 (Nesheiwat 2012; Olwan 2013a).

Each of these new or revised laws provided increased protection of intellectual property. Full discussion of the TRIPS agreement and its various IPR protections can be found elsewhere,[19] but some of the most important changes in Jordanian law included: an extension of patent protection from 16 years to the standard 20 years from the date of application; patent holders were granted the right to claim damages on any IPR-related crimes related to the patent; penalties against IPR violators were increased; compulsory licenses were greatly restricted; and the trademark duration was increased from 7 to 10 years, with the option to renew for continuous 10-year periods (El-Said 2006).

6.2.2 Jordan-US Bilateral Free Trade Agreement

In addition to the TIFA and BIT with the United States and Jordan's accession to the WTO, Jordan signed a bilateral free trade agreement (FTA) with the US in 2001 that

[19] See (Braithwaite and Drahos 2000; Sell 2004, 2007)

increased IPR protections beyond those enshrined in the TRIPS agreement – what scholars refer to as "TRIPS-Plus conditions". For Jordan, these TRIPS-plus rules come in the form of restrictions to parallel importation and compulsory licenses, and extensions of patents and data exclusivity in certain circumstances. Each of these will be discussed briefly.

The TRIPS agreement, while generally requiring extensive intellectual property rights, also provides for certain flexibilities and exceptions. These flexibilities were largely the product of lobbying by NGOs and activists in the "Access to Medicines" campaign. Their lobbying efforts culminated in a TRIPS declaration affirming the primacy of public health during the Doha ministerial in 2001. The *Declaration on the TRIPS Agreement and Public Health* (Doha Declaration), emphasized that the TRIPS agreement should be interpreted in a way that supports public health (World Trade Organization 2001). Its widely quoted paragraph 4 notes,

> We agree that the TRIPS Agreement does not and should not prevent members from taking measures to protect public health. Accordingly, while reiterating our commitment to the TRIPS Agreement, we affirm that the Agreement can and should be interpreted and implemented in a manner supportive of WTO members' right to protect public health and, in particular, to promote access to medicines for all (World Trade Organization 2001).

The Doha Declaration goes on to enumerate the flexibilities built into the TRIPS agreement, and it emphasizes the use of those flexibilities to protect public health.

In the process of joining the WTO, signing the bilateral FTA with the US, and reforming domestic law, Jordan's IPR regulations limited the use of some of these flexibilities. Jordan's *Patent Law No. 32* (1999) and *Patent Law No. 71* (2001) forbid the use of parallel importation without prior consent by the patent holder (Malpani 2007).

Parallel importation is the process of importing generic versions of patented medications by countries without a domestic generic drug industry from another country that does produce generic versions. With this restriction on parallel importation, even if Jordan had a public health emergency and thus a right to override a patent, they could not import any generic versions of patented drugs without the patent holder's permission. Unless they could produce a generic domestically, they would be unable to exercise their right to override the patent. The Doha Declaration allows parallel importation *without* patent holder permission, so Jordan's law clearly goes beyond the requirements of TRIPS. The good news for Jordan is that it has strong generic production capacity, which should limit the need for parallel importation.

The US-Jordan FTA itself imposes several additional TRIPS-plus conditions. These include patent extensions to compensate for delays in the marketing approval process, and an additional three years of data exclusivity (beyond the standard five years) for new uses of already known chemical entities (Malpani 2007). Data Exclusivity effectively extends patents for some drugs beyond the 20 years of protection offered by TRIPS. It also allows for up to five years of market monopoly for drugs that are not patented. Many generic drugs rely on clinical test data submitted for a drug's first (brand name) approval, and regulatory agencies generally accept this test data for unaltered generic versions. Data exclusivity means that generics cannot use the original clinical test data for a period of time after the patent expires, and thus cannot get approval for the generic unless they replicate expensive trials. If the drug is not patented in a country, data exclusivity still prevents the use of clinical trial data for the registration of a generic for five years after the initial registration of the brand name drug in that country.

Finally, the US-Jordan FTA limits the use of compulsory licenses. TRIPS permits all WTO members to issue compulsory licenses for pharmaceuticals, which override a patent and allow the production of a generic version of the protected drug. While TRIPS does not limit the conditions under which compulsory licenses can be granted, it does impose obligations such as fair compensation to the patent owner and a procedural requirement that the government issuing the license first attempt to negotiate lower prices or voluntary generics from the patent owner. This procedural requirement can be waived for health emergencies or public non-commercial use of the patent. Article 31 also requires that licenses be issued "predominately for the supply of the domestic market" and not be exported. The US-Jordan FTA, however, does limit the use of compulsory licenses. It permits them only (a) to remedy anti-competitive practices, (b) in the case of public non-commercial use, or (c) in the case of national emergency or other situations of extreme urgency (Malpani 2007).

6.2.3 The Decision-making Process in Jordan

In general, Jordanian leadership warmly welcomed accession to the WTO and deeper integration into the global trade regime (Al-Sharieh 2008).[20] Public statements by the Jordanian negotiators at the WTO also suggested that Jordanian leadership believed the stronger IPR regulations they were agreeing to would benefit the Jordanian economy.

[20] Faris Nesheiwat notes that, while the Jordanian leadership was eager to join the WTO and enjoy the economic benefits accession was expected to bring, that is not to say that the decision was popularly sanctioned. Two of the most important treaties signed during the process, which imposed significant changes on Jordanian law, were passed at a time when the Jordanian Parliament was dissolved (Nesheiwat 2010).

Dr. Mamoun Talhouni, the head of the National Library, summarized the leadership's position on the eve of WTO accession:

> IP experts agree that intellectual property protection promotes domestic economic activity, attracts foreign investment, facilitates the transfer of technology and creates confidence in Jordanian industries worldwide. These are messages the National Library will be seeking to get across in the coming months (qtd. in Al-Sharieh 2008, 104).

Likewise, Dr. Mahammad Halaiqah – then Secretary General of the Ministry of Industry and Trade and chief negotiator for accession to the WTO – emphasized the role of IP in promoting a technology economy and economic growth:

> By staying committed to protecting intellectual property rights, encouraging knowledge transfer and fostering a thriving IT industry that is second to none, the government foresees Jordan's role in the regional, as well as in the international community, as an influential force in empowering its people with the skills, expertise and resources that they require to excel in today's digital economy (qtd. in Al-Sharieh 2008, 104).

However, Dr. Halaiqah also recognized that there were costs to joining the WTO. Notwithstanding those costs, he believed Jordan had little choice, saying "There is a *great* cost to joining the WTO, but if we do not join, the cost will be higher… our industries will no longer be competitive, they will lose markets and foreign investment in Jordan will be jeopardised" (qtd. in Al-Sharieh 2008, 104).

In many ways, the decision to join the WTO and sign FTAs with the US and EU were as much political choices as economic ones. Jordanian leadership certainly faced political pressure, which is discussed in the next section, but they were also keenly aware that development aid, support, and economic partnerships with the US would be contingent on compliance with WTO and international trade norms. In negotiating the terms of WTO accession and free trade agreements Jordan's leaders focused on market

access, FDI, and economic growth, and the IPR chapter of each treaty was given less consideration. Not only did the Jordanian leadership not seem to focus on IPR during the negotiations, but every expert I have spoken to has said that in all likelihood the negotiators did not fully understand the implications of the intellectual property protections they were agreeing to. Ahmed Abdel Latif, an Egyptian career diplomat and IPR scholar, summarized the process in reference to Jordan and other nations, saying:

> It is not always clear if these TRIPS-Plus obligations in national laws are the result of a conscious and deliberate choice by legislators and policy-makers, or are more the result of inadequate legislative advice given to these Arab countries in the process of modernization of their IP laws by certain bilateral donors and international organizations with a vested interest in promoting higher IP standards (Latif 2009).

In his field interviews with the WTO delegation from Jordan, IPR scholar Faris Nesheiwat said he got the sense that IP and IP standards were not front and center in any of the debates at the WTO. Instead, they were a byproduct of the process. The goal was to get into the WTO and get the "FDI genie out of the bottle". The focus was on the benefits of global trade, and not enough attention was paid to intellectual property (Nesheiwat 2014).

6.2.4 US Pressure

Throughout the process of WTO accession, the signing of the US-Jordan bilateral FTA, and afterwards, Jordanian leadership faced constant and significant pressure from US officials and industry groups. Leaked diplomatic cables published by the Wikileaks

website in 2011 and subsequently analyzed by IPR law scholar Mohammed El-Said (2012), reveal the nature of the pressure the US was placing on Jordan.

Pressure from the US came from both government agencies and private groups. The US embassy in Amman, the US Trade Representative (USTR), the US Agency for International Development (USAID) and its AMIR Program in Jordan, and the US Patent and Trademark Office (USPTO) appear to be the most active agencies pushing for stronger intellectual property rights. In addition, Jordan faced pressure from the Business Software Alliance (BSA), and the International Intellectual Property Alliance (IIPA) on the issue of copyright, as well as the Pharmaceutical Research and Manufacturers of America (PhRMA) on the issue of patents (El-Said 2012). On the Jordanian side, the participants in diplomatic exchanges included the Ministry of Industry and Trade, the National Library, the Jordanian Food and Drug Administration (JFDA), and the Ministry of Health – whose roles will be discussed in the next section.

El-Said described the overall tone of diplomatic interaction as reflecting "a general pattern of encouragement and collaboration where positions are unified. When positions are not, criticism is often associated with suspension – or threat of suspension – of funds from the US side" (El-Said 2012, 10). Throughout the discussions, US officials and industry groups pushed for "maximalist" interpretations of IPR commitments while the Jordanian government's response was usually reactive and at times contrarian.

The leaked cables reveal that the majority of diplomatic pressure regarding IPR focused on patents more than copyright, and focused on data exclusivity provisions specifically. One cable from 2005 suggested that the US and international drug companies were satisfied with the patent registration system in Jordan, but not with the

pro-public health decisions the JFDA's committees had often adopted. The cable went on to describe the committees as "multi-agency committees [that] do not have the same reputation [as the JFDA], being holdovers from a former paternalistic era of healthcare" (El-Said 2012; US Embassy Amman 2005).

The cables reveal efforts by the US to influence the decisions made by JFDA committees, including one situation in which a pharmaceutical company had requested an extension of data exclusivity protection for new dosing instructions on an existing medication. They requested three *consecutive* 5-year protection periods for the adult dose, children's dose, and infant dose of the medicine. When the case was dismissed by Jordanian courts on a technicality not related to the substantive dispute, the US Embassy wrote, "[s]ome in the PhRMA community believe it was a breach of the law for the [government of Jordan] to fail to uphold the FTA obligation to protect data submitted for the once-weekly dose, regardless of any lawyer court decision" (El-Said 2012; US Embassy Amman 2005). They pushed for this outcome despite the fact that separate extensions of data exclusivity for different doses are not guaranteed by TRIPS or by the FTA itself, and the fact that such extensions are not the standard practice in any country.

After a second dispute regarding data exclusivity for a cancer treatment, in which the JFDA disagreed with the start date of data protection, the US Embassy called for a review of the FTA, while the USAID AMIR program called for a gap analysis to determine if Jordanian patent legislation was insufficient. The US Embassy went so far as to demand that a PhRMA representative be placed on the JDFA's *High Committee for Drugs* (El-Said 2012; US Embassy Amman 2005).

In a third example, new chemical data trials on an anti-asthma therapy revealed that the drug could also help patients with coexisting allergic rhinitis. The JFDA approved the new use but not a "new indication" that would grant a 3-year data exclusivity extension, saying that the "gray area of overlapping uses does not permit a distinction" and as a result would not receive exclusivity protection. The leaked cables reveal PhRMA's outrage at this decision, and resulted in an appeal from embassy officials for the JFDA Director General to take a "harder look at what 'protection' means" (El-Said 2012; US Embassy Amman 2005).

Summarizing the US position, El-Said said: "Scrutinizing the cables, a sense of frustration on the part of the U.S. officials is evident, as a result of JFDA's reluctant approach to award additional TRIPS-Plus protection to drug manufacturers. This frustration is apparent despite the fact that the JFDA's position was influenced by domestic public health considerations" (El-Said 2012).

6.2.5 Concluding Remarks Regarding the Process of IPR Reform

While the Jordanian leadership and WTO negotiators highlighted the potential economic benefits of IPR reform, the field research conducted by Jordanian scholars who interviewed the WTO negotiating team and others in the Jordanian leadership suggest that IPR reform was as much a product of negotiations with the US and other WTO members as a deliberate attempt to stimulate innovation. The leaked diplomatic cables further suggest that Jordan strengthened IPR to the extent it did at least partially in response to political pressure applied by the US during the negotiations. Considering all

of the available information, it does not appear that IPR reform was either purely exogenous or purely endogenous, but was instead a product of both internal economic goals and external pressure.

6.3 Institutional Structure for IPR Regulation and Enforcement

Intellectual property rights in Jordan are regulated and enforced by a dizzying array of agencies. Patents are regulated by the Industrial Property Protection Directorate (IPPD) within the Ministry of Industry and Trade (MoIT). The IPPD is also in charge of classifying and registering trademarks, although the enforcement of trademarks against counterfeiting is the responsibility of another MoIT department: the Jordan Institution for Standards and Metrology (JISM). Copyright is regulated by yet another agency: the Author's Right Protection Office (ARPO) at the National Library (NL). Additional confusion is added by the Customs Department, which created a special section to enforce copyright and trademarks called the Customs Procedures Section (CPS). Finally, several other product-specific agencies participate in IPR enforcement, especially the Jordanian Food and Drug Administration (JFDA) which deals with IPR related to pharmaceuticals (Nesheiwat 2012).

The MoIT has been in charge of regulating industrial activity since its founding in the 1950s, with a goal of increasing Jordanian economic growth and global competitiveness. It is through this pro-business perspective that the ministry administers patents and trademarks. Jordan has not developed the expertise or logistical processes for examining and registering patents, and therefore relies heavily on the World Intellectual

Property Organization (WIPO) and its integration of patent filing systems in the developed world for examination and search of patents. The WIPO system allows countries to share the task of examining patent applications and determining whether an invention qualifies for a new patent. Jordan has access to the evaluation and decision made by other countries on previous patent requests for the same product, and can rely on others' judgment. This greatly reduces the administrative burden on Jordan. The result of relying on other patent office's decisions, however, is that a Jordanian patent is almost always awarded for products that have received patents outside of Jordan (Nesheiwat 2012). With weak domestic spending on research and development, the majority of patent requests in Jordan come from international manufacturers. For example, Jordan received 431 international applications in 2010 but only 43 domestic applications. Of those, 64 patents were granted to foreign products and 22 to domestic products (Ministry of Industry & Trade n.d.).

The Jordanian Copyright Law names the National Library (NL) as the repository for authored works seeking protection, although the law does not require works to register with the NL in order to receive protection. That said, the NL plays an important role because it has the authority to prevent a work from being commercially circulated in Jordan if it is not registered with the National Library. This complex relationship is summarized well by scholar and Jordanian IPR lawyer Faris Nesheiwat: "While the foreign work is protected from infringement in Jordan, even if it is not registered with the NL, the NL has veto power over its commercial circulation in Jordan. Similarly, the NL controls the right to publish works in Jordan by asserting its right to approve those works ahead of publication" (Nesheiwat 2012).

6.4 IPR Reform and Health

6.4.1 IPR and Macro-level Health Outcomes

We have data for Jordan from before and after IPR reform regarding the macro-level health outcomes discussed in Chapter 3. The appendix to this case study presents graphs for Jordan's score on the patent and copyright index (Figures 1 and 2) as well as male, female, and population life expectancy (Figure 3); male and female adult mortality (Figure 4); infant, child, and neonatal mortality (Figure 5); and maternal mortality (Figure 6).

Patents are more important than copyright when it comes to health outcomes, as discussed in previous chapters. Figure 1 demonstrates that Jordanian patent strength increased dramatically in 1999 and again (less dramatically) in 2004. However, when we look at life expectancy rates and mortality rates for Jordan (Figures 3-6), there is no noticeable disruption in the long term trend during or following the period of IPR reform. Life expectancy rates follow upward trends from 1990-2014, while mortality rates follow downward trends. These trends are logical, and ones we observe in most countries as development and advances in medicine allow for better health outcomes over time. If stronger IPR did have an impact on these health outcomes, we would not necessarily see a dramatic change in the long term trends, but we would expect to see a disruption around 1999-2004 or shortly afterward. We do not see any such disruption. As more time passes, it is possible that additional negative impacts on these macro-level outcomes will emerge. In summary, these Figures suggest that – for Jordan – there was no immediate or short

term impact of strengthened IPR on the macro-level health outcomes I examined in Chapter 3.

6.4.2 IPR and Drug Prices

Because Jordan was one of the first countries in the Middle East to adopt strong patent protections, scholars and NGOs in the Access to Medicines movement have studied their impact on drug prices directly. In 2007, Oxfam International commissioned a report on IPR and drug prices, ultimately concluding that overall prices had increased by 20% since 2001. The increase has been spread across an array of pharmaceuticals, with 91 therapeutic classes experiencing a price increase over 20%, and 88 therapeutic classes experiencing a price increase between 0-20% (Malpani 2007).

This has translated into dramatically increased government and private expenditure on pharmaceuticals in Jordan. In order to put a dollar figure on the increased costs to the government and consumers, Oxfam analyzed cumulative expenditure for new medicines with no generic equivalent during that time frame, which amounted to $46 million. Of that figure, $31.49 million was spent on medicines that had no generic competition due to data exclusivity. Using previous research showing that generic competition causes the prices of medicines to fall between 30 and 70 percent, Oxfam concluded that stronger IPR resulted in between $6.3 million and $22.04 million in increased drug costs to the government and consumer. This represents between 13.7% and 47.9% of the cumulative costs of new medicines, or between 1.2% and 4.4% of total pharmaceutical spending, holding other factors constant (Malpani 2007).

Ryan Abbott and his colleagues conducted a second, more recent examination of drug prices in Jordan following IPR reform (R. B. Abbott et al. 2012). Using slightly different methodology the study authors found that between 1999 and 2004, adjusting for increased sales volume and inflation, there was a 17% increase in total annual expenditure for medicines in Jordan. Abbott, et. al. compared the prices of 46 of the most essential medicines used in Jordan in 1999 to the price in 2004, adjusting for inflation. None of these 46 drugs was patented in Jordan. To examine the impact of delayed market entry resulting from data exclusivity, the JFDA independently determined which of the medicines was within the ability of Jordanian generic manufacturers to produce, and the authors compared the pre-IPR (1999) prices to the post-IPR (2004) prices for those medicines (R. B. Abbott et al. 2012).

In terms of total private market sales, both the total units of medicines and the total prices of medicines went up, from 26 billion units in 1999 at a price of $81 million, to 32 billion units in 2004 at a price of $125 million. Adjusting for inflation, this is a 17% increase in the total price of medicines. Summarizing the effect of delayed market entry of generics, Abbott and his co-authors write:

> In 2004, the weighted average generic medicine price was 45% the price of its originator [brand name] counterpart. This data suggests that 1 year of data exclusivity of NCEs [New Chemical Entities / a.k.a. new medicines] registered in 2004 cost Jordan's retail market approximately 3.3 million USD. Extrapolating these numbers based on these calculations to include 90 NCEs registered with the JFDA between 2000 and 2003, which were also protected by data protection in 2004, it is estimated that delayed market entry of generics due to enhanced IP protections cost Jordan's retail market approximately 18 million USD in 2004. This represents approximately 14% of the total annual pharmaceutical spending in Jordan's private sector (R. B. Abbott et al. 2012, 80–81).

The size of the impact on drug prices is comparable to the Oxfam study, and on the high

end of Oxfam's calculation of $6.3-$22.04 million of increased cost due to IPR protections. Ideally we would have more than two studies of drug prices, but to my knowledge no others exist, including any examination of this issue from the Jordanian government itself. Newer and more complete studies of Jordanian drug prices and exactly what impact those prices have on larger health outcomes is one potential area for future research.

6.4.3 Data Exclusivity Rather Than Patents

The majority of new drugs introduced in Jordan following the reform of IP laws have, in fact, not been patented there. As discussed above, IPR reform in Jordan brought protections for clinical trial data collected by brand name drug manufacturers for the initial registration of a drug (data exclusivity). Data exclusivity prevents drug regulators from using trial data developed by originator companies to establish the safety and efficacy of a medicine for market approval for a period of five years. Generic companies must either wait until data exclusivity ends, or conduct their own expensive clinical trials (which generally take longer than five years). Since April 2000, when data exclusivity was adopted, multinational pharmaceutical companies registering new products in Jordan have tended to forgo patent protection since they would enjoy five years of automatic protection from generic competition through data exclusivity. This is likely a cost/benefit calculation on their part, given the relatively limited size of the Jordanian pharmaceutical market and the expense and time-consuming process of filing for a patent. It is also far easier for a drug to be granted market monopoly through data exclusivity. While patent

offices carefully review applications for novelty, safety, and other aspects of each product, a pharmaceutical company only needs to submit clinic trial data to obtain a five-year market monopoly for their product through data exclusivity (Malpani 2007).

In their research, Oxfam examined 108 new medicines with no generic equivalent introduced in Jordan by the 21 largest multinational pharmaceutical companies from 2001 through mid-2006 (Malpani 2007).[21] Of these 108 medicines enjoying a market monopoly in Jordan, only five had product patents. The rest were free from generic competition as a result of data exclusivity. Since December 2004, Jordanian law has allowed for an additional three years of data exclusivity for approved new uses of an existing medication, although there has been a back-and-forth debate between the government and pharmaceutical companies over what qualifies as a new use. The government has maintained a policy that only new indications qualify, so far rejecting industry efforts to consider new dosing instructions, drug combinations, and formulations (R. B. Abbott et al. 2012). According to Oxfam, at least 25 medicines have been granted an additional three years of data exclusivity for new indications. Since IPR reform, the market share of drugs without a generic equivalent tripled from 3% in 2002 to 9.4% in 2006 (Malpani 2007).

Drug prices are influenced by many factors, including advances in technology and economies of scale, negotiations with drug manufacturers and wholesalers, inflation, and shifts in currency valuations. Those factors notwithstanding, there is evidence that the increase in drug prices Jordan is the result – at least in part – of the strengthening of intellectual property protections. However, as previously discussed, there is no evidence

[21] These 108 medicines are not an exhaustive list of all medicines introduced in Jordan in the time period, but they account for 42% of all new medicines with no generic equivalent, and more than 70% of *sales* of new medicines with no generic equivalent.

to suggest that the increase in drug prices ultimately resulted in worse overall health outcomes. These two facts taken together suggest that the increase in drug prices was absorbed by increased public and private spending on health. This increased spending is itself a negative impact for Jordan, as it shifts public and private spending from other sectors of the economy. Whether the negative impact of higher health costs outweighs any positive impact from stronger IPR is an empirical question. Fully answering it is beyond the scope of this project, but we can take a cursory look at changes to FDI and innovation in Jordan following IPR reform.

6.4.4 IPR, Local Research & Development, and Foreign Direct Investment

During the IPR reform process, as Jordan joined the WTO and negotiated bilateral free trade agreements with the US and EU, there was considerable focus on IPR as a driver of economic growth and foreign direct investment, both from the Jordanian leadership and from outside Jordan. The US negotiators were particularly adamant that IPR would spur FDI in Jordan (El-Said 2012). The economic logic is discussed in previous chapters, but reform of IPR was promised to bring new innovation and investment in Jordan's economy, including in the pharmaceutical industry. Since IPR reform in Jordan, several scholars have examined the extent to which stronger IPR has led to increases in R&D and FDI (Al Nasa'a et al. 2008; El-Said 2006, 2012; El Said and El-Said 2007; Jaafari 2012; Malpani 2007; Nesheiwat 2010; Ryan 2004).

With one exception (Ryan 2004), each of these studies has concluded that the promised gains in R&D and FDI have failed to materialize, especially in the

pharmaceutical sector. Since 2001, there has been no meaningful uptick in licensing agreements, technology transfer, or collaboration between multinational drug manufacturers and Jordanian companies (El Said and El-Said 2007; Malpani 2007; Nesheiwat 2010). As a senior manager at one of Jordan's few successful licensee firms noted,

> We have several licensing agreements but most of them go back to before 1999 and those signed after 1999 had nothing to do with the FTA itself. It is our firm's long standing policy to sign such strategic agreements whenever possible and beneficial. The FTA did not lead to any licensing agreements because it was a one-sided agreement. They told us that the FTA will be good for us, that it will lead to more innovation, joint ventures, licensing and R&D. It led to none of the above because stronger IP protection was never the problem. The problem itself was lack of resources, lack of sufficient R&D, lack of human skills and lack of infrastructure that are all necessary for innovation (qtd. in El Said and El-Said 2007).

Compare the lack of FDI growth in Jordan with FDI growth in Egypt. While Jordan has dramatically reformed IP protections, Egypt has not. Egypt adopted minimum obligations under TRIPS, introducing patent protection in 2005 but not offering data exclusivity to any products. Unlike Jordan, Egypt has routinely been criticized by the Pharmaceutical Research and Manufacturers Association (PhRMA), the pharmaceutical industry association and lobby, for failing to adequately protect intellectual property. However, from 1995 – 2006 Egypt received $223 million in investment in pharmaceutical manufacturing, 39% of which came from foreign multinational firms. Meanwhile, Jordan has received almost no investment in pharmaceutical manufacturing (Malpani 2007). Much of the international investment in Egypt has come in the form of licensing agreements. According to PhRMA, 30% of all drug manufacturing inside Egypt is from local subsidiaries of foreign drug companies, and an additional 35% is through licensing agreements and partnerships between multinationals and local generics

manufacturers in Egypt (Malpani 2007). Of course there are many factors that explain why FDI has been larger in Egypt than in Jordan. Egypt is a much larger country and potential market, it has a larger and more vibrant economy, and the extant level of medical and pharmaceutical expertise is at least as good as that in Jordan. Investors look at more than intellectual property rights when making decisions about investments and other business collaboration. This example does, however, illustrate the fact that simply having strong IPR protections is not a necessary and sufficient condition for generating FDI, licensing agreements, and technology transfer.

Likewise, local R&D and innovation in Jordan has not seen much growth since passage of IPR reform. Most Jordanian firms that conduct R&D report spending roughly the same 2-3% of sales on R&D that they spent before 2000. Employment in R&D divisions of most local drug manufacturers has not increased, and in many cases it has declined (El Said and El-Said 2007).

Other than superficial claims that IPR will benefit local industry made by the US, PhRMA, and other industry lobbyists, only one scholar has argued that IPR reform in Jordan has or will bring FDI and R&D growth. In discussing strategies for Jordan to spur economic growth and development, professor Michael Ryan points to the increase in multinational pharmaceutical firms' scientific offices in Jordan and several examples of potential collaborations between multinational firms and Jordanian manufacturers (Ryan 2004). In responding to Ryan's claims, Faris Nesheiwat suggests that these science offices established in Jordan have almost uniformly been staffed with aggressive sales associates rather than researchers, and that very little technology transfer is involved in the relationship (Nesheiwat 2010).

To summarize, there appears to be little evidence that strengthening IPR in Jordan has brought with it significant increases in local innovation, R&D, technology transfer, or foreign direct investment.

6.4.5 Concluding Remarks about Health

The studies described in this section offer evidence that stronger IP protections, especially data exclusivity provisions, have increased the costs of drugs to the Jordanian government and private market consumers. The magnitude of this impact is estimated to be between $6.3 and $22.04 million through 2006, although there are no recent empirical studies of the impact after 2006. Jordan does not have a national healthcare system, nor is there a national health insurance regime, which means that both the government and private citizens end up paying more when drug prices go up. Examining the long-term trend for life expectancy rates and mortality rates, however, it does not appear as if these increases in drug prices have translated into worse overall health outcomes. As time goes on, it will be important to revisit these outcomes to see if impacts do eventually emerge.

6.5 IPR Reform and Education

As before, we have data for Jordan from before and after IPR reform regarding the macro-level education outcomes discussed in Chapter 4. In addition to graphs for Jordan's score on the patent and copyright index (Figures 1 and 2), the appendix to this chapter presents male, female, and population primary school enrollment (Figure 7);

male, female, and population secondary school enrollment (Figure 8); male, female, and population tertiary school enrollment (Figure 9); male, female, and population primary school completion rates (Figure 10); male, female, and population secondary school completion rates (Figure 11), and male, female, and population school life expectancy (Figure 12).

When it comes to education outcomes, copyright is more important than patents. Figure 2 displays the trend for Jordanian copyright protection. As you can see, there were two large increases in the copyright score: one in 1990 when the first copyright reform took place, and the second in 2004. To draw attention to these two points in time, I have placed vertical reference lines on Figures 10-15 indicating the two points of copyright strengthening.

For enrollment rates (Figures 7-9), we have interesting results. In the years following each copyright reform, primary school enrollment rates experienced a decline, secondary school enrollment rates experience a very slight increase, and tertiary school enrollments experience a larger increase. This mirrors the results found in Chapter 4 where stronger copyright protections were associated with lower primary school enrollment rates and higher secondary and tertiary school enrollment rates. However, these Figures depict *uncontrolled* correlations between copyright and enrollment rates. We cannot be certain that the decline in primary school enrollment and the uptick in tertiary school enrollment are the result of stronger copyright laws. For primary school enrollments, I have serious doubts that the decline in enrollment is related to IPR. Jordan provides free primary school education to all citizens, including the cost of textbooks and other resources. Jordanian families must pay for transportation, notebooks, pencils, and

food, so poverty remains one factor keeping some children out of school, but the resources families must pay for at the primary school level are not related to IPR. About a sixth of Jordanian students attend private schools rather than public schools, but families who choose private schools are generally wealthier and less likely to keep children home based on the cost of learning materials and school fees.

The results for completion rates (Figures 10 and 11) and school life expectancy (Figure 12) suggest no relationship between IPR reform and outcomes. Primary school completion rates, after improving dramatically in the 1970s, hovered in the 90-105% range through the 1980s, 1990s, and 2000s.[22] There is no noticeable change in the long term pattern following the two increases in copyright strength. Data on secondary school completion rates, as Figure 11 illustrates, is incomplete for Jordan, so we cannot have confidence in any conclusions based on this data. I was unable to locate more complete secondary school enrollment rates for Jordan, other than these World Bank data. Finally, school life expectancy follows the same uninterrupted trend as primary school completion rates, with relative stability in the 11-11.5 year range following dramatic increases in the 1970s. This trend does not appear to be altered by the two increases in copyright protection.

While the impact of IPR on drug prices in Jordan has been studied, the impact of IPR on education and learning material prices has not. The majority of existing research on intellectual property rights generally, and in the Arab world particularly, focus on TRIPS, free trade agreements, pharmaceuticals, e-commerce, and the internet (Olwan 2013a). To my knowledge, there are no empirical studies of intellectual property's role in

[22] As noted in Chapter 4, enrollment rates and completion rates, which are expressed as percentages of the population for the relevant age group, can exceed 100% due to over-aged and under-aged students attending school at each level.

education in Jordan from scholars, organizations, or the Jordanian government itself. As a matter of fact, I could find no empirical studies of copyright in Jordan at all. There is no additional data available for Jordan on textbook and learning material costs.

Instead, we can supplement the aggregate results presented above with a discussion of the process by which Jordan reformed its copyright laws and the potential impacts IPR reform may bring to the educational sector. The following sections do that by examining the specifics of the copyright law, the exceptions to copyright relevant for education, critiques of the law by legal scholars, and the process of copyright enforcement in Jordan.

6.5.1 Copyright Law in Jordan

As noted previously, copyright has been protected in Jordan since the Ottoman era, but a modern copyright law was not introduced until 1992. When Jordan joined the WTO, and following the US and EU free trade agreements, the 1992 law was amended to come into compliance with TRIPS and the FTAs. The Jordanian *Copyright Law* is extensive, and outlines a very modern system of copyright protections. The law, as amended through 2005, includes 62 articles and spans 33 pages (World Intellectual Property Organization n.d.).[23]

With its roots in the French civil law system, Jordan's copyright law does not use the terms "fair use" or "fair dealing" in outlining situations in which copyrighted material can be used without compensation. Instead, Jordan's law refers to "limitations to author's rights." In drafting this portion of the law, Jordan followed closely the principles

[23] Thirty-three pages in English; the Arabic (original) version is 17 pages.

established in the Berne Convention. Article 9(2) of the Berne Convention and Article 13 of TRIPS outline a "three-step test" that restricts how countries can organize exceptions and limitations to copyright without inappropriately restricting the author's copyright (Olwan 2013a). Any limitations should fulfill these three conditions:

1. The limitation or exception is set under specific cases;
2. There is no conflict with normal exploitation of the work; and
3. The limitation and exception cannot prejudice the author's interest.

Among the allowed exceptions in Jordan's law are reproduction for translation purposes; reproduction of published works under certain conditions; reproduction for private purposes; reproduction for teaching and educational purposes; reproduction in the form of quotation; reproduction for information purposes; and reproduction for libraries, non-commercial documentation centers, and educational scientific and cultural institutions.

6.5.2 Limitations and Exclusions with Implications for Education

In most countries, exceptions and limitations to copyright fall into one of three categories (Hackett 2009). The first group includes limitations intended to protect fundamental user rights, such as public speeches, the right to make quotations, the reporting of current events, the right to parody information, and private non-commercial use such as home recordings. The second category involves commercial interest, industry practice, and competition. Examples of these limitations include reviews, short recordings by broadcasters, museum catalogues, and reverse engineering of computer software for the purpose of interoperability. The third category concerns the needs of

society, and includes exceptions for libraries, teachers, persons with disabilities, and religious uses (Hackett 2009; Olwan 2013a, 2013b). The Jordanian *Copyright Law* includes limitations from all three of these categories.

The two limitations that have the biggest impact on education come from Article 17(c) and Article 20 of the *Copyright Law*. Article 17(c) allows copyrighted works to be used without the author's permission for educational and teaching purposes. The article says this use is allowed when:

> Relying on the work for illustration in education through publications, programs and sound, audio and visual recordings for education, cultural, religious or vocational purposes within the parameters necessary for achieving these purposes provided that this does not conflict with the regular exploitation of the work and that relying on this work in this case does not aim to achieve any financial gain and that the name of the work and author are mentioned (*The Copyright Law Law No. 22 for the Year 1992 and Its Amendments* 1992, art 17(c)).

These exceptions make copyrighted materials available to educators for use in the classroom, although the law does not specify what a "reasonable limit" means, and leaves it up to judicial interpretation.

Article 20 of the *Copyright Law* grants public libraries, non-commercial documentation centers, educational academies, and scientific and cultural institutions the authority to reproduce works for their use, without the copyright holder's consent, provided "that the photocopying and the number of copies is limited by the needs of these institutes and that same does not harm the copyright of the author and does not conflict with the normal exploitation of the work" (*The Copyright Law Law No. 22 for the Year 1992 and Its Amendments* 1992 art 20). As before, the law does not explicitly state what number of copies is reasonable or what it would mean for the photocopying to harm the copyright of the author. As Rami Olwan points out, this exception is apparently not

granted to private and commercial libraries. However, most libraries in Jordan are public and/or affiliated with a University (Olwan 2013a, 2013b).

Article 11 discusses the granting of licenses by the Ministry of Culture for the purpose of translating works into Arabic and when sufficient numbers of copies are not available. Article 11(a) allows for the right to obtain a license from the Minister of Culture or his designee for the purpose of translating a work into Arabic, provided that at least three years have passed since the work was first published and that it is not available elsewhere in Arabic, or if all Arabic translations are out of stock. Article 11(b) allows for a license to reproduce or publish any item when at least three years have passed since its initial publication, there are not enough copies in Jordan to fulfill the needs of the public, and the published copies are sold at a price equal to or less than prices of available copies. Article 11(c) further clarifies that both of these exclusion are only for the purposes of school or university education and research, and Article 11(d) further states that upon granting of these licenses the author shall be entitled to just compensation (*The Copyright Law Law No. 22 for the Year 1992 and Its Amendments* 1992, art 11). While this exclusion makes it possible for educators to obtain Arabic language versions of copyrighted materials or additional copies of undersupplied items, it does not make that process easy or particularly affordable. It is likely that educational institutions will opt to copy material under Articles 17 and 20 rather than applying for a license to publish copyrighted materials.

6.5.3 Critique of the Law

Little research exists on the Jordanian *Copyright Law* and its impact on Jordanian society. Those scholars that have examined the law, and the process of adopting and revising the law, have been largely critical. Rami Olwan, a Jordanian copyright expert and intellectual property lawyer, has said the law is "poorly drafted, inadequate, and outmoded" (Olwan 2013b, 248). Olwan notes that the limitations and exclusions for teaching purposes and libraries are vague and do not cover some of the most important aspects of fair use. Article 17(a) permits the performance or display of a work for educational purposes only within the physical classroom, preventing similar use in online education using the internet. Similarly, Article 20 does not make it clear whether or not libraries have the ability to make electronic items available online. In short, "Article 17(a) and (c) of the *Copyright Law* in Jordan does not support distance education" (Olwan 2013b, 248).

Saleh Al-Sharieh is also critical of the copyright law's vague language, especially when the law states that exceptions and limitations must not interfere with the normal exploitation of the work, and must not cause unjustified damage to the interests of the rights holder (Al-Sharieh 2008). The law does not provide means for a test of interference or unjust damage, leaving it to a judge to decide how to interpret these exceptions.

One of the biggest challenges, especially for the educational sector, is the outright rejection of the "first sale doctrine" in the Jordanian *Copyright Law* (Al-Sharieh 2008). Many copyright regimes include a limitation that is known as the first sale doctrine, which allows for the re-sale of copyrighted material without permission from the

copyright holder.[24] In other words, the initial sale of the item exhausts the copyright for that particular copy. It is the first sale doctrine that allows students, schools, and universities to sell used books to students rather than always requiring the purchase of new copies. Articles 9 and 15 of the *Copyright Law* outline the rights reserved to the copyright holder, including the right of distribution. Article 9(d) says "The author shall have the right to financially exploit his work in any way he chooses. No other person may engage in any of the following conducts without the author's written permission, or the permission of his successors: (a)… (b)… (c)… (d) Distribution of the work or copy thereof through sale or other disposition of ownership" (*The Copyright Law Law No. 22 for the Year 1992 and Its Amendments* 1992, art 9(d)). Article 15 further states, "The transfer of the title of the original copy of the work or the only reproduction or a number of reproductions thereof to other shall not include the transfer of the copyright of this work to same…" (*The Copyright Law Law No. 22 for the Year 1992 and Its Amendments* 1992, art 15). Read together, these articles amount to a rejection of the first sale doctrine (Al-Sharieh 2008).

Several observers have raised questions about how the *Copyright Law* treats temporary and transient electronic copies of copyrighted material (Consumers International n.d.; Olwan 2013b; World Intellectual Property Organization 2002). This is particularly an issue for computer software, eBooks, and other digital works. Some legal scholars and technology companies argue that temporary copies made by a computer's random access memory (RAM) in the normal course of computer use constitutes a reproduction of the item in material form, and an infringement of its copyright

[24] For example, see Section 109 of the US Copyright Act. Available at www.copyright.gov/title17/92chap1.html.

(Consumers International n.d.; Olwan 2013b; World Intellectual Property Organization 2002). Many countries include an exception to copyright that excludes temporary or transient copies incidental to lawful use. However, Article 9(a) of the Jordanian Copyright Law does not include any such prevision, leaving all rights of reproduction, whether permanent or temporary, to the rights holder (*The Copyright Law Law No. 22 for the Year 1992 and Its Amendments* 1992, art 9(a)). This same article prevents consumers of copyrighted material from legally making a backup copy for their own purposes, even if the original software, music, DVD, ebook, or other item was obtained legally.

Finally, the Jordanian *Copyright Law* has been criticized for failing to allow limitations for people with visual and sensory impairments (Olwan 2013a, 2013b). Without such limitations, the adaptation of a work in an accessible format for the benefit of persons with visual or sensory impairment requires the permission of the copyright owner. Limitations for the visually impaired has been a topic of discussion among scholars of copyright in the Access to Knowledge movement, and at treaty discussions at the World Intellectual Property Organization (*Proposal By Brazil, Ecuador And Paraguay, Relating To Limitations And Exceptions: Treaty Proposed By The World Blind Union (WBU)* 2009; Ress 2008; World Intellectual Property Organization 2009). With 4-5% of the Jordanian population living with a visual or sensory impairment, according to the UN Development Program, the lack of any relevant exclusion in the Jordanian *Copyright Law* could restrict access to educational materials for some.

6.5.4 Enforcement of Copyright in Jordan

There is also little existing research into the enforcement of copyright in Jordan, and the Jordanian government does not make extensive data on copyright enforcement available. However, data from 2008 suggest that among the various types of intellectual property, copyright cases do get referred to the Jordanian court system at a high rate:

Table 6.1: Number of cases dealing with IPR enforcement in 2008

Copyright Enforcement	Pharmaceutical Enforcement	Trademark Enforcement	Custom Enforcement
345	14	5	109

Source: (Nesheiwat 2014, 127)

Of the 473 IP-related cases in Jordan in 2008, just under 73% of them dealt with copyright. Additionally, Table 2 displays the number of copyright cases annually from 2000-2008, showing a marked increase from 2000-2003, followed by a leveling off and slight fluctuation year over year afterwards:

Table 6.2: Number of copyright cases referred to the National Library (ARPO), 2000-2008.

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008
Cases	6	149	298	384	218	296	285	357	354

Source: (Nesheiwat 2014, 135)

Discussing this trend, Faris Nesheiwat noted that the enforcement of copyright in Jordan – despite the comparatively large number of cases referred to the National Library and courts – has been both weak and selective:

> It is not clear why these numbers fluctuate or why they are not increasing, as data are not readily available and often hard to obtain. One reason might be that

> enforcement by the NL takes into consideration the economic and social aspects of Jordanian society. In other words, while the NL is technically charged with fighting copyright infringement, it is also aware of its limited resources and the particularities of Jordanian society. Therefore, the NL might be striking a balance between fighting piracy and accommodating the needs of citizens access to copyrighted material (Nesheiwat 2014, 134).

Unfortunately, data is not available on the types of products generating copyright cases in the legal system, but there is some evidence to suggest that the majority of cases involve foreign software and entertainment media. Given the lack of data on this point, it is difficult to say whether material that is specifically useful for education is being protected at the same rate as other author's works.

Another study examining the enforcement of copyright protections in Jordan suggested that Jordan had made progress over the years, but that numerous enforcement challenges remained (Mulki 2008). The study concluded that "these challenges were not experienced because the protection of intellectual property, as a concept, was new; rather that these challenges emerged because the enforcement of such laws is new to both the people and the government of Jordan" (Mulki 2008, 195).

What does seem clear is that enforcement efforts are hampered by poor coordination between the various agencies and ministries involved. Poor coordination is further exacerbated by overlapping responsibilities and serious lack of resources for each agency. Furthermore, there is a disconnect between the legislative language and intent on the one hand, and the actual implementation of IP protections on the other, which Nesheiwat attributes to the inexperience of Jordanian leaders in both the drafting and implementing of intellectual property laws (Mulki 2008; Nesheiwat 2014).

6.5.5 Concluding Remarks About Education

While there is some scholarship critiquing the *Copyright Law* in Jordan, as discussed above, there is no empirical research on the impact of copyright on education in Jordan, nor on the costs of education inputs such as textbooks and educational software. In fact, there is little empirical research on copyright of any kind, in large part because there are few – if any – scholars doing empirical work on intellectual property rights in Jordan. That said, we are able to make some comments about the application of copyright in practice in Jordan.

While Article 11(a/b) of the Copyright Law allows the Ministry of Culture to issue licenses to make copies of material without the author's consent, given several stipulations discussed in section 6.4.2, no such licenses have been granted by the Ministry or local authorities (Consumers International n.d.). In all likelihood, this is not a reflection of the government's unwillingness to issue licenses, but more likely the result of a lack of demand for them.

6.6 IPR Reform and Income Inequality

Jordan provides less insight regarding income inequality than it does for health and education outcomes. The appendix to this chapter presents data for the Gini index (Figure 13) and Palma ratio (Figure 14) before and after IPR reform in Jordan. Gini index values are available from 1973 - 2010, and Figure 13 presents an up and down pattern for Gini values during that time frame. Inequality levels appear to be going down in the

period following IPR reform (after 2004), although given the fluctuation in Gini values during the entire period, this decline does not appear dramatic. Gini index values do not drop as low as they were in the early 1980s.

Income distribution data are available for Jordan only from 1985 – 2010, so this is the period of time for which we can calculate a Palma ratio. Figure 14 displays a dramatic increase in the Palma ratio from 1985 – 1992, and then a steep decline from 1992 – 1995. After that, the Palma ratio increases slightly in the early 2000s and drops off sharply after 2005. Again, it is possible that this decline in inequality after 2005 is the result of IPR reform, but given the variation in the Palma ratio since 1985 the decline is not dramatic, and Palma ratio values do not drop much below where they were in the mid-1980s. Without controlling for alternative factors affecting income inequality in Jordan during the 1970s-2000s, we cannot draw any firm conclusions about the impact of IPR on inequality from these graphs.

Beyond the World Bank data on Gini index scores and income distribution, there has been no empirical work on income inequality in Jordan following IPR reform. There are few published studies of inequality in Jordan, and I was not able to find any documents, reports, or public statements about income inequality from the Jordanian government. The experts on Jordan I spoke to suggested that income inequality, while a serious social challenge for Jordan, is not well studied and is not a focus of the Jordanian leadership. As a result, I am unable to further explore the impact of stronger IPR on inequality in Jordan.

6.7 Discussion

Jordan's accession to the WTO and completion of bilateral free trade agreements with the US and EU were clearly the product of both external pressure and eagerness to further join the global trade regime and spur economic development. Reform of intellectual property rights came along with these processes, and Jordan faced additional pressure to dramatically strengthen its protection of patents, trademarks, and copyright.

Several experts have discussed cultural attitudes about intellectual property rights as important factors (Mulki 2008; Nesheiwat and Adcock 2014). Scholars have suggested that ordinary citizens in Jordan have little understanding of or appreciation for intellectual property rights, and that few people understand that the unauthorized reproduction of an authored work is illegal (Mulki 2008). Among those who do understand their wrongdoing, citizens are often motivated more by pragmatic cost/benefit calculations rather than a sense of legal obligation. As Faris Nesheiwat and Mike Adcock put it, "The strong collectivist culture of the Arab world, of which Jordan is part, results in little personal freedom, which leads to a weak individual assumption of responsibility" (Nesheiwat and Adcock 2014, 4). They go on to say, "In such a collectivist society, where individuals sacrifice their personal ambitions for the good of the collective, the spread of IP piracy is more likely, as individuals motivated by solidarity, cooperation, trust, and support are likely to share property with others and expect them to do the same, without much regard for the notion of IPR" (Nesheiwat and Adcock 2014, 4).

The point here is that, much like average citizens in every country, the Jordanian public does not have a sophisticated understanding of IPR, and these issues do not make their way into regular political and economic conversations. During WTO accession, the

argument over the pros and cons of strengthening IPR did not occur at the lay level, or even at the legal professional level. Whether the reason has to do with Arab culture or simply not having a deep understanding of intellectual property rights in the first place, it appears to be the case that Jordanians do not view the copying of books and other resources as a matter of ethical or legal consequence.

I return to the argument I previewed in the introduction. The evidence from Jordan supports the idea that the *process* of IPR reform, the *political* motivations behind strengthening of IPR, and the *institutional* agencies responsible for the reform and enforcement of IPR partially determine the impact of IPR on outcomes. In Jordan, stronger intellectual property rights have not translated into measurably worse health and education outcomes because of intervening political and institutional factors.

We see these political and institutional factors in the Jordanian Food and Drug Administration's reticence to extend data exclusivity protection to new indications for existing drugs, as discussed in sections 6.2 and 6.4 above. Even under heavy pressure from the US Embassy, the US Trade Representative, and the pharmaceutical industry lobby, the JFDA avoided maximalist protection decisions in several instances. When stronger patent protection – and more importantly expanded data exclusivity – did eventually drive up the prices of drugs, the Jordanian government increased health spending to partially compensate for this effect. Figures 15 and 16, presented below, display government spending on health per capita and as a percentage of the budget. Following IPR reform in the 1999-2004 period, both measures increased dramatically. By offsetting the increased price of drugs and other medical inputs, the Jordanian government may have avoided larger impacts on health outcomes. Of course this added

health spending comes from somewhere, and does represent a net negative to Jordan, especially in light of the lack of local innovation or FDI studies suggest the change in IPR has generated.

Figure 15: Health Spending Per Capita

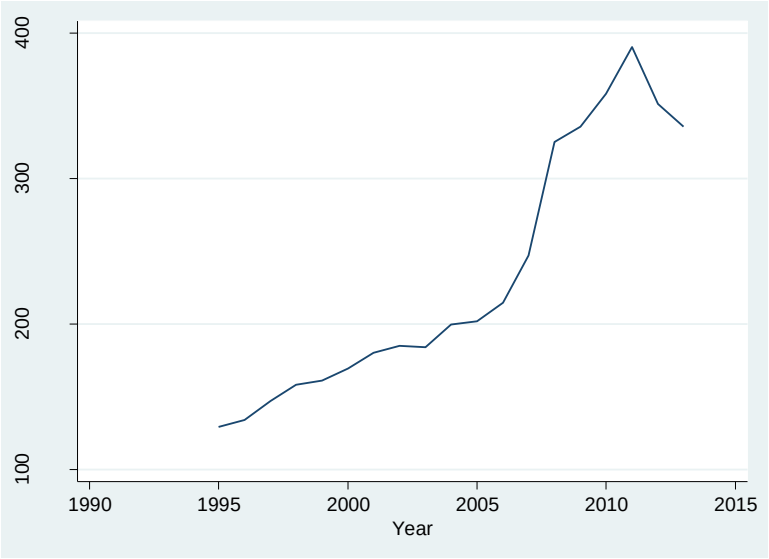
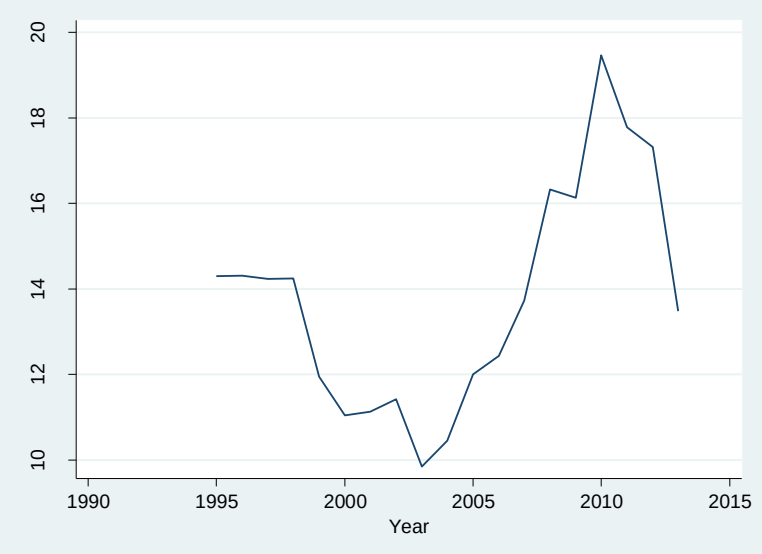


Figure 16: Health Spending (% Budget)



We also see political and institutional factors at work regarding the impact of IPR on education in Jordan. Here the intervening institutional factor is a lack of copyright enforcement. Despite the suggestive evidence in Figures 10-12 that stronger copyright may be associated with lower primary school enrollment and increased secondary and tertiary school enrollment, studies examining the enforcement of copyright in Jordan highlight the poor coordination between the agencies involved in enforcement. The number of agencies and ministries involved, along with the lack of resources available to them, lead to overall weak enforcement. Even when enforcement does happen, Faris Nesheiwat suggests that the National Library selectively enforces copyright infringement taking into account the needs of society – paying more attention to entertainment software piracy and less attention to other copyrighted material with more important social impacts (Nesheiwat 2014). If copyright in Jordan had been aggressively enforced, we may have seen larger and more consistent impacts on educational outcomes. Of course we cannot test this counterfactual.

As I have said, we cannot fully test these arguments with a single case study. However, evidence from IPR reform in Jordan supports the idea that political and institutional factors intervene in the relationship between IPR and health and education outcomes.

Appendix to Chapter 6

Figure 1: Patent Index for Jordan, 1975-2005

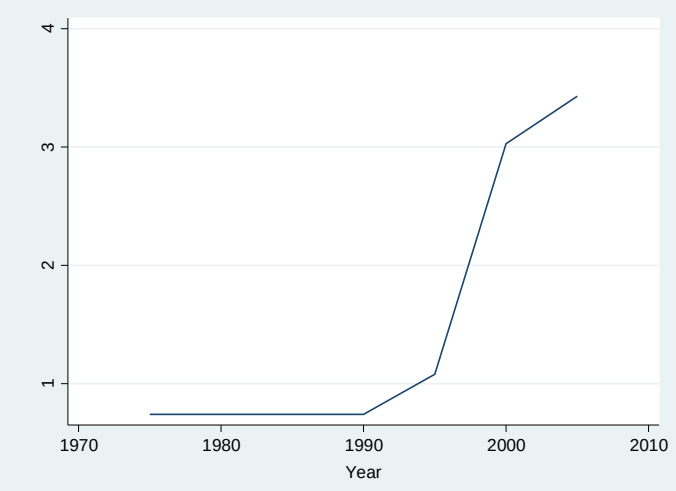


Figure 2: Copyright Index for Jordan, 1970-2010

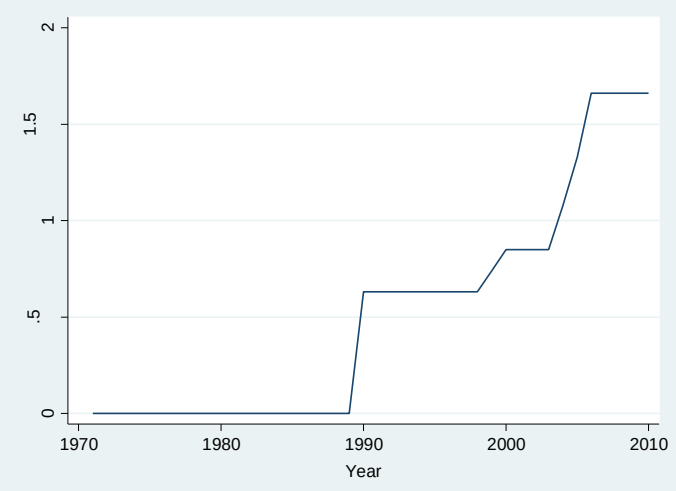


Figure 3: Life Expectancy Rates in Jordan, 1990-2013

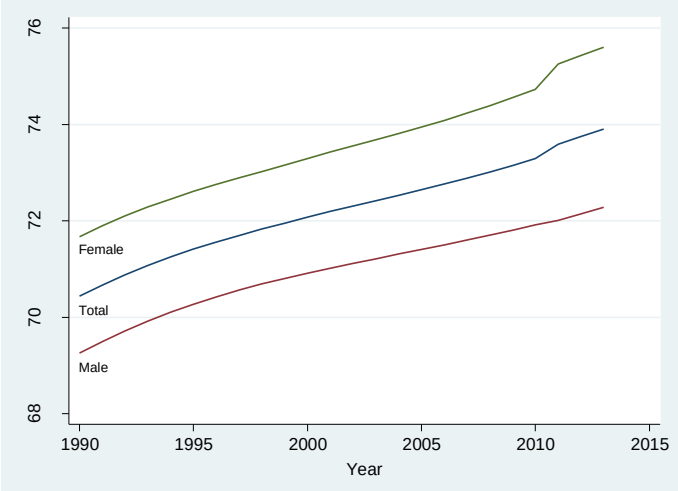


Figure 4: Adult Mortality Rates in Jordan, 1997-2013

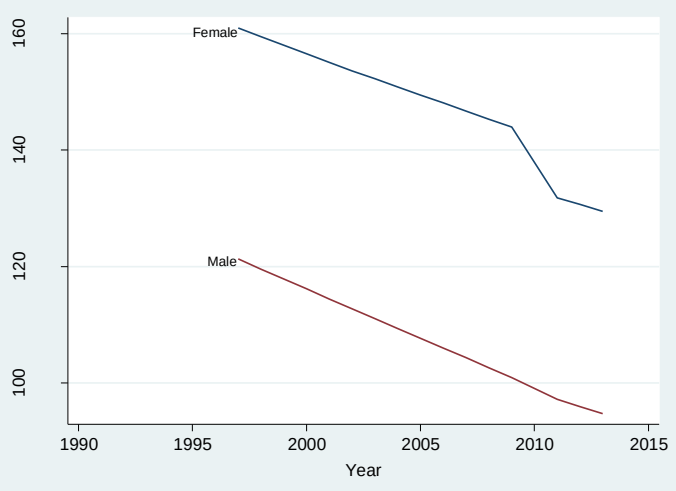


Figure 5: Youth Mortality Rates in Jordan, 1990-2013

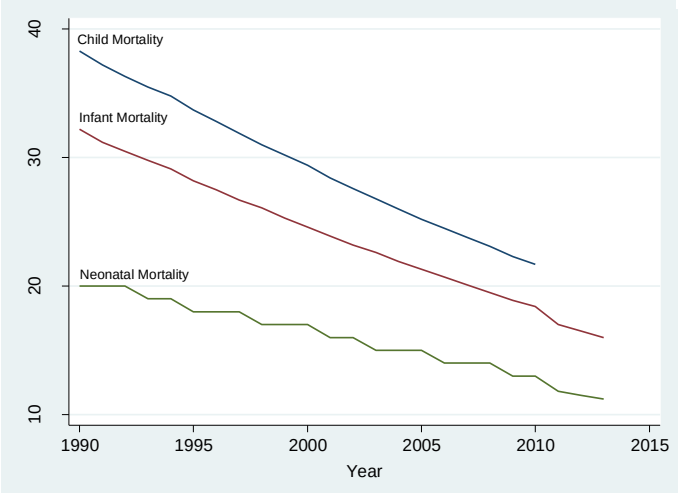


Figure 6: Maternal Mortality Rate in Jordan, 1990-2010

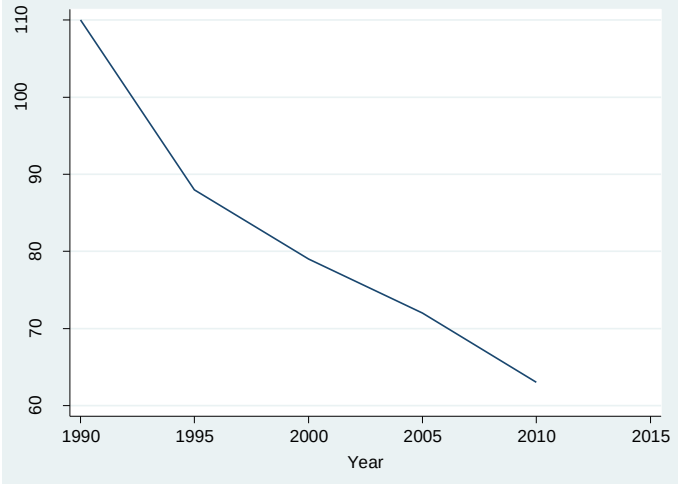


Figure 7: Primary School Enrollment Rates in Jordan, 1970-2010

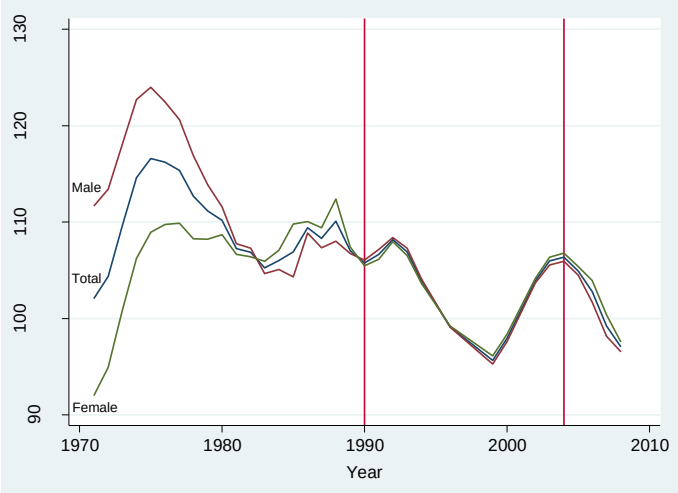


Figure 8: Secondary School Enrollment Rates in Jordan, 1970-2010

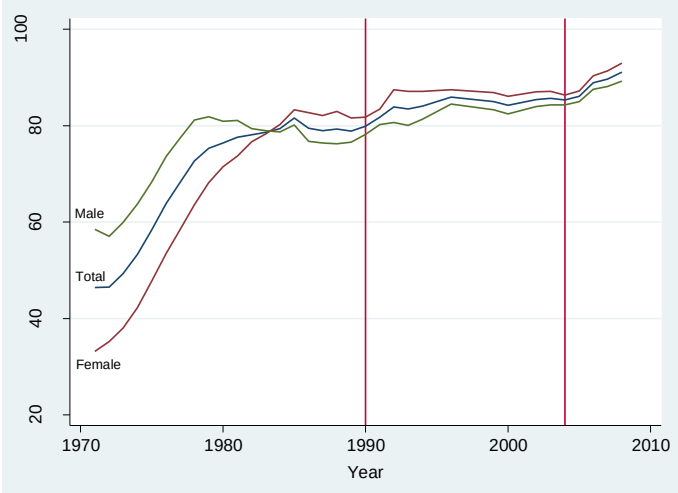


Figure 9: Tertiary School Enrollment Rates in Jordan, 1970-2010

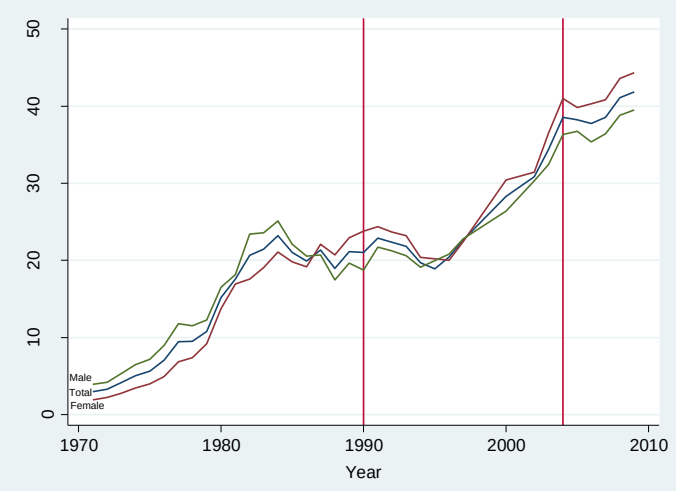


Figure 10: Primary School Completion Rates in Jordan, 1970-2010

Figure 11: Secondary School Completion Rates in Jordan, 1989 - 2010

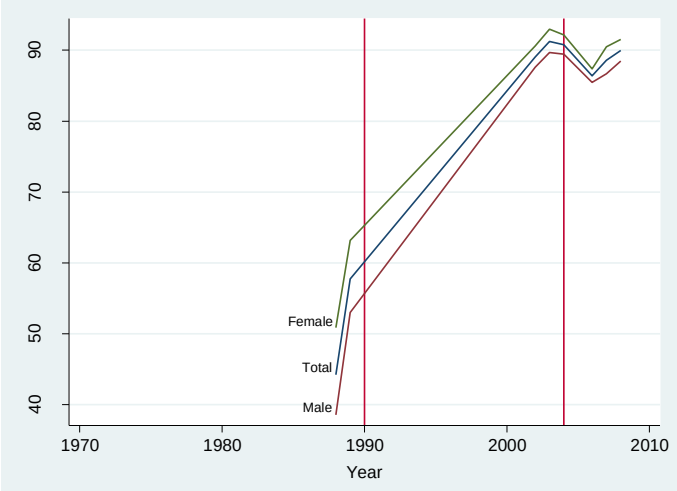


Figure 12: School Life Expectancy Rates in Jordan, 1970 - 2010

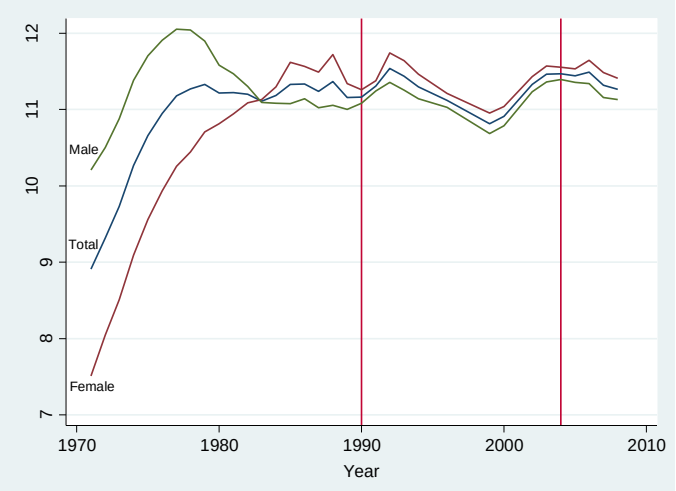


Figure 13: Gini Index for Jordan, 1973-2010

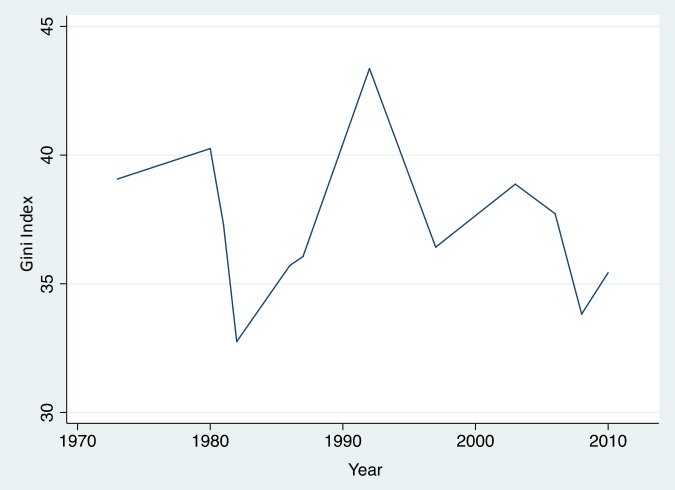
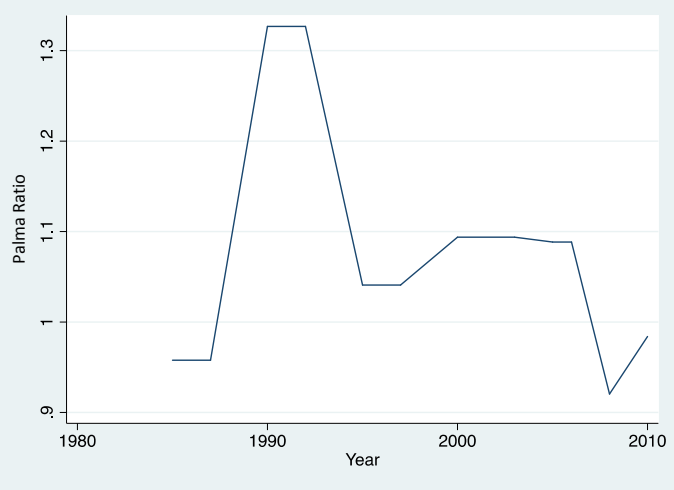


Figure 14: Palma Ratio for Jordan, 1985-2010



Chapter 7

Conclusion

The goal of this project is to examine the impact of intellectual property rights on human development. I have done this by focusing on three core social outcomes: health, education, and inequality. While scholars, activists, and other IPR critics have made the case against IPR, suggesting that stronger IPR will be associated with worse health and education outcomes, they have not presented systematic empirical evidence to test that theory.

Meanwhile, economists and IPR supporters offer abundant empirical evidence to support their claim that IPR are good for economic development, innovation, FDI, and growth. Unfortunately, these literatures talk past one another and fail to consider the other side's arguments. My goal is to offer a large-N empirical test of the impact of IPR on the social outcomes IPR critics champion, and to consider both the positive impact of IPR on growth and a potential negative impact of IPR on health, education, and inequality.

I have also tried to highlight the role politics plays in the process of IPR reform and as an intervening factor in the relationship between IPR and human outcomes. This chapter summarizes the findings from the statistical models in Chapters 3, 4, and 5, as well as the case study on Jordan in Chapter 6. I then offer some suggestions for future research.

7.1 Summary of Findings

7.1.1 Intellectual Property Rights and Health

The statistical models in Chapter 3 suggest that IPR strength is consistently related to health outcomes. Stronger patent protections are associated with worse life expectancy rates, for both men and women. When we lag the IPR variable five, ten, and fifteen years, we find an even more dramatic effect. The statistical significance and the magnitude of the effect are larger than in the contemporary IPR models. We find similar results for maternal mortality rates, for which patent strength is negatively correlated. This result is also stronger when IPR is lagged, although the results only hold for countries at higher levels of development. We do not observe this outcome in poor and lower-middle income countries. Lagged IPR is also associated with worse mortality rates for adult men and women, infants, and children. While the contemporary measure of IPR was insignificant for each of these mortality rates, when lagged the IPR variable becomes highly significant. Each of these results offers support for the hypotheses being tested, that stronger IPR will be associated with worse health outcomes.

Interestingly, when examining the difference in impact for developed and developing countries, I find no difference by level of development for any health measure except for maternal mortality. IPR's association with worse (higher) maternal mortality rates is true only in developed countries. The observed relationships for all other variables are the same regardless of the level of development. Finally, when I disaggregate the patent index and separately test each component of patent protection, it

becomes clear that not all aspects of IPR are equally important. When IPR is associated with worse outcomes, treaty membership is routinely the most important factor explaining the connection.

I want to be clear that these results suffer from data and methodological limitations. Because cross national data for government health spending is available only since 1991, the timeframe of the analysis is limited to fifteen years, from 1991-2005. At the same time, the patent index is measured only every five years, with values for 1995, 2000, and 2005. As a result, we have just three time periods for each country. This does not give the fixed effects regression much within-case variation on which to model the relationship. As a result, I also report single-year OLS models for each health outcome, and the conclusions discussed above come from those single year cross-sectional models. This evidence is suggestive of a relationship between IPR and each outcome, but future research should try to improve data and explore these relationships further, as discussed below.

7.1.2 Intellectual Property Rights and Education

When considering education outcomes, both IPR skeptics and IPR supporters will find evidence in the education models to support their point of view. In general, at the primary school level stronger copyright protections are associated with worse outcomes: lower enrollment rates, less school life expectancy, and lower completion rates. However, these results are not true at the secondary and tertiary level. In fact, stronger copyright protections are associated with higher secondary and tertiary enrollment rates.

In Chapter 4 I discussed three potential explanations for this result, but it bears repeating that discussion here. First, stronger copyright (and other IPR) may be stimulating domestic creation of educational materials, making those materials in fact cheaper. Alternatively, stronger copyright (and other IPR) may be stimulating overall economic growth. This may have two beneficial effects on enrollments, increasing public and private resources and student/family financial conditions which allow students to stay enrolled, while at the same time increasing the economic incentive to attend secondary and tertiary programs. Finally, we may be observing reverse causality with enrollment rates driving copyright protection. When more students are enrolled in secondary and tertiary education, society is developing more human capital and higher capacity for developing intellectual property and authored works. This increases the incentive for governments to protect intellectual property as citizens shift from importers of intellectual property to creators of intellectual property.

For each education outcome I also test a secondary hypothesis: that the impact of IPR on education will be larger for women than for men. As discussed in Chapter 4, the literature suggests that when increased costs force families to prioritize education for their children, boys receive more education than girls. The models presented in Chapter 4 support this argument, with larger coefficients for women than men for each outcome.

Somewhat surprisingly, the education models follow the health models in suggesting that the impact of IPR on each outcome is the same at all levels of development. The lone exception is tertiary enrollment rates, where the positive relationship with copyright is significant for all countries but much larger in developed countries. Regression models for disaggregated copyright and lagged copyright provide

fewer generalizable conclusions. Each of the four components of copyright are significant in some models but not others, and the lagged measures of copyright strength report roughly the same impact as the contemporary copyright index.

The data for education regressions are also more complete. We have cross national education spending data since 1970 and the copyright index is measured annually since 1965, so as a result the fixed effects models of education outcomes have significantly more observations with which to model the relationship. As a result, these conclusions do not rely on single year OLS results.

7.1.3 Intellectual Property Rights and Income Inequality

I examined the impact of both the patent index and the copyright index on two measures of income inequality: the Gini index and the Palma ratio. For the Gini index, there is a significant positive relationship with patents, but no observable relationship with copyright in the full panel model. However, when development interaction terms are included, we see that copyright strength is positively associated with the Gini index in developing countries, but not in the developed world. The positive relationship between the patent index and the Gini index appears to be the same for all countries.

The analysis found no relationship between either index and the Palma ratio. Since the two measures of inequality are theoretically linked and empirically correlated ($r = 0.8688$), we might expect the results to be similar. As I noted in Chapter 5, there are several possible interpretations of this result. Since data on the income share held by each decile is less complete than Gini index data, the Palma models have fewer

observations on fewer countries. The difference in results could be due to these data limitations. Alternatively, it could be the case that – while correlated – the Gini index and Palma ratio are measuring fundamentally different things. Determining which measure is a more accurate operationalization of income inequality is a debate worth having in the literature, but for now these results could be suggesting that these measures of inequality are fundamentally different in various ways. Finally, perhaps the difference in results suggests that when IPR affects income inequality, it does that by affecting incomes in the middle 50% of households. Recall that the Palma ratio ignores the middle 50% and measures the ratio of the top 10% to the bottom 40%. Meanwhile, the Gini index methodology tends to overemphasize the middle 50%. By finding significant relationships between IPR and the Gini index but not the Palma ratio, these analyses could suggest that changes in inequality are taking place in the middle of the income distribution.

When I disaggregate the two IPR indices and examine the impact of each component, it becomes clear that not all aspects of IPR are related to income inequality. Only the number of categories covered by patents, membership in copyright treaties, and enforcement mechanisms for both patents and copyright proved to be significant determinants of inequality.

Lagging the IPR indices leads to interesting results. When lagged fifteen years, patents appear to *improve* rather than harm income inequality. Assuming this result is not merely a product of data limitations or anomalies, we may have evidence of a short term increase in inequality followed by longer term decreases in inequality

resulting from stronger IPR. This result is far from conclusive, and requires additional investigation to properly understand.

A final note is needed regarding magnitudes. Where the statistical models present statistically significant results, the magnitude of the effect of IPR is usually small. Significant strengthening of IPR is usually related to single-digit percentage changes in outcomes. This is true for health, education, and inequality outcomes. Even with small magnitudes, finding evidence of a relationship between IPR and each outcome is still important, but one potential conclusion is that IPR matters only at the margins. Changes in IPR may either help or hurt outcomes by a few percentage points, but other factors are likely to be bigger drivers of success for each of these social objectives.

7.1.4 Intellectual Property Rights in Jordan

The case study of IPR reform in Jordan complicates the picture drawn by the statistical models in Chapters 3, 4, and 5. I argue that the process of IPR reform, the political motivations behind strengthening of IPR, and the institutional agencies responsible for regulation and enforcement IPR intervene in the relationship between IPR and social outcomes. We see political and institutional factors at work both in the JFDA's reticence to extend data exclusivity to drugs for new indications, and in the relatively poor level of copyright enforcement. While the case is just one test of this argument, it does offer support for the idea.

7.2 Directions for Future Research

7.2.1 Improving Data

There are several variables for which we lack sufficient data, and several for which we have no large-N data. Rather than examining the impact of patents and copyright on macro-level health and education outcomes and making the case that the causal pathway operates through the price of medical and educational inputs, it would be much better to examine the impact of IPR on the price of those inputs directly. One of the most valuable data collection efforts would involve amassing cross sectional time series data on drug prices and the prices of select medical inputs and technologies, as well as prices for textbooks, educational software, and other select educational resources.

Additionally, for the healthcare models, having government health spending only since 1991 severely limits the timeframe of the analysis. Supplementing World Bank data on health spending with additional pre-1991 years would allow for a richer, more rigorous, and more methodologically sound analysis of the impact of IPR on health. The nature of the patent index also limits the timeframe of the health models. Rather than a value for patent protection every five years, assembling annual data on patent strength would allow for more observations through time and generate more powerful statistical models.

I would also like to improve the measurement of enforcement used in these two indices. While both IPR indices include enforcement, each enforcement component measures only the statutory availability of enforcement mechanisms. This tells us

whether patents and copyright *could* be enforced in the country, but it does not effectively tell us whether or not IPR is enforced thoroughly in practice. In addition to a measure of statutory availability of enforcement mechanisms, it would be helpful to have data on actual enforcement practices. Of course, collecting this data would require an extensive commitment of time and resources. Evaluating actual enforcement practices across this panel of countries through time is a monumental task. That said, actual enforcement data would deeply enrich the analysis of IPR's role in human development.

Finally, the case study points to several new variables for which data could be collected. If it is true that the process of IPR reform and the political motivations behind reform are important intervening factors, data on the motivation behind IPR changes would be helpful. This could be done in a number of ways, but a simple ordinal measure of the degree to which changes in IPR were the result of outside pressure would allow us to differentiate the motivations behind reform. Perhaps IPR has a different impact in countries that reform IPR for economic reasons than in those that reform for political reasons or in response to pressure.

7.2.2 New and Unanswered Research Questions

The statistical analysis in Chapters 3-5 generated new and unanswered questions. The following questions require follow-up investigation, and finding answers to them will give significant insight into the relationship between IPR and human development:

First, why don't we see a bigger difference in the impact of IPR on health, education, and inequality in developing countries? We have good reason to believe that

IPR will affect these outcomes differently at different levels of development, but the analyses presented in this project suggest that is generally not the case. The statistically significant relationships observed, with only a few exceptions, were true for all countries regardless of their level of development.

Second, the analysis of maternal mortality found a dramatic and statistically significant relationship in which a 20% increase in patent strength corresponded to a 39.5% increase in maternal mortality in developed countries (but a much smaller impact in developing countries). This is a difficult result to explain. I suggested one potential explanation: Perhaps in the developing world maternal mortality is more a function of other factors, including proximity to a hospital, the availability of doctors, cultural norms around childbirth, healthcare infrastructure, etc. In the developing world, perhaps these factors dwarf any impact of IPR on maternal mortality. However, in the developed world, where these issues may be less important, we can see an impact of IPR on maternal mortality. At this point, my explanation is purely conjecture. Further exploring the relationship between patents and maternal mortality, especially in the developed world, would give us greater insight into this important measure of public health.

Third, the education models demonstrated a negative relationship between copyright strength and primary school enrollment, but a positive relationship between copyright and secondary and tertiary enrollment. This result in particular can be plausibly explained through causality operating in *either* direction, as discussed above. Future research should explore the causal process behind this relationship to determine whether strengthening IPR can itself improve education outcomes. If so, this is a public policy some countries may wish to pursue.

Fourth, why do we observe a statistically significant relationship between IPR and the Gini index, but no relationship between IPR and the Palma ratio? If this difference is merely the result of data limitations regarding the Palma ratio, that is less interesting. If, however, there is a difference because when IPR affects income inequality, it does so by affecting incomes in the middle 50% of households, this is a much more interesting finding. It will take additional investigation to determine if this is the case.

Fifth, in Chapter 5 the results suggested that contemporary measures of IPR were associated with worse income inequality, while 15-year lagged measures of IPR were associated with improved income inequality. Future research should examine this difference to determine whether there is a short term increase in inequality following IPR reform, but a long term decrease. If this is the case, it has public policy implications for adopting stronger IPR, at least when it comes to income inequality.

Sixth, and finally, future research should supplement the Jordanian case by examining other countries, their process of IPR reform, political motivations, and institutional dynamics to see if the results from Jordan represent a pattern that holds in multiple countries. Additionally, further research within Jordan would provide insight into the true impact of IPR on health and education, whether increased drug prices eventually impact aggregate public health measures, and whether stronger copyright do increase the costs of educational inputs and ultimately harm education outcomes.

Decisions about IPR reform and enforcement have powerful implications for countries at all levels of development. Answers to these questions will enrich our

understanding of the role intellectual property rights play in human development, especially regarding health, education, and inequality.

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