INCOME DISTRIBUTION IN INTELLECTUAL PROPERTY RIGHTS PROTECTION

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ABSTRACT

Aisling Winston: Income Distribution in Intellectual Property Rights Protection
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This paper proposes a general model of the government's choice of intellectual property rights protection given the structure of the import market and the distribution of consumers' incomes. The model shows that the optimal level of protection chosen by the government, while most heavily influenced by institutional structures, differs depending on whether there is a competitive domestic fringe or a single domestic firm and on whether consumers' incomes are relatively equally or unequally distributed. Measures of de facto and de jure intellectual property rights protection are used to test the implications of the models.

The model is then extended to include local governments in trying to explain the divergence between the formal level of protection and the reality of protection in different localities. Localities, in response to their constituents and their preferences for foreign actors, will choose to deviate from the federal level of protection, subject to the level of autonomy. The federal government will take the chosen deviations and international obligations into consideration when choosing the federal level of protection. These deviations are affected by the objective of domestic production: local consumption or export.

Finally, the models are complemented by a country study of Jordan which examines more closely the effect of specific institutional structures in understanding one government's choice of protection. The pharmaceutical industry in Jordan provides a compelling case study, as it is dependent upon intellectual property rights protection. The level of protection increased markedly in 2000, following a distinct change in government policy in favor of foreign firms, moving Jordan from one of the worst to one of the best protectors of intellectual property rights protection in its region. The country study uses the model to explain the levels of protection before and after this change in Jordan as compared to protection in institutionally similar countries.

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GDP	Gross Domestic Product
GNI	Gross National Income
GP Index	Ginarte and Park Index
IPR	Intellectual Property Rights
TRIPS	Agreement on Trade-Related Aspects of Intellectual Property Rights
WEF	World Economic Forum
WTO	World Trade Organization

CHAPTER 1: INTRODUCTION

1.1 Introduction

Despite the international community's demand for ever increasing protection of intellectual property rights (IPR), divergence in the protection of IPR persists. While a number of countries have continued to strengthen protection over time, mandating IPR protection clauses in bilateral and multilateral agreements and instituting and strictly enforcing patent laws, others have been persistent in their non-protection, both within the formal legal sphere and in terms of actual enforcement. Given the recent emphasis in international agreements on increased and somewhat homogenized enforcement of IPR protection, it is interesting to examine why governments persist in choosing low levels of IPR enforcement, even in the face of potential retaliation from trading partners or potential loss of investment. This paper argues that governments, especially those in developing economies, take into consideration the structures of their import markets, levels of inequality, and institutions in determining their optimal levels of IPR protection.

The model introduced in this paper assumes a developing country importing a good with exogenously-determined quality from a developed country. The general form of this model has two cases: 1) the import sector has a competitive domestic fringe attempting to imitate and sell their own versions of the foreign good, and 2) the import sector has a single domestic firm attempting to imitate and sell its own version of the good. In both cases, the timeline is as follows: first, the government chooses the level of IPR protection, then the firms choose their prices (the domestic price will be equal to the marginal cost, assumed to be zero, in the case of the competitive domestic fringe), and finally consumers choose to purchase 0 or 1 unit of the good (either the domestic or the foreign). The government's choice of IPR protection will ultimately depend on institutions—in this model, institutions specifically refer to how much weight the government places on the interests of domestic actors versus the weight it places on the interests of the foreign producer—but the application of the model to two different income distributions

will help to elucidate incentives to raise or lower protection despite the influence of institutions. The general model takes institutions as exogenously determined. The case in which the institutions are determined by the consumers and firms themselves is left for a later extension.

The model shows that, in the case of the competitive domestic fringe, higher levels of protection benefit only the foreign firm and hurt all consumers (the domestic firms are ultimately unaffected). In the case of a duopoly, higher levels of protection benefit the foreign firm and the consumers of the foreign good but hurt the consumers of the domestic good. Higher protection first benefits then hurts the domestic firm. It is also shown that more inequality (specifically a majority of consumers of the poorest type) encourages the government to choose a lower level of protection, all else equal.

The model in its current form is inherently simplistic in its conception of the government with the intention of highlighting the role of the distribution of income in influencing the government's behavior. It cannot, therefore, fully explain why governments deviate from the optimal level of protection. An extension of the model explored in Chapter 3 introduces one reason for this deviation: local governments. The extension considers the impact of local governments with objectives that might either align with or contradict those of the federal government in explaining the deviation between the formal and de facto levels of protection. The chosen deviation of the local government is dependent upon the interests of the domestic actors and the local government's preferences for domestic versus foreign actors. It is further affected by whether the foreign and domestic firms are producing for consumption in the locality, consumption in other localities, or export. Local governments are constrained in their deviations by the level of autonomy. The federal government chooses its level of protection by weighing the chosen levels of deviation and international obligations.

Finally these models are complemented by a country study of Jordan which examines more closely the effect of specific institutional structures in understanding one government's choice of protection in comparison to policies in similar countries. The pharmaceutical industry in Jordan provides a compelling case study, as it is dependent upon intellectual property rights protection. The level of protection increased markedly in 2000, following a distinct change in government policy in favor of foreign firms. This change moved Jordan from one of the worst to one of the best protectors of IPR protection among similar countries. The country study uses the model to

explain the levels of protection in Jordan before and after this change as compared to a group of countries with similar religious make-up, colonial and legal history, per capita incomes, and cultures.

The order of this paper is as follows: Chapter 1 introduces the model and looks at the related literature, Chapter 2 lays out the base model, Chapter 3 gives the extension with local governments, Chapter 4 examines the case of Jordan, and Chapter 5 concludes.

1.2 Literature Review

Very little of the economic literature on IPR protection tries to predict protection itself. The most closely-related attempts to explain IPR protection in the economic literature are those of Ginarte and Park (1997), in the same article in which they introduce their measure of IPR protection, and that of Chen and Puttitanun (2005). While both look at the role of per capita income on predicting IPR, neither looks at the distribution of income.

Ginarte and Park attempt to explain the level of IPR protection by looking at per capita GDP, openness to trade, political and market freedom, and investment in innovation. They predicted that increases in all of the aforementioned factors would increase the incentive to protect IPR. They found that different factors were more or less important depending upon the per capita GDP. For example, investment in innovation was only an important driver of protection if the country was sufficiently wealthy to be creating new technologies when investing, and openness was only an important driver of protection in the poorer countries, ostensibly because most of the wealthier countries were already relatively open. An alternative explanation to the co-occurrence is that poorer countries are more vulnerable to outside pressures to adopt neo-liberal policies, including openness to trade.

Chen and Puttitanun attempt to explain the government's choice of IPR protection by examining the trade-off between allowing firms to imitate foreign technology and promoting domestic innovation as avenues for growth. The authors conclude that innovation in a country increases IPR protection, but that this protection is U-shaped in development, as defined by per capita income. As Ginarte and Park (1997) concluded, much of the variation in IPR protection in the data seems to be explained by the per capita GDP, and the interaction between per capita

GDP and other explanatory variables is important. It is possible that GDP per capita is obscuring or reflecting the importance of other institutions, as there appears to be a relatively strong link between colonial and institutional history and GDP per capita.

Instead of trying to predict IPR protection, much of the related literature looks at the impact of IPR protection on growth, innovation, and foreign investment. The below sections consider some of the literature that uses IPR as a determinant of other measures of development and related literature that is not specific to IPR protection.

1.2.1 IPR Protection as a Determinant of Growth, Innovation, and Investment

Until recently, conventional wisdom, reflected in the stance of the World Trade Organization and other international organizations, has dictated that stronger enforcement of IPR should lead to an increased level of international investment in a country. In contrast, however, we have seen foreign investment grow in countries with relatively weak enforcement of IPR (Zhao 2006). Zhao argues that companies that are able to effectively protect their valuable intellectual property through internal structures are likely to continue to invest abroad to take advantage of lower costs, despite low protection of IPR. If companies are able to use their internal structures to provide the protection a country cannot or will not provide, then the necessity of strong formal protection is alleviated, encouraging foreign investment.

Additionally, many economists have argued that strict IPR enforcement may have quite negative short-term consequences for developing countries, including the suppression of innovation (Glass 2004), a reduction in technology and knowledge transmission (Helpman 1993, Lai 1998, Parello 2008), and a decrease in current consumption (Kwan and Lai 2003). Others have argued that, for lower levels of development, relatively weak IPR protection might be more conducive to growth as the imitation effect dominates the innovation effect. That is, countries with low levels of development are unable to innovate on a par with core countries and so could benefit more from imitating current technology. As a country's level of development rises, it can benefit more instead from the efficiencies that accompany innovation (Acemoglu 2006, Chen 2005, Maskus 2000, Parello 2008). Despite this, strict IPR enforcement remains an effective tool for attracting foreign investment, and so countries often endeavor to provide adequate protection of IPR, through both formal and informal channels (Parello 2008). This idea of the innovation and

imitation effects supports the frequently seen argument of a quadratic relationship between development, as illustrated by GDP per capita, and IPR protection.

Other literature in the field examines the relationship between patents, their enforcement, and innovation. Again, conventional wisdom dictates that stronger IPR protection promotes innovation. Moser (2013) showed that the historical record does not necessarily support this view. The ability to keep trade secrets, not effective legal IPR protection, has mattered more historically to innovation. However, Moser did note that IPR protection has had a notable impact on the direction of technological change. Countries with effective IPR regimes have a wider breadth of innovation, especially in manufacturing industries. This being said, Moser shows, based on a survey of firms, that most sectors do not perceive patents as an effective means of IPR protection, preferring secrecy. The notable exceptions to this are the chemical and pharmaceutical sectors. Lerner (2009) found a striking relationship between patents and IPR protection, namely that while foreign patent applications in a country increased steeply following an increase in IPR protection, patent applications by the residents of that country decreased following the same increase in protection. This lends support to the idea that better protection encourages foreign involvement in a country, but certainly also casts doubt on the idea that better protection fosters innovation. The experience of countries such as Lebanon and Jordan have demonstrated that increased protection at least correlates with additional foreign investment and confidence, and while rhetoric in both countries extols the potential benefits of increased protection for domestic innovation, it is still too early to see if that benefit has been realized.

1.2.2 Other Related Literature

A common theme throughout the literature is that institutions matter and that these institutions often behave differently depending upon the level of development. Persson and Tabellini (1994) take a dynamic model approach in examining the relationship between democracy and growth, showing a non-monotonic relationship seemingly dependent on income inequality, and argue that democracies might intentionally curtail innovation in favor of redistribution of wealth, slowing their growth. Easterly (2007) argues that agricultural endowments lead to inequality, which shapes institutions, which further shapes economic growth. Rodrik, et al. (2004), in analyzing claims made by Acemoglu et al. (2001) conclude that the quality of institutions is the

most important determinant on modern levels of development. Geographical variables, such as distance to the equator and settler mortality rates, as posited by Acemoglu et al. (2001), influence modern GDP per capita through their influence on the development of institutions.

Literature on contract enforcement in the presence of international trade, international investment, and domestic innovation also provides useful insight into the optimal choice of IPR protection. Markusen (2001) explores the demand for strong contract law on the part of multinational firms, federal governments, and local agents. He argues that while multinational firms tend to favor strong contract law, country governments tend to oppose protection. He incorporates imitation, in that his local agents are able to learn technology then start local rival firms. Markusen concludes that contract enforcement makes multinational firms better off, but that enforcement has more complicated implications for the country. If enforcement causes the multinational to prefer local production over export, welfare improves. If, however, local production was already occurring, enforcement resulted in loss to local agents and reduced welfare.

CHAPTER 2: A MODEL OF THE CHOICE OF INTELLECTUAL PROPERTY RIGHTS PROTECTION

This model of the choice of the level of IPR protection assumes a developing country importing a good with exogenously-determined quality from a developed country. The general form of this model has two cases: 1) the import sector has a competitive domestic fringe attempting to imitate and sell their own versions of the foreign good, and 2) the import sector has a single domestic firm attempting to imitate and sell its own version of the good. In both cases, the timeline is as follows: first, the government chooses the level of IPR protection, then the firms choose their prices (the domestic price will be equal to the marginal cost, assumed to be zero, in the case of the competitive domestic fringe), and finally consumers choose to purchase 0 or 1 unit of the good (either the domestic or the foreign). The government's choice of IPR protection will ultimately depend on institutions, but the application of the model to two income different distributions will help to elucidate other elements affecting the choice of IPR.

The model shows that, in the case of the competitive domestic fringe, higher levels of protection benefit only the foreign firm and hurt all consumers (the domestic firms are ultimately unaffected). In the case of a duopoly, higher levels of protection benefit the foreign firm and the consumers of the foreign good but hurt the consumers of the domestic good. The utility of the domestic firm is first increasing then decreasing in protection. The model also shows that more inequality (specifically a majority of consumers of the poorest type) encourages the government to choose a lower level of protection, all else equal.

The model in its current form is inherently simplistic in its conception of the government with the intention of highlighting the role of the distribution of income in influencing the government's behavior. It cannot, therefore, fully explain why governments deviate from the optimal level of protection.

This chapter is organized as follows: Section 1 lays out the general model, Section 2 applies the model to two specific distributions to better illustrate the effects of the consumer distribution,

Section 3 uses data to test the implications of the model, and Section 4 concludes.

2.1 A Basic Model of Consumers and Firms in a Country with IPR Protection

This model aims to explain the impact on a government's optimal choice of IPR protection of a country's distribution of consumer incomes, market structure, and government preferences. The model is of vertically differentiated goods in which consumers purchase either 0 or 1 units.

2.1.1 Set-Up

In this model, a foreign firm and a single domestic firm or competitive domestic fringe sell a product. The foreign firm creates the product outside the country of interest, and the domestic firm or firms attempt to imitate the product. The government first chooses the level of IPR protection. The foreign firm and the domestic firm or firms then choose their prices. Finally, consumers make their purchasing decisions.

For ease of exposition, both the lowest consumer type (consumer income) and the costs of production are assumed to be zero.

Firms

The model assumes vertically differentiated goods produced by a foreign firm that has created a product outside the country and a single domestic firm or competitive fringe that attempts to imitate the foreign good. The quality of the foreign good, μ^F, is determined exogenously; that is, the quality of the foreign good sold in the country of interest is taken to be the same as the quality of that same good in any other market. It is assumed that the foreign firm will not intentionally reduce (or raise) the quality of the good.

The quality of the domestic good, μ^D, is determined wholly by the *inability* of the domestic firm or firms to imitate the foreign good, α, in which $\alpha \in [0, 1]$ represents the government's choice of IPR protection. The domestic firm's *ability* to imitate is therefore given by $1 - \alpha$. While it is reasonable to assume that under strict IPR protection a domestic firm might prefer to innovate, existing research makes it difficult to argue that domestic firms do in fact respond this way. Therefore, the quality of the domestic good is taken to depend only upon the level of IPR

protection.

With any positive level of intellectual property rights protection, the domestic firm can produce a good of quality equal to, at most, $\mu^D = (1-\alpha)\mu^F$. With no intellectual property rights protection, the domestic firm can, at best, produce a good of the same quality as the foreign firm. Therefore, $\mu^D \in [0, \mu^F]$. It is assumed that the domestic firm's *inability* to imitate is increasing in intellectual property rights protection.

For ease of exposition, domestic and foreign firms are assumed to face the same fixed cost of entry, and this cost is taken to be zero. In the case with the competitive domestic fringe, therefore, the market will be covered as the domestic firms will compete, driving prices to equal marginal cost, which is also assumed to be zero. In the case with a single domestic firm, the market will not be covered.

Consumers

In this model, the "type" of the consumer is assumed to be the consumer's income. The assumption here is that consumers with higher incomes have more utility from the consumption of the good, especially the foreign good, as they are more quality-conscious than are lower-income consumers. The distribution of utilities obtained from consumption therefore resembles that of the income distribution. Henceforth, "the distribution of consumers" will refer to the distribution of consumer incomes. The distributions of consumer incomes are assumed to be log-concave, distributed according to $h(x)$ along $[0, b]$. This is consistent with research on income distribution.

Consumers purchase either 0 or 1 unit of a good. If consumers do not purchase either the foreign or the domestic good, they receive zero utility. If a consumer purchases a unit of the good, she receives a utility of $\mu^i x - p^i$, where μ^i is the quality of the good, p^i is the price of the good, $i \in \{F, D\}$ represents the firm (foreign or domestic), and x is the consumer's type.

A consumer will only purchase a good if $x \geq \frac{p^i}{\mu^i}$. Since the model assumes that the quality of the foreign good is higher than the quality of the domestic good, this implies that the lowest type consumer, x_L, will only purchase the good if $x_L \geq \frac{p^D}{\mu^D}$ and that every consumer $x \geq \frac{p^D}{\mu^D}$ will purchase one unit of a good. All else equal, a consumer who receives zero utility from purchasing would prefer to have the good to not having the good, so consumers of type $x = \frac{p^D}{\mu^D}$ will purchase the domestic good despite receiving zero utility from purchasing.

The "indifferent consumer" is the consumer who is indifferent between the purchase of the foreign good and the purchase of the domestic good. The indifferent consumer is characterized as having type $\hat{x}$ such that $\hat{x} = \frac{p^F - p^D}{\mu^F - \mu^D} > x_L$. All else equal, consumers prefer the foreign good to the domestic good due to its higher quality. Therefore, every consumer with type $x \geq \frac{p^F - p^D}{\mu^F - \mu^D}$ will purchase the foreign good.

Government

The government chooses the level of IPR protection, α, to maximize its own welfare function, G:

$$G = \rho(CU^F + CU^D + \pi^D) + (1 - \rho)\pi^F,$$

in which ρ represents the government's preference for domestic actors, CU^i represents the consumer surplus from consumption of the domestic or foreign good, and π^i represents the profit earned by the domestic or foreign firm.

The government's preference for domestic actors can be thought of as illustrative of the government type - democratic governments may be more responsive to voters and therefore may be more likely to respond to the interests of domestic consumers and firms, whereas autocratic governments may benefit more from deals made with foreign firms and may therefore be more likely to respond to the interests of foreign firms. The government therefore faces a trade-off between the well-being of domestic actors and the well-being of the foreign actor.

Structuring the government's welfare function such that it faces a trade-off between consumers and firms (both domestic and foreign) to examine differences between governments more and less responsive to the needs of its domestic consumers affects the size of the incentives it faces to increase or decrease protection but not the general conclusions of the model. The form of this welfare function would be:

$$G = \rho(CU^F + CU^D) + (1 - \rho)(\pi^D + \pi^F)$$

2.1.2 Competitive Domestic Fringe

In this first case, there is a competitive domestic fringe. Because the domestic fringe is competitive, the domestic firms will compete until profits are zero and prices are equal to marginal cost, that is, $p^D = 0$. The quality of the domestic good is given by $\mu^D = (1-\alpha)\mu^F$.

Because the domestic price is 0, in this case, the market will be covered. The identity of the type of the indifferent consumer is given by $\hat{x} = \frac{p^F}{\alpha\mu^F}$.

Without specifying a distribution, it is impossible to explicitly state the foreign price, as the identity of the type of the indifferent consumer is itself a function of the foreign price. However, the foreign price is unique and can be expressed as $p^F = \frac{1-H(\hat{x})}{h(\hat{x})}\alpha\mu^F$, and it is possible to show that for all log-concave distributions the foreign price is everywhere increasing in α. The resulting condition is $\frac{\partial p^F}{\partial \alpha} = \lambda(\hat{x})\mu^F > 0$, in which $\lambda(x)$ represents the reciprocal of the hazard function, $\frac{1-H(x)}{h(x)}$. Given this characterization of the foreign price, it can be shown that for all distributions the indifferent consumer is characterized by $\hat{x} = \lambda(\hat{x})$. The demand for the foreign good is given by $1 - H(\hat{x})$ and the demand for the domestic good is given by $H(\hat{x})$. The type of the indifferent consumer is not changing in protection; therefore, the demands for the foreign and domestic goods are not changing in protection.

Due to the increasing price and constant demand, the consumer surplus from the consumption of the foreign good is falling in protection:

$$\frac{\partial CU^F}{\partial \alpha} = -\mu^F \lambda(\hat{x})(1 - H(\hat{x})) < 0$$

The consumer surplus from the consumption of the domestic good is also falling in protection due to the worsening quality of the domestic good under increased protection:

$$\frac{\partial CU^D}{\partial \alpha} = \mu^F [\int_0^{\hat{x}} H(x)dx - \lambda(\hat{x})H(\hat{x})] < 0$$

Therefore, the total consumer surplus from the consumption of both goods is everywhere falling in protection in the case of a competitive domestic fringe.

The foreign profit, however, is everywhere increasing in protection:

$$\frac{\partial \pi^F}{\partial \alpha} = \lambda(\hat{x})\mu^F(1 - H(\hat{x})) > 0$$

The government choice of IPR protection leads to a trade-off between the well-being of consumers and that of the foreign firm. Its optimal level of protection depends upon how much it cares for each set of actors. In the case of a competitive domestic fringe, a government will choose to either protect completely or not protect at all depending on its institutions. If the government cares primarily for the well-being of the domestic actors, the government's objective function will be everywhere decreasing in α, and it will want to minimize its level of protection, choosing a complete *lack* of protection of IPR. If the government cares primarily for the well-being of the foreign firms, the government's objective function will be everywhere increasing in α, and it will want to maximize its level of protection, choosing to protect completely.

$$\frac{\partial G}{\partial \alpha} = (1 - 2\rho)\mu^F \lambda(1 - H(\hat{x}))$$

2.1.3 Single Domestic Firm

Now assume that, instead of a competitive domestic fringe, there is a single domestic firm with the ability to choose its price, p^D, and its quality, $\mu^D \leq (1 - \alpha)\mu^F$. Because the domestic price might not be zero (and it will be demonstrated that in this scenario it will not be), the market will not necessarily be covered.

The identity of the type of the indifferent consumer is given by $\hat{x} = \frac{p^F - p^D}{\mu^F - \mu^D}$. The identity of the lowest-type consumer who consumes a good is given by $x_L = \frac{p^D}{\mu^D} \geq 0$. Any consumer with type below x_L will consume zero units. Consumers with types between x_L, inclusive, and $\hat{x}$ will consume one unit of the domestic good. Consumers with types between $\hat{x}$ and b inclusive will consume one unit of the foreign good.

The domestic firm maximizes its profit by choosing p^D and μ^D subject to $\mu^D \leq (1 - \alpha)\mu^F$:

$$\max_{p^D, \mu^D} \int_{x_L}^{\hat{x}} p^D h(x) dx \text{ st } \mu^D \leq (1 - \alpha)\mu^F$$

If the constraint were not to bind, then it would be the case that either $p^D = 0$, which requires $\hat{x} = x_L$, or $\frac{h(\hat{x})\hat{x}}{\mu^F - \mu^D} = \frac{-h(x_L)x_L}{\mu^D}$. The latter is only possible if both prices equal zero, given that the price of the domestic good must be less than or equal to the price of the foreign good and that both prices must be non-negative. Both preclude the possibility of two firms participating in the market. Therefore, it is assumed that the constraint binds, $\mu^D = (1-\alpha)\mu^F$, and that the domestic firm will choose the following price:

$$p^D = \frac{H(\hat{x}) - H(x_L)}{(1-\alpha)h(\hat{x}) + \alpha h(x_L)}\alpha(1-\alpha)\mu^F$$

As before, the foreign firm's problem is to maximize its profit by choosing p^F:

$$\max_{p^F} \int_{\hat{x}}^{b} p^F h(x)dx$$

resulting in:

$$p^F = \frac{1 - H(\hat{x})}{h(\hat{x})}(\mu^F - \mu^D)$$

Given this, the two prices can be given by the following:

$$p^F = \alpha\lambda(\hat{x})\mu^F$$

$$p^D = \alpha(1-\alpha)\Lambda(\hat{x}, x_L)\mu^F$$

Where $\lambda(\hat{x}) = \frac{1-H(\hat{x})}{h(\hat{x})}$ and $\Lambda(\hat{x}, x_L) = \frac{H(\hat{x})-H(x_L)}{(1-\alpha)h(\hat{x})+\alpha h(x_L)}$. This gives $\hat{x} = \lambda(\hat{x}) - (1-\alpha)\Lambda(\hat{x}, x_L)$ and $x_L = \alpha\Lambda(\hat{x}, x_L)$, and thus, since $\hat{x} > x_L$, $\lambda(\hat{x}) > \Lambda(\hat{x}, xL)$.

The type of the indifferent consumer is not changing in protection; however, the type of the lowest-type consumer is increasing in protection. Therefore, both the foreign and domestic prices are increasing in protection:

$$\frac{\partial p^F}{\partial \alpha} = \mu^F\lambda(\hat{x}) > 0$$

$$\frac{\partial p^D}{\partial \alpha} = (1-\alpha)\mu^F\Lambda(\hat{x}, x_L) > 0$$

Although the demand for the foreign good is not changing in protection, the demand for the domestic good is falling in protection. The quality of the domestic good is also falling in

protection. As a result, the consumer surplus from the consumption of the foreign good and the consumer surplus from the consumption of the domestic good are both falling in protection:

$$\frac{\partial CU^F}{\partial \alpha} = -\mu^F \lambda(\hat{x})(1 - H(\hat{x})) < 0$$

$$\frac{\partial CU^D}{\partial \alpha} = \mu^F [\int_{x_L}^{\hat{x}} H(x)dx + \Lambda(\hat{x}, x_L)H(x_L) - \lambda(\hat{x})H(\hat{x})] < 0$$

At the same time, the constant demand for the foreign good and the rising price of the foreign good mean that the profit earned by the foreign firm is increasing in protection:

$$\frac{\partial \pi^F}{\partial \alpha} = \mu^F \lambda(\hat{x})(1 - H(\hat{x})) > 0$$

The impact on the domestic profit of a change in protection is less straightforward. On the one hand, the domestic firm can charge higher prices as protection increases, putting upward pressure on its profits. On the other hand, the demand for the domestic good is decreasing in protection, putting downward pressure on its profits. Domestic profit is therefore first increasing then decreasing in protection:

$$\frac{\partial \pi^D}{\partial \alpha} = \mu^F \Lambda(-\alpha \Lambda h(x_L) + (1 - \alpha)(H(\hat{x}) - H(x_L))) \gtrless 0$$

As in the case of a competitive domestic fringe, the government's choice of IPR protection leads to a trade-off between the well-being of consumers and the domestic firm and that of the foreign firm. Its choice of the optimal level of protection will therefore depend primarily upon the relative weights on the domestic and foreign actors, bearing in mind that domestic profit is first rising then falling in protection. The government will choose α such that the following equals zero, given ρ:

$$\frac{\partial G}{\partial \alpha} = \rho \mu^F [\int_{x_L}^{\hat{x}} H(x)dx - \lambda(\hat{x}) + \Lambda(\hat{x}, x_L)((1 - \alpha)H(\hat{x}) + \alpha H(x_L)) - \alpha \Lambda(\hat{x}, x_L)h(x_L)] + (1 - \rho)\mu^F \lambda(\hat{x})(1 - H(\hat{x}))$$

This α is given by:

$$\alpha = \frac{\rho[\int_{x_L}^{\hat{x}} H(x)dx - \lambda(\hat{x}) + \Lambda(\hat{x}, x_L)H(\hat{x})] + (1 - \rho)\lambda(\hat{x})(1 - H(\hat{x}))}{\rho \Lambda(\hat{x}, x_L)[(H(\hat{x}) - H(x_L)) + h(x_L)]}$$

For ρ sufficiently close to zero, that is, for sufficient weight placed on the foreign firm, the

government's objective function will be everywhere increasing in α, so the government will choose to maximize its protection. More specifically, the government will always choose a positive level of protection if $\frac{1-\rho}{\rho} < \frac{\lambda(\hat{x})-\Lambda(\hat{x},x_L)H(\hat{x})-\int_{x_L}^{\hat{x}} H(x)dx}{\lambda(\hat{x})(1-H(\hat{x}))}$. For ρ sufficiently close to one, that is, for sufficient weight placed on the domestic actors, the government's objective function will be everywhere decreasing in α, so the government will choose to minimize its protection.

2.1.4 Comparing the Cases of the General Model

Table 2.1 shows the results from the two models, side-by-side.

Table 2.1: General Model - Key Results

Competitive Domestic Fringe	**Single Domestic Firm**
$\hat{x} = \lambda(\hat{x})$	$\hat{x} = \lambda(\hat{x}) - (1-\alpha)\Lambda(\hat{x}, x_L)$
$x_L = 0$	$x_L = \alpha\Lambda(\hat{x}, x_L)$
foreign demand $= 1 - H(\hat{x})$	foreign demand $= 1 - H(\hat{x})$
domestic demand $= H(\hat{x})$	domestic demand $= H(\hat{x}) - H(x_L)$
$p^F = \alpha\mu^F\lambda(\hat{x})$	$p^F = \alpha\mu^F\lambda(\hat{x})$
$p^D = 0$	$p^D = \alpha(1-\alpha)\mu^F\Lambda(\hat{x}, x_L)$
$\pi^F = \alpha\mu^F\lambda(\hat{x})(1-H(\hat{x}))$	$\pi^F = \alpha\mu^F\lambda(\hat{x})(1-H(\hat{x}))$
$\pi^D = 0$	$\pi^D = \alpha(1-\alpha)\mu^F\Lambda(\hat{x}, x_L)(H(\hat{x}) - H(x_L)))$
$CU^F = (1-\alpha)\mu^F\lambda(1-H(\hat{x})) + \mu^F\int_{\hat{x}}^{b}(1-H(x))dx$	$CU^F = (1-\alpha)\mu^F\lambda(1-H(\hat{x})) + \mu^F\int_{\hat{x}}^{b}(1-H(x))dx$
$CU^D = (1-\alpha)\mu^F\lambda H(\hat{x}) - (1-\alpha)\mu^F\int_0^{\hat{x}} H(x)dx$	$CU^D = (1-\alpha)\mu^F(\lambda-\Lambda)H(\hat{x}) - (1-\alpha)\mu^F\int_{x_L}^{\hat{x}} H(x)dx$

As can be seen in Table 2.1, while the forms of the foreign demand, foreign price, foreign profit, and consumer surplus from the consumption of the foreign good are the same in both models, the form of the type of the indifferent consumer differs between the two models. The impact on foreign variables depends only upon the value of the indifferent consumer's type.

Much of the difference between the two models is driven by the domestic firm. The type of the lowest-type consumer is higher under a single domestic firm, so, whereas under a competitive domestic fringe the market is covered, the market is not covered with a single domestic firm (unless there is no protection of IPR). Under a single domestic firm, the demand for the domestic good is smaller, but the price is higher, so the domestic firm earns some profit and, for sufficiently low levels of protection, has incentive to pressure the government to increase protection. As a result of this increased domestic profit, the consumer surplus from the consumption of the domestic good under a single domestic firm is lower.

Table 2.2 shows the responses of key variables to changes in protection for the two models, side-by-side.

Table 2.2: General Model - Responses to Changes in Protection

Competitive Domestic Fringe	**Single Domestic Firm**
$\frac{\partial \hat{x}}{\partial \alpha} = 0$	$\frac{\partial \hat{x}}{\partial \alpha} = 0$
$\frac{\partial \lambda(\hat{x})}{\partial \alpha} = 0$	$\frac{\partial \lambda(\hat{x})}{\partial \alpha} = 0$
$\frac{\partial x_L}{\partial \alpha} = 0$	$\frac{\partial x_L}{\partial \alpha} = \frac{\Lambda(\hat{x},x_L)}{1-\alpha} > 0$
	$\frac{\partial \Lambda(\hat{x},x_L)}{\partial \alpha} = \frac{\Lambda(\hat{x},x_L)}{1-\alpha} > 0$
$\frac{\partial}{\partial \alpha}$(foreign demand) $= 0$	$\frac{\partial}{\partial \alpha}$(foreign demand) $= 0$
$\frac{\partial}{\partial \alpha}$(domestic demand) $= 0$	$\frac{\partial}{\partial \alpha}$(domestic demand) $= -h(x_L)(\frac{\Lambda}{1-\alpha}) < 0$
$\frac{\partial p^F}{\partial \alpha} = \mu^F \lambda > 0$	$\frac{\partial p^F}{\partial \alpha} = \mu^F \lambda > 0$
$\frac{\partial p^D}{\partial \alpha} = 0$	$\frac{\partial p^D}{\partial \alpha} = (1-\alpha)\mu^F \Lambda > 0$
$\frac{\partial \pi^F}{\partial \alpha} = \mu^F \lambda(1 - H(\hat{x})) > 0$	$\frac{\partial \pi^F}{\partial \alpha} = \mu^F \lambda(1 - H(\hat{x})) > 0$
$\frac{\partial \pi^D}{\partial \alpha} = 0$	$\frac{\partial \pi^D}{\partial \alpha} = \mu^F \Lambda(-\alpha \Lambda h(x_L) + (1-\alpha)(H(\hat{x}) - H(x_L)))$
$\frac{\partial CU^F}{\partial \alpha} = -\mu^F \lambda(1 - H(\hat{x})) < 0$	$\frac{\partial CU^F}{\partial \alpha} = -\mu^F \lambda(1 - H(\hat{x})) < 0$
$\frac{\partial CU^D}{\partial \alpha} = \mu^F [\int_0^{\hat{x}} H(x)dx - \lambda H(\hat{x})] < 0$	$\frac{\partial CU^D}{\partial \alpha} = \mu^F [\int_{x_L}^{\hat{x}} H(x)dx + \Lambda H(x_L) - \lambda H(\hat{x})] < 0$

As can be seen in Table 2.2, the impacts on the foreign variables of an increase in protection are the same for the two cases (the relative sizes of $\hat{x}$ and $\lambda(\hat{x})$ not withstanding). The variation comes from the domestic variables. The type of the lowest-type consumer under a single domestic firm is increasing in protection, causing the size of the demand for the domestic good to decrease in protection. Additionally, the price of the domestic good in a single domestic firm is increasing in protection. Both the type of the lowest-type consumer and the domestic price are unchanging in protection under a competitive domestic fringe.

In the case of the competitive domestic fringe, the consumer surplus from the consumption of the domestic good is falling in protection due only to the decreasing quality of the domestic good as protection rises, as neither the domestic price nor the size of demand for the domestic good is changing in protection. However, in the case of a single domestic firm, the domestic price is rising and the size of the demand for the domestic good is falling, in addition to the quality of the domestic good falling. The fact that the consumer surplus from the consumption of the domestic good is necessarily falling in both cases gives the following two conditions.

For the competitive domestic fringe,

$$\lambda H(\hat{x}) > \int_0^{\hat{x}} H(x)dx$$

For the single domestic firm,

$$\lambda H(\hat{x}) > \int_{x_L}^{\hat{x}} H(x)dx + \Lambda H(x_L)$$

With a competitive domestic fringe, domestic firm profits are zero, and this is not changing with protection. However, the domestic firm profits under a single domestic firm are positive. When protection is low, the domestic firm has a low price and high demand. The impact of an increase in protection is therefore an increase in profit, as the benefit of an increase in price outweighs the detriment of a decrease in demand. When protection is already high, the demand for the domestic good is much smaller. Therefore, the detrimental impact of a decrease in demand that results from a further increase in protection outweighs the beneficial impact of an increase in price, and the profit decreases in protection.

The impact on the government surplus of an increase in protection differs between cases in three ways (the relative sizes of $\hat{x}$ and $\lambda(\hat{x})$ notwithstanding): 1) the expected type of the consumer of either good, 2) the impact on the consumer surplus from the domestic good, and 3) the impact on the domestic profit.

$$\frac{\partial G^{CDF}}{\partial \alpha} = \rho\mu^F[\int_0^{\hat{x}} H(x)dx - \lambda] + (1-\rho)\mu^F\lambda(1-H(\hat{x}))$$

$$\frac{\partial G^{SDF}}{\partial \alpha} = \rho\mu^F[\int_{x_L}^{\hat{x}} H(x)dx - \lambda + \Lambda\big(((1-\alpha)H(\hat{x}) + \alpha H(x_L)) - \alpha\Lambda h(x_L)\big)] + (1-\rho)\mu^F\lambda(1-H(\hat{x}))$$

In the case of the competitive domestic fringe, the government chooses either complete protection or a complete lack of protection. The presence of the domestic firm and the uncovered market adds additional complexity in the case of the single domestic firm, complexity that allows for the possibility of an interior solution for ρ insufficiently extreme.

2.2 Applications of the Model to Specific Distributions

The analysis of the general model does not allow for an easy understanding of how a change in the shape of the distribution affects the government's choice of optimal IPR protection. To do this, it is easier to look at specific distributions. The two distributions used are the triangular

distribution and the Weibull distribution. The shape of the triangular distribution moves from uniform at one extreme to linearly decreasing to a mass of zero on the highest-type consumer at the other extreme. The shape of the Weibull distribution moves from everywhere decreasing at one extreme to an increasing concentration about a mode located away from the lower bound as the shape parameter increases.

Inequality varies with the shape parameter in both cases, though the extent of the variety is much more pronounced in the case of the Weibull distribution. Inequality here refers to the relative proportions of income and population. Perfect equality therefore means that 10% of the population accounts for 10% of the income and 90% of the population accounts for 90% of the income, etc. Perfect inequality means that no one but the highest-type consumer accounts for any income, and the highest-type consumer accounts for 100% of the income.

In the case of the triangular distribution, the difference in inequality between the two extremes is quite small, so the main effect of an increase in the shape parameter is a shift of consumers toward the lower bound. In the case of the Weibull distribution, the effect of an increase in the shape parameter is a concentration of consumers about the mode, away from the lower bound. Therefore, the results suggested by the model for the different distributions are somewhat different. As the shape parameter for the Weibull distribution falls, it begins to look more like the triangular distribution with the shape parameter at its maximum. Looking at these two distributions therefore paints two different pictures describing two different behaviors.

2.2.1 Triangular Distribution

This example uses a triangular distribution with a parameter, c, that allows it to vary from uniform to downward-sloping with no weight on the highest-type consumer. The triangular distribution does not accurately depict the reality of distributions of consumer incomes; however, much of the theoretical literature assumes uniform distributions of consumers. Using this distribution therefore allows for an analysis of the impact of changes in the distribution of incomes in this context. Additionally, using this distribution allows for an analysis of the impact of an increasing concentration of consumers at the bottom of the income distribution.

The pdf for the triangular distribution is as below:

$$h(x) = \frac{2}{b^2}(1-c)x + \frac{c}{b}$$

for which the support is $[0, b]$ and b is the highest-type consumer. The parameter $c \in (1, 2]$ controls the slope, with $c = 1$ representing a uniform distribution. It is important to note that there is a discontinuity at $c = 1$ in the characterization of the indifferent consumer, so the distribution can never be perfectly uniform.

As c increases, the weight on the lowest-type consumer is increased and inequality increases. As b increases, the type of the highest-type consumer increases, reducing the slope of the distribution.

Competitive Domestic Fringe

Under a competitive domestic fringe, the indifferent consumer is decreasing in c. As a country becomes relatively more unequal, as consumers become increasingly concentrated at the bottom of the income distribution, the price chosen by the foreign firm falls, and so the type of the indifferent consumer decreases.

At the same time, as type of the indifferent consumer falls, the domestic demand falls and the foreign demand rises. However, the decrease in foreign price dominates the increase in demand for the foreign good, so the foreign firm sees its profits fall as inequality rises. The drop in foreign price and increase in demand for the foreign good mean that consumer surplus from the consumption of the foreign good is rising in c. The consumer surplus from the consumption of the domestic good is falling in c as the domestic demand falls.

For c sufficiently close to 1 or 2, that is, for perfect uniformity or if there is a sufficient mass of consumers of the lowest type, the government will always choose not to protect IPR. However, as c approaches $\frac{3}{2}$, such that there is enough weight on the highest-type consumers that the utility earned from the consumption of the foreign good is an important driver of the government's objective function, a government's choice to fully protect or not protect will depend upon the value of ρ, its institutions.

As c increases, the value of the government's objective function increases, driven in large part

Table 2.3: Triangular Distribution with Competitive Domestic Fringe

Variables	Responses to Changing Parameters
$\hat{x} = \lambda(x) = \frac{bc - b\sqrt{c^2+3-3c}}{3(c-1)}$	$\frac{\partial \hat{x}}{\partial c} < 0$
	$\frac{\partial \hat{x}}{\partial b} > 0$
$x_L = 0$	
$1 - H(\hat{x}) = \frac{c(6+\sqrt{c^2+3-3c})-c^2-6}{9(c-1)}$	$\frac{\partial(1-H(\hat{x}))}{\partial c} = -h(\hat{x})\frac{\partial \hat{x}}{\partial c} > 0$
	$\frac{\partial(1-H(\hat{x}))}{\partial b} = -h(\hat{x})\frac{\partial \hat{x}}{\partial b} < 0$
$H(\hat{x}) = \frac{c^2+c(3-\sqrt{c^2+3-3c})-3}{9(c-1)}$	$\frac{\partial H(\hat{x})}{\partial c} = h(\hat{x})\frac{\partial \hat{x}}{\partial c} < 0$
	$\frac{\partial H(\hat{x})}{\partial b} = h(\hat{x})\frac{\partial \hat{x}}{\partial b} > 0$
$p^F = \alpha\mu^F(\frac{bc - b\sqrt{c^2+3-3c}}{3(c-1)})$	$\frac{\partial p^F}{\partial c} = \alpha\mu^F\frac{\partial \hat{x}}{\partial c} < 0$
	$\frac{\partial p^F}{\partial b} = \alpha\mu^F\frac{\partial \hat{x}}{\partial b} > 0$
$p^D = 0$	
$\pi^F = \alpha\mu^F(\frac{bc - b\sqrt{c^2+3-3c}}{3(c-1)})(\frac{c(6+\sqrt{c^2+3-3c})-c^2-6}{9(c-1)})$	$\frac{\partial \pi^F}{\partial c} < 0$
	$\frac{\partial \pi^F}{\partial b} > 0$
$\pi^D = 0$	
	$\frac{\partial CU^F}{\partial c} > 0$
	$\frac{\partial CU^F}{\partial b} < 0$
	$\frac{\partial CU^D}{\partial c} < 0$
	$\frac{\partial CU^D}{\partial b} > 0$

by the benefit to those consuming the foreign good. As a result, as consumers are increasingly concentrated at the bottom of the income distribution, the incentive for the government to protect IPR increases, even if it's final decision is still not to protect at all.

As b increases, all else equal, the slope of the distribution is reduced, and so the effect is similar to reducing c. Therefore, the impact on the variables of an increase in b is opposite that of an increase in c.

Single Domestic Firm

In the case of a single domestic firm, an increase in c, an increase in inequality as consumers are increasingly concentrated at the bottom of the income distribution, or a decrease in b causes the prices of both goods to fall, causing the types of the indifferent and low-type consumers to decrease. The difference between the indifferent and low-type consumers falls as c increases or b decreases. Therefore, demand for the foreign good increases in inequality while demand for the domestic good decreases in inequality.

Foreign profits increase when the change in demand more than offsets the fall in price, and

Table 2.4: Triangular Distribution with Single Domestic Firm

Change in Slope (c)	**Change in Top Type (b)**
$\frac{\partial \hat{x}}{\partial c} < 0$	$\frac{\partial \hat{x}}{\partial b} > 0$
$\frac{\partial x_L}{\partial c} < 0$	$\frac{\partial x_L}{\partial b} > 0$
$\frac{\partial p^F}{\partial c} < 0$	$\frac{\partial p^F}{\partial b} > 0$
$\frac{\partial p^D}{\partial c} < 0$	$\frac{\partial p^D}{\partial b} > 0$
$\frac{\partial \pi^F}{\partial c} \gtrless 0$	$\frac{\partial \pi^F}{\partial b} \lesseqgtr 0$
$\frac{\partial \pi^D}{\partial c} < 0$	$\frac{\partial \pi^D}{\partial b} > 0$
$\frac{\partial CU^F}{\partial c} > 0$	$\frac{\partial CU^F}{\partial b} < 0$
$\frac{\partial CU^D}{\partial c} \gtrless 0$	$\frac{\partial CU^D}{\partial b} \lesseqgtr 0$

decrease when the it does not. Domestic profits fall in inequality. Consumer utility from the consumption of the foreign good increases, but consumer utility from the consumption of the domestic good first increases then decreases in inequality. Incentives for the government to raise or lower IPR protection therefore depend both upon c itself and upon the weights placed on the domestic and foreign actors.

2.2.2 Weibull Distribution

The Weibull distribution is a more accurate representation of the distribution of consumer incomes than is the triangular distribution. Indeed, Bandourian, et al. (2003) show that the Weibull distribution is the best-fitting two-parameter distribution among the countries in their sample. This example uses a Weibull distribution with a scale parameter, $b \in (0, \infty)$, and a shape parameter, $c \in (1, e)$. The PDF and CDF for this distribution are (for $x \geq 0$):

$$h(x) = \frac{c}{b}(\frac{x}{b})^{c-1} \exp[-(\frac{x}{b})^c]$$

$$H(x) = 1 - \exp[-(\frac{x}{b})^c]$$

The shape parameter, c, represents how tightly clustered around the mode the distribution is. As c increases, the distribution becomes more tightly clustered, away from both the highest and lowest types. An increase in c can therefore be understood as a *decrease* in inequality. The scale parameter, b, spreads the distribution out as it increases and moves the mode to the right. Responses of key variables to changes in c when using the Weibull distribution change sign based

upon the size of c, specifically, its relation to Euler's constant. Since most estimates of the shape parameters of income distributions using the Weibull distribution are less than 2.5, the assumption will be that c is less than Euler's constant. The Weibull distribution is only log-concave for values of the shape parameter greater than 1. Most estimates of the shape parameters of income distributions using the Weibull distribution are greater than 1, so the assumption will be that c is also greater than 1.

Competitive Domestic Fringe

Under a competitive domestic fringe, the foreign price is decreasing in c, that is, as consumers are more concentrated about the mode and inequality is decreasing, the price of the foreign good falls. Since the price of the domestic good is zero, this means that the type of the indifferent consumer is also falling in c. As a result, the demand for the foreign good is rising in c, and the demand for the domestic good is falling.

The profit earned by the foreign firm is falling in c, that is, it falls as inequality falls, as the drop in price has a larger impact than the increase in demand for the foreign good. The increase in demand combined with the drop in price means that the utility from the consumption of the foreign good is increasing as inequality decreases. The decreasing demand for the domestic good means that the utility from the consumption of the domestic good is decreasing as consumers are more concentrated about the mode.

For sufficient weight placed on the domestic actors, that is, for $\frac{\rho}{1-\rho} > \frac{-\ln c}{1-\ln c}$, the government objective function is increasing in c, and vice versa. The optimal choice of IPR protection follows the same pattern. For sufficient weight placed on the domestic actors, the incentive to increase protection is increasing as consumers are more clustered about the mean since the utility from the consumption of the foreign good is increasing.

As the scale parameter, b, increases, the distribution spreads out. This reduces the concentration about the mode, and so the impact of an increase in b is analogous to a decrease in c. However, b does not influence the sizes of the demands for the foreign and domestic goods. All of the impact on the foreign profit and utility from the consumption of the foreign good of a change in b therefore comes from the change in the domestic price. Since the domestic variables are not impacted by b, the impacts on the government's objective function and its choice of IPR

protection of a change in b is much more straightforward, depending only upon the changes in the foreign variables. For sufficient weight on the domestic actors, that is, for $\rho > \frac{1}{2}$, the government's objective function and its incentive to protect IPR are decreasing in b, and vice versa.

Table 2.5: Weibull Distribution with Competitive Domestic Fringe

Variables	**Responses to Changing Parameters**
$\hat{x} = \lambda(x) = \frac{b}{c^{\frac{1}{c}}}$	$\frac{\partial \hat{x}}{\partial c} = bc^{\frac{-1}{c}-2}(\ln c - 1) < 0$
	$\frac{\partial \hat{x}}{\partial b} = (\frac{1}{c})^{\frac{1}{c}} > 0$
$x_L = 0$	
$1 - H(\hat{x}) = \exp[-\frac{1}{c}]$	$\frac{\partial(1-H(\hat{x}))}{\partial c} = \frac{1}{c^2}\exp[\frac{-1}{c}] > 0$
	$\frac{\partial(1-H(\hat{x}))}{\partial b} = 0$
$H(\hat{x}) = 1 - \exp[-\frac{1}{c}]$	$\frac{\partial H(\hat{x})}{\partial c} = -\frac{1}{c^2}\exp[\frac{-1}{c}] < 0$
	$\frac{\partial H(\hat{x})}{\partial b} = 0$
$p^F = \alpha\mu^F \frac{b}{c^{\frac{1}{c}}}$	$\frac{\partial p^F}{\partial c} = \alpha\mu^F bc^{\frac{-1}{c}-2}(\ln c - 1) < 0$
	$\frac{\partial p^F}{\partial b} = \alpha\mu^F(\frac{1}{c})^{\frac{1}{c}} > 0$
$p^D = 0$	
$\pi^F = \alpha\mu^F b(\frac{1}{c})^{\frac{1}{c}}\exp[-\frac{1}{c}]$	$\frac{\partial \pi^F}{\partial c} = \alpha\mu^F bc^{\frac{-1}{c}-2}\exp[-\frac{1}{c}]\ln c < 0$
	$\frac{\partial \pi^F}{\partial b} = \alpha\mu^F(\frac{1}{c})^{\frac{1}{c}}\exp[-\frac{1}{c}] > 0$
$\pi^D = 0$	
	$\frac{\partial CU^F}{\partial c} > 0$
	$\frac{\partial CU^F}{\partial b} < 0$
	$\frac{\partial CU^D}{\partial c} < 0$
	$\frac{\partial CU^D}{\partial b} = 0$

Single Domestic Firm

In the case of a single domestic firm, an increase in c, which represents a decrease in inequality as consumers are increasingly concentrated about the mode, causes the types of both the indifferent and the low-type consumers to fall. The difference between the indifferent and low-type consumers is decreasing in c, that is, the type of the indifferent consumer is falling faster than is the type of the low-type consumer. An increase in b, the scale parameter, both increases the mode and spreads out the distribution. Therefore, the types of the indifferent and low-type consumers respond in the opposite direction to an increase in b: both increase.

Both the foreign and domestic prices fall as inequality decreases and rise as the mode and inequality increase. Demand for the foreign good is increasing as inequality decreases, but demand for the domestic good is falling. Therefore, consumer utility from the consumption of the

Table 2.6: Weibull Distribution with Single Domestic Firm

Change in Shape (c)	**Change in Scale (b)**
$\frac{\partial \hat{x}}{\partial c} < 0$	$\frac{\partial \hat{x}}{\partial b} > 0$
$\frac{\partial x_L}{\partial c} < 0$	$\frac{\partial x_L}{\partial b} > 0$
$\frac{\partial p^F}{\partial c} < 0$	$\frac{\partial p^F}{\partial b} > 0$
$\frac{\partial p^D}{\partial c} < 0$	$\frac{\partial p^D}{\partial b} > 0$
$\frac{\partial \pi^F}{\partial c} \gtrless 0$	$\frac{\partial \pi^F}{\partial b} \lessgtr 0$
$\frac{\partial \pi^D}{\partial c} < 0$	$\frac{\partial \pi^D}{\partial b} > 0$
$\frac{\partial CU^F}{\partial c} > 0$	$\frac{\partial CU^F}{\partial b} < 0$
$\frac{\partial CU^D}{\partial c} \gtrless 0$	$\frac{\partial CU^D}{\partial b} \lessgtr 0$

foreign good is increasing and domestic profits are decreasing as inequality decreases.

While at first glance it appears that these two applications give opposite predictions about the relationship between inequality and pressures for IPR protection, they are actually telling different stories entirely. The Triangular distribution is demonstrating the response of actors to an increasing mass of consumers at the bottom of the income distribution, with a relatively (when compared to the Weibull distribution) small loss of consumers higher along the income distribution. The Weibull distribution demonstrates the response of actors to an increasing mass of consumers at some income away from the bottom of the distribution, with a relatively (when compared to the Triangular distribution) large loss of consumers at both the bottom and the top of the income distribution. Since the changes in the shape parameters of these two distributions tell different stories, it is reasonable that the responses to "increased inequality" in the two cases be different.

2.3 Empirical Analysis

This section aims to test the central claims of the model, namely that IPR protection is changing in income distribution, market structure, and institutions, taking into consideration the importance of development, as defined by GDP per capita.

This section includes a description of the data and an explanation of regression results.

2.3.1 Data

Quantitative measures of IPR protection, income distribution, development, and political institutions are notoriously fraught with controversy. While it is possible to measure components for each of these, it is often argued that these components provide an incomplete or potentially misleading picture. However, including a number of countries from different income classes and with different government types necessitated the use of these more frequently used, though potentially incomplete, measures, even if more holistic metrics existed.

Intellectual Property Rights Protection

Two measures of IPR protection were used for this analysis. The Ginarte and Park (GP) Index was used to represent formal protection of IPR, while the World Economic Forum IPR score was used to represent de facto protection of IPR.

The GP Index measures a country's formal IPR protection. This index was developed by Ginarte and Park in 1997 and then updated by Park in 2008, with data through 2010 available on his website. The GP Index includes information on 130 countries for the period 1960-2010. An index measure is given every five years.

The index is created by summing the weighted averages of indicators in five categories: the extent of patent coverage, membership in international agreements, provisions for loss of protection, enforcement mechanisms, and duration of protection. The index ranges from 0 to 5, with higher values representing stronger levels of protection.

In the literature, the biggest complaint about the GP Index, common to many measures of IPR protection, is that it is a better measure of formal, legal protection than of actual enforced protection. Since there are certainly instances in which governments have laws on the books which are inconsistently enforced, it is not clear that the behavior seen in the GP Index is the same behavior demonstrated by the model, nor is it clear that the GP Index is actually an accurate representation of protection. It is therefore prudent to examine a different measure of de facto IPR protection.

The World Economic Forum (WEF) measure of intellectual property protection provides a better measure of de facto protection. It exists for 148 countries from 2006-2009 and 2011-2017,

with some exceptions. The measure was created as part of the WEF's Executive Opinion Survey. The question asked was, "In your country, to what extent is intellectual property protected?" A score of 1 represents no protection. A score of 7 represents exceptional protection.

This measure is somewhat more volatile than the GP Index. However, it arguably provides a more realistic measure of de facto protection than does a measure that is based on the existence of IPR protection laws.

A comparison between the two measures is only possible between 2005 and 2010. To do this, data for the missing years was linearly interpolated for both measures. This interpolated data was used when attempting to directly compare the two measures, not when running regressions on the measures independently. A list of countries included in each measure can be found in Appendix B.

Income Distribution

Income distribution was measured using the Gini coefficient. The Gini coefficient ranges from 0 to 1, with 0 representing perfect income equality and 1 representing perfect income inequality. As it is derived from the shape parameter of income distributions, it is independent of the mean or median income. Changes in the Gini coefficient, therefore, are analogous to changes in the shape of the income distributions and do not illustrate the impacts of increases in income.

The primary concern with using the Gini coefficient is that datat is not available for all countries in all years. To address this, a linearly-interpolated measure of the Gini coefficient was used in regressions.

Institutions

In order to get a sense of how incentives differ across rough institutional lines, institutions are represented by government type. It should be expected that the broad government type is an imperfect representation of institutions, especially as there is so much variation of institutions within each of these government types between countries.

The Polity IV dataset was used to measure government type. This dataset covers almost 170 countries beginning in 1800. The Polity IV dataset gives each country a score from 0 to 10 on each of two scales, a democracy scale and an autocracy scale. The autocracy score is then subtracted from the democracy score to yield a score from -10 to 10, with -10 representing a

hereditary monarchy and 10 representing a consolidated democracy. Based on the suggested classifications, countries receiving scores of 6 or higher was classified as democracies, countries receiving scores between 1 and 5 were classified as open anocracies, countries receiving scores between -5 and 0 were classified as closed anocracies, and countries receiving scores of -6 or lower were classified as autocracies.

The Polity IV process, like other oft-used measures of democracy such as the ones put forth by the Economist Intelligence Unit and Freedom House, looks primarily at the executive branch. It takes into consideration executive recruitment, constraints on executive authority, and the presence or lack of political competition. Other measures, such as the Democracy and Dictatorship data put forth by Cheibub, Gandhi, and Vreeland (2009), are somewhat more full, including information on legislative selection and power in addition to the information about the executive. However, the Democracy and Dictatorship dataset ended in 2008 and did not cover all countries for the time period. That being said, the correlation between the Democracy and Dictatorship classification and the Polity IV classification was fairly high, 0.81, suggesting that not much was lost in using the Polity IV classification instead.

In addition to Polity IV, Political Constraints data was used for supplemental regressions. This index aims to measure the extent to which changes in the preferences of single political actors lead to changes in government policy. The index ranges from 0 to 1, with higher scores representing more constraint, and thus a smaller likelihood of policy change due to the preferences of a single actor. The index takes into consideration the number of independent branches of the government with veto power, the extent of party alignment across branches of the government, and the extent to which preferences within branches of government are aligned. Regressions using this data can be found in Appendix B.

To examine the impact of a trade-off between consumers and producers (as opposed to the trade-off between domestic actors and foreign actors), two measures from the World Development Indicators were used: a measure of taxes on goods and services as a percent of total revenue and a measure of taxes on income, profits, and capital gains as a percent of total revenue. The former is used to represent the preference for consumers, and the latter is used to represent the preference for firms. This data is only regularly available over the years covered by the WEF measure of IPR. Using taxes to represent the government's preference for consumers and producers is a

different way to conceptualize institutions. Representing institutions with Polity IV assumes that preferences are based on executive (and legislative) power derived from voting. Using taxes, however, assumes that preferences are based on sources of revenue. These two ways of conceptualizing institutions should be interpreted as substitutes for each other. They are two different ways of understanding how the government makes decisions.

Other measures of institutions used include the origin of the legal structure and colonizing country, both of which from the Quality of Government Institute Standard Dataset. Countries were also grouped according to their regions, as there can be religious and institutional similarities between countries in the same region. Regional groupings were according to the World Bank regional groupings, and include East Asia and Pacific, Europe and Central Asia, Latin America and Caribbean, Middle East and North Africa, North America, South Asia, and Sub-Saharan Africa.

Market Structure

For the years covered by the WEF measure of IPR, the WEF also provided two measures of market structure. The first is a measure of local competition: respondents were asked to rate the intensity of local competition, in which 1 represents local competition that was not intense at all and 7 represents local competition that was extremely intense. The second is a measure of the extent of market dominance, in which 1 represents a market dominated by a few businesses and 7 represents a market spread among many firms. The question for the first was, "In your country, how intense is competition in the local markets?" The question asked for the second was, "In your country, how do you characterize corporate activity?" Unsurprisingly, these two measures are closely correlated.

Income

GDP per capita was used to measure the level of development, with its natural log used in regressions. GDP per capita data was available for all countries for each year, making it a more ideal measure of development than GNI per capita, which had a few missing observations. The correlation between GDP per capita and GNI per capita was quite strong, however, so not much is lost by using GDP per capita. The only concern is that differences between GDP and GNI per

capita may be larger in developing economies, the same economies with the higher instances of missing GNI per capita data, but also the same economies which are the focus of this model.

Countries were grouped into four development classes: low income, lower-middle income, upper-middle income, and high income. Low income is defined as a GNI per capita less than $1006. Lower-middle income is defined as a GNI per capita between $1006 and $3955. Upper-middle income is defined as a GNI per capita between $3956 and $12235. High income is defined as a GNI per capita above $12235.

There is a question of reverse-causality when using GDP per capita in regressions, as it may be argued that the level of IPR protection is a driver of GDP per capita. To address this question, the distance from the equator was used instead of GDP per capita in some regressions. Acemoglu et al. (2001) and Rodrik et al (2004), among others, have used this measure as well as a measure of European settler deaths in trying to determine current levels of GDP per capita. Both appear to be closely tied to current levels of GDP per capita through other institutions, including legal origins and colonizing power. These measures were used in regressions on average levels of protection prior to 1990.

2.3.2 Descriptive Statistics

Descriptive statistics for the variables used in regressions can be seen in Tables 2.7-2.9. Observations are country-year.

Income distribution was quite similar across development groups, with high income economies demonstrating slightly more equal income distribution than the rest of the development groups. Formal IPR protection is quite similar for the middle two income groups, notably lower in the lowest income group, and notably higher in the highest income group. De facto IPR protection appears to increase as income increases. In each development group, at least a few countries had higher de facto protection than formal protection, but most had higher formal protection than de facto protection. This tendency to have formal protection in excess of de facto protection increases, predictably, in formal protection. Despite this, formal and de facto protection are quite positively correlated.

Income distribution is slightly lower for autocracies, but fairly similar across other government types. Formal protection is noticeably higher for democracies than for autocracies,

Table 2.7: Descriptive Statistics by Income Classification

	Observations	Mean	Standard Deviation	Minimum	Maximum
Low Income Economies					
Ginarte and Park Index	532	1.76	0.67	0.13	3.92
World Economic Forum IPR Score	171	2.97	0.64	1.57	4.85
Gini Coefficient	272	0.41	0.09	0.16	0.66
Lower-Middle Income Economies					
Ginarte and Park Index	295	2.27	0.82	0.58	4.83
World Economic Forum IPR Score	263	3.04	0.59	1.70	4.74
Gini Coefficient	435	0.43	0.11	0.17	0.65
Upper-Middle Income Economies					
Ginarte and Park Index	150	3.04	0.82	0.92	4.92
World Economic Forum IPR Score	259	3.36	0.76	1.64	5.46
Gini Coefficient	274	0.42	0.09	0.26	0.65
High Income Economies					
Ginarte and Park Index	157	4.04	0.69	1.33	4.88
World Economic Forum IPR Score	370	4.87	0.93	1.70	6.48
Gini Coefficient	264	0.32	0.05	0.24	0.51

Table 2.8: Descriptive Statistics by Government Type

	Observations	Mean	Standard Deviation	Minimum	Maximum
Autocracy					
Ginarte and Park Index	320	1.67	0.64	0.13	4.83
World Economic Forum IPR Score	101	3.98	0.94	1.96	5.98
Gini Coefficient	101	0.36	0.09	0.16	0.61
Closed Anocracy					
Ginarte and Park Index	163	2.01	0.81	0.20	4.83
World Economic Forum IPR Score	132	3.37	1.05	1.57	6.28
Gini Coefficient	98	0.41	0.09	0.23	0.61
Open Anocracy					
Ginarte and Park Index	108	2.15	0.81	0.20	3.76
World Economic Forum IPR Score	110	2.86	0.63	1.63	5.20
Gini Coefficient	128	0.41	0.08	0.24	0.60
Democracy					
Ginarte and Park Index	535	2.90	1.11	0.13	4.92
World Economic Forum IPR Score	670	3.89	1.17	1.70	6.48
Gini Coefficient	856	0.40	0.10	0.22	0.66

but de facto protection is similar. However, de facto protection and formal protection move in opposite directions for the mixed government types. As with the development groups, at least a few countries had higher de facto protection than formal protection, but most had higher formal protection than de facto protection.

Finally, it is worth noting that there was a sizable jump in formal IPR protection for most countries between 1995 and 2005, the period during which TRIPS was enacted and adopted. This can be seen quite clearly in the GP Index. The data from the WEF survey only exists after most countries had adopted TRIPS.

Table 2.9: Descriptive Statistics before and after TRIPS

	Observations	Mean	Standard Deviation	Minimum	Maximum
Before TRIPS					
Ginarte and Park Index	737	1.85	0.80	0.13	4.92
World Economic Forum IPR Score	N/A				
Gini Coefficient	201	0.42	0.12	0.19	0.63
After TRIPS					
Ginarte and Park Index	122	3.35	0.87	0.20	4.88
World Economic Forum IPR Score	1067	3.74	1.14	1.57	6.48
Gini Coefficient	578	0.38	0.09	0.24	0.65

2.3.3 Results

Regressions were run on formal protection (the GP Index) and de facto protection (the WEF IPR score). Standard errors have been clustered by country. In all regressions, income, as measured by GDP per capita, seemed to be the most important determinant of IPR protection. However, it is possible that the GDP per capita is absorbing some of the explanatory power of the shape of the distribution of income, as measured by the Gini coefficient. Finally, there are potential endogeneity and reverse causality issues with GDP per capita. To address this, distance from the equator is used instead of GDP per capita in one set of regressions.

It is interesting to note that while the distribution of income, as measured by the Gini Coefficient, is important in the determination of the formal level of protection, it is not as important in the determination the de facto level of protection. It is possible that this decreased importance of the Gini Coefficient for the WEF IPR years is due to the increasing international pressure to maintain a level of IPR protection consistent with the requirements of TRIPS, of which most of the countries are signatories in most of the later years covered by the WEF IPR measure. The GP Index covers years before TRIPS, and so it may be that considerations such as the distribution of income mattered more during this time when determining the appropriate level of IPR protection. Since having a certain standard of IPR protection is increasingly necessary to facilitate international interactions, this necessity may be overshadowing the impact of income distributions. It is also possible that including developed economies has obscured the impact of the shape of the income distribution, as there may be norms of protection that matter more than other concerns, norms that may not exist to the same extent in developing economies. Appendix B includes regressions run only on developing economies.

Table 2.10: Regressions on Formal IPR Protection

	(1) GP Index	(2) GP Index	(3) GP Index	(4) GP Index
Log GDP per Capita	0.346***	0.365***	0.00505	0.299***
	(0.0430)	(0.0392)	(0.268)	(0.0482)
Gini Coefficient	-2.479***	-1.682**	-1.333	-0.554
	(0.625)	(0.516)	(1.153)	(0.612)
Polity Score	0.0332**	0.0132	-0.0106	-0.00306
	(0.0101)	(0.00970)	(0.0103)	(0.00909)
Constant	0.948	-0.246	2.241	-0.273
	(0.529)	(0.537)	(2.157)	(0.590)
Year FE	No	Yes	No	Yes
Region FE	No	No	No	Yes
Country FE	No	No	Yes	No
Observations	372	372	372	372
Adjusted R^2	0.481	0.698	0.684	0.756

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 2.11: Regressions on De Facto IPR Protection

	(1) WEF IPR	(2) WEF IPR	(3) WEF IPR	(4) WEF IPR
Log GDP per Capita	0.603***	0.606***	1.650***	0.781***
	(0.0563)	(0.0566)	(0.270)	(0.0635)
Gini Coefficient	-0.472	-0.549	0.854	-0.766
	(0.811)	(0.821)	(1.298)	(1.135)
Polity Score	-0.0160	-0.0157	-0.0150	-0.00714
	(0.0164)	(0.0165)	(0.0237)	(0.0176)
Constant	-1.262*	-1.368*	-10.83***	-2.580***
	(0.594)	(0.600)	(2.492)	(0.666)
Year FE	No	Yes	No	Yes
Region FE	No	No	No	Yes
Country FE	No	No	Yes	No
Observations	721	721	721	721
Adjusted R^2	0.584	0.587	0.286	0.693

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The negative coefficient on the Gini coefficient indicates that as countries become relatively less equal, IPR protection decreases. This is consistent with the incentives described by the application of the Weibull distribution.

In both cases, the Polity measure does not seem to play a very important role, though again it is possible that GDP per capita and/or the region indicator is absorbing some of the explanatory power of this as well. It also suggests that although government preferences are important, the style of government does not do a great job of elucidating these preferences.

It should be noted that the year and region are often significant. The former supports the conclusion that as time has progressed, international pressure to increase protection has become increasingly important in understanding why protection has risen and suggests that the model may be better at explaining differences between countries than changes over time. The second supports the conclusion that there are regionally-similar institutions that help to explain differences in protection, perhaps better than the style of government, and that other considerations, such as regional trading agreements, might have an impact on the choice of level of protection.

The second set of regressions on the de facto measure of IPR (Table 2.12) introduces the alternative conception of institutions and measures of market structure. Since this data is not available prior to 2006, these regressions cannot be run on the GP Index. Using this data constitutes a different interpretation of institutions, one in which the government's preference for actors is dependent upon the revenue they generate rather than the influence they hold. In this case, the tax on consumers is used to represent a preference for consumers, as traded off with a preference for firms, both domestic and foreign. This variable was derived by taking the income from taxes on consumers divided by the sum of the incomes from consumers and producers. An increase in the tax on consumers is analogous to increasing weight placed on the consumers, as it means that a greater portion of the government revenue is derived from consumers. The negative coefficient suggests that as the weight on consumers increases, the level of protection decreases, which is consistent with the model.

The Local Competition and Market Dominance variables are measures of market structure. They are positively correlated (more intense local competition would occur in markets spread among many firms and vice versa), and an increase in both indicates a move from a market

Table 2.12: Regressions on De Facto IPR Protection

	(1) WEF IPR	(2) WEF IPR	(3) WEF IPR	(4) WEF IPR	(5) WEF IPR	(6) WEF IPR
Log GDP per Capita	0.606***	0.579***	0.407***	0.441***	0.270***	0.360***
	(0.0566)	(0.0586)	(0.0611)	(0.0672)	(0.0473)	(0.0589)
Gini Coefficient	-0.549	-1.533	-0.755	-1.494	-0.0991	-0.749
	(0.821)	(0.843)	(0.763)	(0.822)	(0.649)	(0.771)
Polity Score	-0.0157		-0.0151		0.00118	
	(0.0165)		(0.0130)		(0.0109)	
Consumer Tax		-1.588***		-1.179**		-0.762*
		(0.420)		(0.372)		(0.377)
Local Competition			0.644***	0.522***		
			(0.0997)	(0.123)		
Market Dominance					0.770***	0.592***
					(0.0624)	(0.0791)
Constant	-1.368*	0.0611	-2.736***	-1.579	-1.568***	-0.993
	(0.600)	(0.834)	(0.548)	(0.840)	(0.425)	(0.690)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	721	591	721	591	721	591
Adjusted R^2	0.587	0.662	0.666	0.702	0.759	0.756

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

described by a single domestic firm toward one described by a competitive domestic fringe. The positive coefficient suggests that protection is higher in the case of a competitive domestic fringe. However, it is possible that including developed economies in these regressions has obscured somewhat the impact of market structure. These regressions can be found in Table 2.12. Regressions run just on developing countries are included in Appendix B.

Finally, alternatives to GDP per capita were used to try to explain average formal protection between 1960 and 1990. Distance to the equator was used instead of GDP per capita. Polity IV, regions, identity of the colonial power, and legal origins were used to describe institutions. Average Gini coefficient was used to describe the income distribution. While the effects are much more significant in this set-up, most are close to zero. These regressions can be found in Table 2.13.

Table 2.13: Regressions on Formal IPR Protection

	(1) GP Index	(2) GP Index	(3) GP Index	(4) GP Index	(5) GP Index
Distance to Equator	0.000810***	0.00198***	0.00152***	0.00234***	0.00223***
	(0.000187)	(0.000237)	(0.000263)	(0.000232)	(0.000273)
Gini Coefficient	-0.00135***	-0.00128***	0.00157***	-0.00141***	0.00000664
	(0.000273)	(0.000225)	(0.000304)	(0.000314)	(0.000294)
Polity Score	0.00635***	0.00967***	0.0108***	0.00411***	0.00975***
	(0.000627)	(0.000625)	(0.000692)	(0.000536)	(0.000729)
Constant	0.355***	0.329***	0.212***	0.410***	0.275***
	(0.0130)	(0.0125)	(0.0191)	(0.0142)	(0.0198)
Region FE	No	Yes	No	No	Yes
Colonial FE	No	No	Yes	No	Yes
Legal FE	No	No	No	Yes	Yes
Observations	2100	2100	2100	2001	2001
Adjusted R^2	0.103	0.457	0.249	0.281	0.583

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

2.4 Conclusion

The relationship between IPR protection and income inequality and market structure is difficult to disentangle. Institutions and the level of development play large roles in determining the level of protection, and the impacts of income distribution and market structure are often altered or masked by the effects of these. Still, they do seem to play an important role, especially in determining the level of formal protection.

The model in this section demonstrates that changes in income inequality change the size of incentives to increase or decrease protection. As the demand for improved IPR protection increases internationally, understanding these incentives can help to explain why countries, especially developing countries, fail to protect at their contracted levels or resist improvements to their existing standards and why this behavior is not consistent among all countries.

CHAPTER 3: EXTENSION - LOCAL GOVERNMENTS

In this extension, there are local governments with different preferences for foreign firms. This can be understood as a desire for the benefits of production undertaken by foreign firms, such as job creation and infrastructure development. Depending on the firm, these benefits may be substantial or non-existent. Because of this, de facto protection of IPR may differ from the formal level of protection.

In this scenario, there are N localities, each with a local government that cares about consumer utility from consumption and the profits of the foreign and domestic firms. In each locality, a single foreign firm is producing a good of exogenous quality μ^F. A competitive domestic fringe or single domestic firm sells an imitation of the foreign good. The ability of the domestic firm(s) to imitate the foreign good depends on the final level of IPR protection, which is a deviation, determined by the local government, from a standard set by the federal government. The ability of the local government to deviate from the federally-determined standard depends upon the level of decentralization in the country. The local governments incur a cost of deviating below the federal standard. If there is no decentralization, then local governments are unable to set levels of protection that deviate from the federal standard. If there is complete decentralization, local governments have the power to set any standard of protection.

The order is as follows:

1. The federal government chooses the formal level of IPR protection.
2. The N localities each choose their own de facto levels of protection as deviations from the standard, subject to the level of decentralization.
3. Firms in each locality set their prices.
4. Consumers in each locality purchase either the foreign or the domestic good.

For simplicity, localities are assumed to be the same size, distributions of consumers in each

locality are the same, foreign firms in each locality are the same, and consumers can only purchase from the firms in their locality.

3.1 Consumers

Consumers in each locality are distributed according to $h(x)$ along $[0, b]$, assumed to be log-concave. Each can purchase either 0 or 1 unit of a good. If consumers do not purchase either the foreign or the domestic good, they receive zero utility. If a consumer purchases a unit of the good, she receives a utility of $\mu_n^i x - p_n^i$, where μ_n^i is the quality of the good, p_n^i is the price of the good, $i \in \{F, D\}$ represents the firm (foreign or domestic), $n \in \{1, ..., N\}$ indicates the locality, and x is the consumer's type.

A consumer will only purchase if $x \geq \frac{p_n^D}{\mu_n^i}$. Since the model assumes that the quality of the foreign good is higher than the quality of the domestic good, this implies that the lowest type consumer, x_L, will only purchase the good if $x_L \geq \frac{p_n^D}{\mu_n^D}$ and that every consumer $x \geq \frac{p_n^D}{\mu_n^D}$ will purchase one unit of a good. In the case of a competitive domestic fringe, in every locality $p_n^D = 0$, so every consumer will purchase one unit of a good, and the market is covered. In the case of a single domestic firm, the market will not be covered.

The indifferent consumer is characterized as having type $\hat{x}$ such that $\hat{x} = \frac{p_n^F - p_n^D}{\mu_n^F - \mu_n^D} > x_L$. Every consumer with type $x \geq \frac{p_n^F - p_n^D}{\mu_n^F - \mu_n^D}$ will purchase the foreign good.

3.2 Firms

The model assumes vertically differentiated goods produced by a foreign firm that has created a product outside the country and a competitive domestic fringe or single domestic firm that attempts to imitate the foreign good. The quality of the foreign good, μ_n^F, is determined exogenously. It is assumed that the foreign firm will not intentionally reduce (or raise) the quality of the good.

The quality of the domestic good, μ_n^D, is determined wholly by the *inability* of the domestic firm(s) to imitate the foreign good, $\alpha + \gamma_n$, in which $\alpha \in [0, 1]$ represents the federal government's choice of IPR protection and γ_n represents the deviation from the federal standard chosen by the local government. The domestic firm's *ability* to imitate is therefore given by $1 - (\alpha + \gamma_n)$. While

it is reasonable to assume that under strict IPR protection domestic firms might prefer to innovate, existing research makes it difficult to argue that domestic firms do in fact respond this way. Therefore, the qualities of the domestic goods are taken to depend only upon the level of IPR protection.

With any positive level of IPR protection, the domestic firms can produce a good of quality equal to, at most, $\mu_n^D = (1 - (\alpha + \gamma_n))\mu_n^F$. With no IPR protection, the domestic firm can, at best, produce a good of the same quality as the foreign firm. Therefore, $\mu_n^D \in [0, \mu_n^F]$. It is assumed that the domestic firm's *inability* to imitate is increasing in IPR protection.

All firms, both foreign and domestic, face the same costs of entry and marginal costs, assumed to be zero.

3.2.1 Competitive Domestic Fringe

In the case of a competitive domestic fringe, the foreign firm chooses its price, p_n^F to maximize its profit:

$$\pi_n^F = \int_{\hat{x}_n}^{b_n} p_n^F h(x) dx$$

The foreign price is therefore $p_n^F = (\alpha + \gamma_n)\mu_n^F \lambda_n$, where $\lambda_n = \frac{1 - H_n(\hat{x}_n)}{h_n(\hat{x}_n)}$.

The domestic firms compete profits down to zero, which, assuming a marginal cost of zero, yields a domestic price of $p_n^D = 0$. The domestic firms choose the highest possible quality given the level of protection. This, the domestic price, and the foreign price characterize the indifferent consumer as $\hat{x}_n = \lambda_n$. Since the domestic price is zero, the market is covered. The low-type consumer is thus $x_{Ln} = 0$.

The demand for the foreign good is $1 - H(\hat{x}_n)$. The demand for the domestic good is $H(\hat{x}_n)$. The profit for the foreign firm is:

$$\pi_n^F = \alpha \mu_n^F \lambda_n (1 - H(\hat{x}_n))$$

The profit for the domestic firms is zero. The utility from the consumption of the foreign good is:

$$CU_n^F = \mu_n^F [(1 - (\alpha + \gamma_n))\lambda_n (1 - H(\hat{x}_n)) + \int_{\hat{x}_n}^{b_n} (1 - H(x)) dx]$$

The utility from the consumption of the domestic good is:

$$CU_n^D = (1 - (\alpha + \gamma_n))[\lambda_n H(\hat{x}_n) - \int_0^{\hat{x}_n} H(x)dx]$$

3.2.2 Single Domestic Firm

In the case of a single domestic firm, the foreign firm chooses its price, p_n^F to maximize its profit:

$$\pi_n^F = \int_{\hat{x}_n}^{b_n} p_n^F h(x)dx$$

The foreign price is therefore $p_n^F = (\alpha + \gamma_n)\mu_n^F \lambda_n$, where $\lambda_n = \frac{1-H_n(\hat{x}_n)}{h_n(\hat{x}_n)}$.

The domestic firm chooses its price, p_n^D to maximize its profit:

$$\pi_n^D = \int_{x_L n}^{\hat{x}_n} p_n^D h(x)dx$$

The domestic price is therefore $p_n^D = (\alpha + \gamma_n)(1 - (\alpha + \gamma_n))\mu_n^F \Lambda_n$, where $\Lambda_n = \frac{H(\hat{x}_n) - H(x_L n)}{(1-(\alpha+\gamma_n))h(\hat{x}_n)+(\alpha+\gamma_n)h(x_L n)}$. The domestic firm will choose the highest quality possible given the level of protection. This then means that the indifferent consumer is described by $\hat{x}_n = \lambda_n - (1 - (\alpha + \gamma_n))\Lambda_n$ and the low-type consumer is described by $x_L n = (\alpha + \gamma_n)\Lambda_n$.

The demand for the foreign good is $1 - H(\hat{x}_n)$. The demand for the domestic good is $H(\hat{x}_n) - H(x_L n)$. The profit for the foreign firm is:

$$\pi_n^F = (\alpha + \gamma_n)\mu_n^F \lambda_n (1 - H(\hat{x}_n))$$

The profit for the domestic firm is:

$$\pi_n^D = (\alpha + \gamma_n)(1 - (\alpha + \gamma_n))\mu_n^F \Lambda_n (H(\hat{x}_n) - H(x_L n))$$

The utility from the consumption of the foreign good is:

$$CU_n^F = \mu_n^F[(1 - (\alpha + \gamma_n))\lambda_n(1 - H(\hat{x}_n)) + \int_{\hat{x}_n}^{b_n} (1 - H(x))dx]$$

The utility from the consumption of the domestic good is:

$$CU_n^D = (1 - (\alpha + \gamma_n))\mu_n^F[(\lambda_n - \Lambda_n)H(\hat{x}_n) - \int_{x_L n}^{\hat{x}_n} H(x)dx]$$

3.3 Local Governments

Local governments care for the utility of their consumers, the profits of the domestic firms, the profits of the foreign firm, weighted by σ_n. This weight represents the extent to which foreign activity benefits a locality or, alternatively, the extent of a local government's desire to attract the foreign firm. Local governments are responsible for choosing an optimal deviation from the federal standard of IPR protection, γ_n, subject to the level of decentralization, τ. A local government that chooses to deviate pays a penalty for deviation, $\varphi(\gamma_n)$. The more autonomy enjoyed by a local government, the more it is able to deviate. Increased downward deviation incurs an increased penalty. Upward deviation does not incur any penalty.

The local government's available range of deviation is determined by the level of autonomy, $\tau \in [0, 1]$. Complete centralization is represented by $\tau = 0$. Complete decentralization is $\tau = 1$. The available range of deviation is therefore $\gamma_n \in [-\tau\alpha, \tau(1 - \alpha)]$.

3.3.1 Competitive Domestic Fringe

The local government chooses γ_n to maximize its objective function:

$$G_n^{LG} = \sigma_n^{LG}\pi_n^F + CU_n^F + CU_n^D - \varphi(\gamma_n)$$

subject to $\gamma_n \in [-\tau\alpha, \tau(1 - \alpha)]$.

Interior Solution

If the constraints on γ_n are non-binding, then the local governments choose γ_n^* such that:

$$-\varphi'(\gamma_n^*) = \mu_n^F\lambda_n[\sigma_n^{LG}(1 - H(\hat{x}_n)) - (1 - \frac{1}{\lambda_n}\int_0^{\hat{x}_n} H(x)dx)]$$

The first term represents the additional benefit to the local government of the increased profit enjoyed by the foreign firm with higher protection. This puts upward pressure on the deviation. The second term represents the negative impact on the consumers due to the increased foreign price and the decreased quality of the domestic good. The relative sizes of these will determine the size of the deviation.

Corner Solution

If the optimal size of the deviation is less than $-\tau\alpha$, then the local government will choose $\gamma_n^* = -\tau\alpha$. If the optimal size of the deviation is greater than $\tau(1-\alpha)$, then the local government will choose $\gamma_n^* = \tau(1-\alpha)$.

3.3.2 Single Domestic Firm

The local government chooses γ_n to maximize its objective function:

$$G_n^{LG} = \sigma_n^{LG}\pi_n^F + CU_n^F + CU_n^D + \pi_n^D - \varphi(\gamma_n)$$

subject to $\gamma_n \in [-\tau\alpha, \tau(1-\alpha)]$.

Interior Solution

If the constraints on γ_n are non-binding then the local government chooses γ_n^* such that:

$$\gamma_n^* = \frac{-(\lambda_n - \int_{x_L n}^{\hat{x}_n} H(x)dx - \Lambda_n H(x_L n) + \alpha\Lambda_n^2 h(x_L n)) + \Lambda_n(1-(\alpha+\gamma_n))(H(\hat{x}_n) - H(x_L n)) + \lambda_n\sigma_n^{LG}(1-H(\hat{x}_n)) - \varphi'(\gamma_n^*)}{\Lambda_n^2 h(x_L n) + \Lambda_n(H(\hat{x}_n) - H(x_L n))}$$

The first term is negative and represents the negative impact on consumers of increased foreign and domestic prices due to an increase in protection as well as the decreased quality experienced by consumers of the domestic good. The second term is positive and represents the profit of the domestic firm. The third term is positive and represents the profit of the foreign firm. The final term is negative and reflects the penalty paid for deviation.

Corner Solution

If the optimal size of the deviation is less than $-\tau\alpha$, then the local government will choose $\gamma_n^* = -\tau\alpha$. If the optimal size of the deviation is greater than $\tau(1-\alpha)$, then the local government will choose $\gamma_n^* = \tau(1-\alpha)$.

3.4 Federal Government

The federal government maximizes the utility from the consumption of the foreign and domestic goods in each locality and the benefit earned by each local government, scaled by its preference for that locality, and some benefit from each of the foreign firms. It is responsible for choosing a standard level of IPR protection, α, from which localities may choose to deviate, subject to the level of decentralization.

For ease of solving and exposition, the consumer distribution, market structure, and quality of the foreign good are the same in each locality. This means that $\hat{x}_n$, x_{Ln}, $H(\hat{x}_n)$, and $H(x_{Ln})$ are the same in each locality. The only difference between localities, therefore, is σ_n^{LG}, the local government preferences for the foreign firms, which will lead to different choices of deviations from the formal level of protection, γ_n^*.

3.4.1 Competitive Domestic Fringe

The federal government chooses the formal protection, α, to maximize its objective function:

$$G^{FG} = \sum_{n=1}^{N} \delta_n(G_n^{LG}) + \sum_{n=1}^{N} \sigma^{FG}\pi_n^F$$

The optimal choice of α will be such that the weighted sum of the deviations (or, more specifically, the weighted sum of the penalties paid due to the deviations) is offset by the benefits to the local and federal governments from foreign profits, balanced by the harm to consumers:

$$-\tau\sum_{n=1}^{N}\delta_n\varphi'(\gamma_n) = -(1-H(\hat{x}))\sum_{n=1}^{N}(\sigma^{FG} + (\delta_n - \tau)\sigma_n^{LG}) + (1-\tau)(1-\frac{1}{\lambda}\int_0^{\hat{x}} H(x)dx)$$

In general, the federal government will prefer a higher level of protection than that of localities

due to the gain it gets from the foreign firm (this could also be interpreted as international pressure to protect). However, since the government is balancing the weighted average of the interests of localities, it is possible that individual localities might wish to have protection in excess of the standard set by the federal government. Additionally, the federal government's decision is influenced by the amount of autonomy enjoyed by the localities. If there is complete centralization, the government will put considerable weight on the interests of the consumers and choose either complete protection or complete lack of protection, as in the base model. If there is full autonomy, the federal government will not put any weight on the interests of consumers, and instead choose its standard of protection to balance the benefits accrued from the foreign profits.

3.4.2 Single Domestic Firm

The federal government chooses α to maximize its objective function:

$$G^{FG} = \sum_{n=1}^{N} \delta_n(\sigma_n^{LG}\pi_n^F + CU_n^F + CU_n^D + \pi_n^D) + \sum_{n=1}^{N} \sigma^{FG}\pi_n^F$$

The optimal choice of α is given by:

$$\alpha^* = \frac{-\lambda + \int_{x_L}^{\hat{x}} H(x)dx + \Lambda H(\hat{x}) + \lambda(1 - H(\hat{x}))\sum_{n=1}^{N}\delta_n\sigma_n^{LG}}{\Lambda(\Lambda h(x_L) + H(\hat{x}) + H(x_L))} + \frac{N\sigma^{FG}(1 - H(\hat{x}))}{(1-\tau)(\Lambda h(x_L) + H(\hat{x}) + H(x_L))} - \sum_{n=1}^{N}\delta_n\gamma_n^* + \frac{\tau\sum_{n=1}^{N}\delta_n\varphi'(\gamma_n^*)}{(1-\tau)\Lambda^2\mu^F(\Lambda h(x_L) + H(\hat{x}) + H(x_L))}$$

The complexity of the result obscures somewhat the interpretation, which does not differ substantially from that of the result with a competitive domestic fringe: the government balances the weighted averages of the interests of local governments and its own benefit, constrained by the level of autonomy.

3.5 Discussion

This model is most appropriate for developing economies in which there is no existing norms of IPR protection. In more developed economies, the norms of protection may prevent local governments from deviating in their level of protection in response to economic objectives. However, in developing economies, this limitation may not exist. Jordan is a good example of this - between 1995 and 2005 it increased its level of IPR protection substantially, moving from one of

the lowest levels of IPR protection in the region to one of the highest. This was in response to a desire for growth driven by foreign investment. This control over the level of protection, both de jure and de facto, is possible in a country where the norm is not to protect. As a result, this model of incentives is more appropriate for explaining behavior in developing countries.

The local governments are constrained in their deviation by the level of autonomy. Especially in cases in which there is very little local autonomy, the limits of deviation are likely to bind. All else equal, as equality increases (Gini decreases), the deviation is pushed downward (that is, the local government will choose to protect below the federal level) toward the lower bound. For local preferences for the local firm sufficiently low, the lower constraint will always bind. As the quality of the foreign good increases or the preference for the foreign firm increases, the deviation will be pushed upward (that is, the local government will choose to protect more than the federal level) toward the upper bound. For consumer distribution sufficiently unequal, the upper constraint will always bind.

Relaxing the assumption that the distribution of consumers is the same across localities introduces more heterogeneity in the desire to deviate. The federal government sees this through the chosen deviations of the local governments and chooses its federal standard in response.

Relaxing the assumption that firms only sell their goods in the localities in which they are located introduces additional interesting heterogeneity. It is possible that firms locate in a specific locality to take advantage of protection while also selling their goods elsewhere within the country (and outside the country). In this case, the price chosen by the foreign firm (and single domestic firm) reflects the level of protection in the locality and the distribution of consumers throughout the entire country. This could lead to one of three outcomes: 1) the prices are higher than those chosen in the extension without export, 2) the prices are lower than those chosen in the extension without export, or 3) the prices are the same. In each case, the local government sees additional incentives to either increase or decrease deviation. In all cases, the foreign profit is increased. Contingent upon the size of the preference for the foreign firm and the size of the increased foreign profit being sufficiently large, the benefit from increasing protection will outweigh the detrimental impact on local consumer utility, putting upward pressure on the chosen level of de facto local protection. If prices are lower than in the extension without trade, there will also be an increase in consumer utility from the consumption of the foreign good. This could reduce the

pressure to reduce protection, allowing the local government to increase protection to benefit from the increase in the foreign profit that would result. Trade within a country would affect the local government's decision both through the impact on domestic actors and through the increased foreign profit. It would also likely lead to a concentration of foreign firms in those localities with higher protection. As a result, other localities might intentionally keep their levels of protection low to the benefit of their citizens, with the understanding that their citizens would still have access to the foreign goods produced in other localities. This would be more likely in localities with extreme levels of inequality and relatively low preference for foreign actors.

Trade with other countries would impact the local government's decision through the foreign profit, assuming that the price chosen for the exported good does not directly affect the local price, and vice versa. Successful exporting to foreign countries would put upward pressure on protection in order to increase the profit through the increased price so long as doing so does not crowd out profit from selling the foreign good domestically and reduce consumer utility more than the international gain. Increased preference for the foreign firm would magnify the incentive to increase protection. As this preference can be interpreted in ways other than profit-sharing agreements, such as local employment, this suggests that local governments that benefit from increased local employment due to foreign production would have increased incentive to protect IPR, even if foreign production is destined for export.

If domestic firms are also able to produce for export to other countries, this would put downward pressure on protection, as these firms would benefit from producing a quality of good as close to that of the foreign firm as possible and being able to sell at a price below the prices of firms in other countries. The local government's level of protection would depend, therefore, on the relative sizes of demands for the foreign and domestic goods both within and outside the country, in addition to benefits accruing from foreign production.

3.6 Conclusion

This extension looks at the incentives leading to a difference between the federal standard of IPR protection and the reality of protection at the local level. Local governments respond to the needs of the domestic actors, including consumers of the domestic and foreign goods and the

domestic firms trying to imitate the foreign firms, and the profits of the foreign firms. Depending on the preferences of the local governments, they will have incentive to either protect in excess of the federal standard or less than the federal standard, with this deviation being constrained by the level of autonomy enjoyed by the local government and chosen based on the cost of deviation. The federal government then chooses its federal standard based on a weighted average of the desired deviations of the local governments, constrained by the level of autonomy, and their international obligations or benefits from the foreign firm. Allowing firms to sell within the country and outside their localities further impacts the local government's chosen level of deviation, possibly increasing the spread of chosen levels of deviation. International trade puts further upward pressure on protection until doing so crowds out domestic consumers.

This model is best applied to countries without existing norms preventing local governments from responding to economic incentives. As a result, while it can help explain differences in protection in developing economies, it does a poor job of doing the same in developed economies.

CHAPTER 4: COUNTRY STUDY - JORDAN

Much literature regarding the role of IPR protection concludes that countries, in order to court foreign investment, should increase their IPR protection. This tendency towards the increase in IPR protection has been quite noticeable since the early 1990s, with the signing of the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS). Since then, any country wishing to become part of the World Trade Organization (WTO) must bring its IPR standards up to those of TRIPS. Developing countries especially have been changing their laws to bring themselves into accordance with TRIPS since that moment, often to encourage international confidence and attract foreign investment.

Jordan has followed this trend, with a notable uptick in its IPR protection since the early 2000s. Prior to this change, Jordan had one of the lowest levels of protection among Middle Eastern and North African countries and among Lower-Middle Income countries. Since 2000, however, Jordan has maintained one of the higher levels of protection among Middle Eastern and North African and Lower-Middle Income countries. Additionally, concurrently with its increase in protection, Jordan has formed itself into a major strategic partner for Western countries and launching pad for Western countries investing elsewhere in the Middle East.

A government's choice of its appropriate level of IPR protection is influenced by the country's level of development. Also contributing to this decision, though, is the historical strength of institutions and the interests of strong parties. IPR protection is not implemented without significant trade-offs. Much of the current research agrees that while IPR protection might encourage foreign direct investment, it does so at the expense of current consumption and potentially domestic innovation, especially in those countries with relatively poor human capital when compared to the investing country. IPR protection, while providing an attractive safety net for foreign companies, often stems the flow of technical knowledge transfer to domestic companies.

Despite the potential negative impacts of increased IPR protection for developing countries, the Western treaties that Jordan has joined and aspires to join, as demonstrated by the actions of

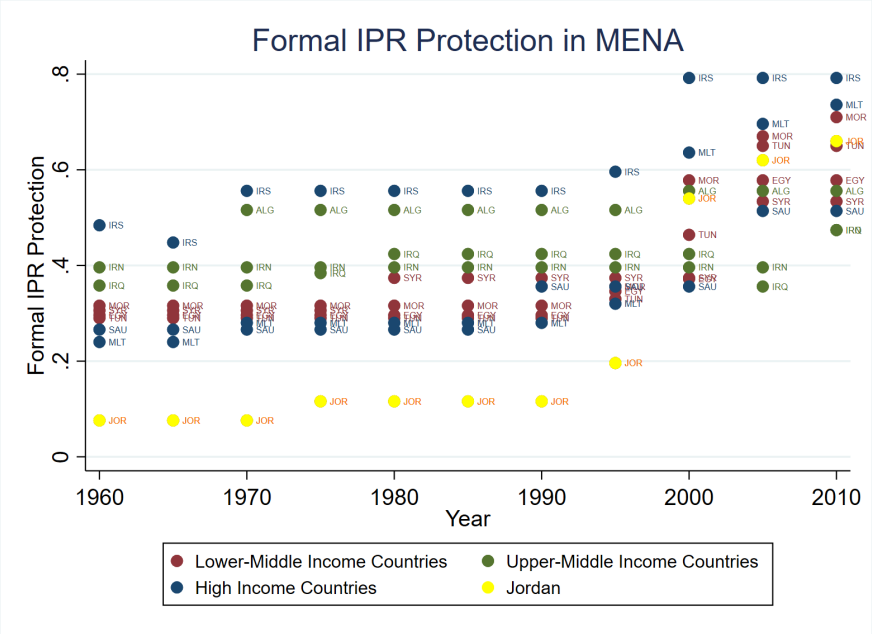
its government, consistently extol the virtues of IPR protection. Jordan has taken substantial steps towards adopting these policies, not only by signing TRIPS, but also by enacting laws designed to bring its legal standards and enforcement standards more in line with TRIPS and the requirements of its free trade agreements and other international agreements. In doing so, Jordan has moved from having one of the lowest levels of protection in the region to having one of the highest.

This paper will utilize a model of government choice of intellectual property rights to shed light on the incentives facing the Jordanian government in its decision. The paper will focus on three primary questions: 1) Why was Jordan's level of protection so low prior to 2000? 2) Why did Jordan's level of IPR protection jump so significantly in 2000? and 3) Why has Jordan's level of protection been so (relatively) high since 2000? Recognizing that culture, colonial history, legal systems, and religion play an important role in influencing the choice of IPR protection, this analysis will be conducted in comparison to seven countries in the region: Egypt, Iraq, Lebanon, Morocco, Syria, Tunisia, and Yemen. These countries have similar colonial and legal histories and religious makeup, controlling for the importance of these influences in determining the level of protection. They are all lower-middle and upper-middle income countries and have similar levels of development. They differ in their distributions of income and preferences for foreign firms, however, and these differences will help shed light on the incentives compelling Jordan to keep its protection relatively low prior to 2000 and relatively high following 2000.

This chapter will look at the distribution of incomes, dominant industries, strengths of local or tribal governments, and participation in international agreements in these eight countries to help elucidate Jordanian behavior. It will proceed in the following order: Section 1 will give an overview of IPR protection in Jordan, Section 2 will give brief overviews of the state of IPR protection in the rest of the comparison countries, Section 3 will apply the model, and Section 4 concludes.

Much research into IPR protection in developing countries is biased in favor of stricter protection of intellectual property. This paper will attempt to analyze forces for and against the implementation of IPR regimes without this normative assumption. However, it should be noted that much of the recent regulation in both countries has been heavily influenced by Western governments, and so this bias is increasingly present in discussions surrounding this topic.

Figure 4.1: Formal IPR Protection in MENA

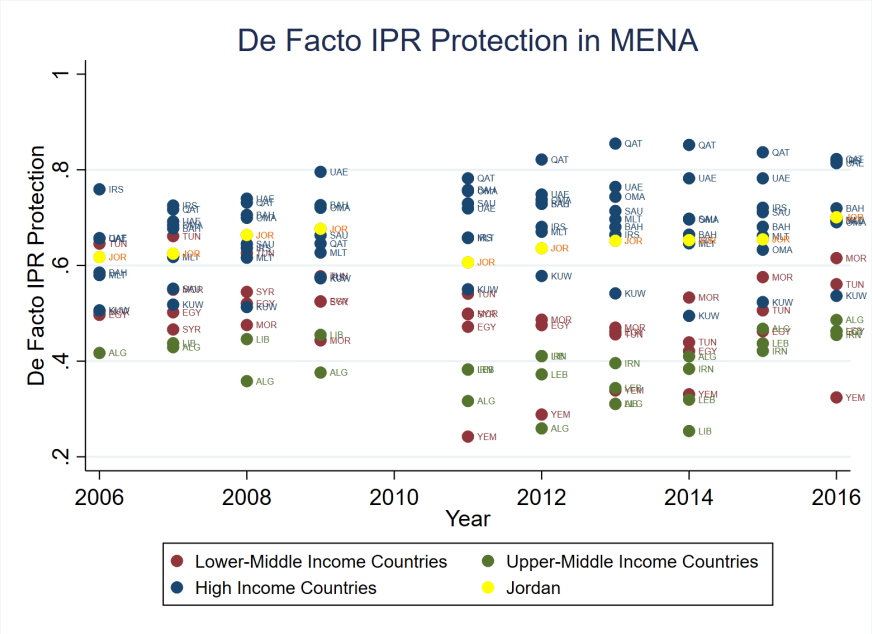


4.1 History of Intellectual Property Rights Protection in Jordan

Jordan as an independent state has only existed since 1946, following recognition by the United Nations and the later withdrawal of British troops. Prior to that, Trans-Jordan existed as a British protectorate beginning in 1921. Jordan is a hereditary monarchy, and so it has had a very slow succession of leadership. Under the current king's rule, there has been an emphasis on political and economic liberalization. Though the US has been involved in Jordan for its entire history, it became increasingly involved in the mid-1990s, both through a USAID partnership and through the UN and World Bank. During this time, the Jordanian government actively sought membership in the WTO and, in order to support its bid for membership, enacted a series of economic and political reforms, including many related to IPR protection. As a result, it is useful to compare protection before 1995-2000 to protection after.

A number of legal scholars have provided fairly comprehensive analyses of the state of Jordanian IPR laws before and after the change, including Al Dajani (2007) and Nesheiwat (2012). Additionally, the USAID has maintained a presence in Jordan since the mid-1990s, and regularly released reports detailing the state of IPR laws (1995, 2004, 2007). A summary of the state of the IPR legal landscape as described by these authors follows.

Figure 4.2: De Facto IPR Protection in MENA



4.1.1 IPR Protection before 2000

Prior to the late-1990s, Jordan had very limited IPR protection. Few laws existed that supported protection, and, as a result, few intellectual property cases were brought before Jordanian courts. Despite the soundness of the few existing laws, the paucity of cases left judges and lawyers with little experience (Nesheiwat 2012).

This lack of experience and a culture that often neither recognized the importance of IPR protection nor considered imitation to be theft meant that Jordan had a reputation as a country with very little protection for IPR (USAID 1995). Piracy of software and multimedia was (and still is) abundant, and music artists tended to make their recordings in Cairo, Egypt, where there was more protection for the artists' work. Jordanian technology innovators first published their discoveries in other countries to take advantage of international copyright treaties, fearing that publishing first in Jordan would mean that their discoveries would not be protected (USAID 1995). There is still no good mechanism for preventing pirating videos or software, and it is quite common to find pirated movies being sold in full view on the street.

Foreign companies enjoyed some protection and a somewhat facilitated copyright and trademark registration processes in Jordan prior to the changes. The Patent Office gave some

protection to famous trademarks without registration, and foreign patent applicants tended to have their applications registered without much examination (USAID 1995). While Jordan did not at that time have external copyright relations, the Jordanian courts were required to abide by the statutes of international treaties without first needing to ratify additional legislation. However, this alone was insufficient to indicate to other countries or foreign firms that their intellectual property would be protected in Jordan. To do that, Jordan would need to ratify and implement bilateral or multilateral IPR treaties or sign on to international agreements (USAID 1995).

Though the level of Jordanian IPR protection was very low, WTO accession talks began to reverse this trend. Jordan's membership application stalled in 1994, but when King Abdullah II took over the throne in February of 1999, he set an ambitious deadline of December 1999 for completing the process of bringing the Jordanian IP landscape more closely into line with what would be required for WTO admission. During this process, Jordan drafted, amended, or enacted more than 25 laws regarding trade, investment, customs, and IPR, leading to the acceptance of Jordan's WTO application in December 1999 and its accession in April 2000.

4.1.2 Increase in IPR Protection

The rapid increase in protection between 1994 and 2000 was done with the support of such agencies as the USAID and the UN as part of Jordan's attempt to bring its laws into compliance with TRIPS to facilitate WTO accession. The Jordanian and US governments both stated that adopting more stringent IPR protection would be beneficial for Jordan, and this is especially true for the pharmaceutical industry. Jordan is a small country with little in the way of natural resources. It does, however, have a relatively well-educated population and is relatively politically stable. Jordan's main export markets include potash and pharmaceuticals, the latter of which is dependent upon IPR protection. In order to facilitate economic growth, it appeared that the Jordanian government took steps to make the country more attractive to investment by foreign firms, especially those that could benefit from relatively less expensive and more skilled labor in industries that might prefer improved IPR protection. To do this, it pursued WTO membership as well as free trade agreements with the US and EU, all of which required substantial legal reform.

The process of becoming a member of the WTO was begun in 1994 under King Hussein, but the process was accelerated considerably under his son and successor, King Abdullah II, who took

the throne in February 1999. During this period, in addition to the new laws on trade and investment, eight new IPR laws were added to the four already in existence, with more being added after accession, for a total of 15 new IPR laws added. The pace of reform was rapid; however, many of the changes were passed while Parliament was not in session and without much, if any, feedback from citizen groups in the country (Nesheiwat 2012). This unilateral action, possible in a hereditary monarchy, undoubtedly enabled the rapid changes in the legal landscape. However, it also may have led to a gap between the laws themselves and their local understanding and enactment (Nesheiwat 2012, Al Dajani 2007, USAID 2004). This being said, policymakers in Jordan wished to take advantage of the potential opportunities provided by WTO membership and make the transition from a consumer of intellectual property to a producer of intellectual property. This necessitated bringing its laws and economic environment into compliance with WTO standards, educating the citizenry, and signaling to foreign companies that it is an attractive market for investment and development.

4.1.3 IPR Protection after 2000

WTO accession and the adoption of the new IPR legislation has helped Jordan to improve its reputation with regard to IPR protection. By 2004, the IPR reforms resulted in Jordan's removal from the International Intellectual Property Association watch list. Customs had improved its identification of shipments of counterfeit goods. The number of IPR cases brought in front of Jordanian courts increased markedly, as can be seen in Table B.8 (Nesheiwat 2012, USAID 2004, USAID 2007). Additionally, in 2000 Jordan became the fourth country to sign a bilateral free trade agreement with the US, and in 2002 it signed a free trade agreement with the EU. Both of these agreements further increased the protection of IPR. They also served as indicators of Jordan's desire to liberalize its domestic and foreign economic policies and commitment to creating an attractive market for foreign investment and involvement.

By 2007, despite a considerable increase in the extent of protection and enforcement, Jordan was still not in full compliance with either the US or the EU free trade agreements. Multimedia and software piracy remained high, and while the number of raids and copyright cases had increased, decisions made by the judiciary were not as successful at deterring infringement cases as was hoped by various international and domestic agencies. Very little legal action had been

taken against pirates or shops selling goods known to be pirated. Additionally, goods discovered to be pirated had received approval for sale from the Jordanian Audiovisual Commission. Judicial decisions in IPR cases demonstrated a lack of full comprehension of the new laws and did not appear to be providing an effective deterrent to counterfeiting behavior (USAID 2007).

The Government of Jordan, with the assistance of the US, continues to train members of its own judiciary and members of other governments in the region in the prosecution of IPR cases (for example, according to the US Trade and Patent Office, Jordan hosted a Regional Workshop for Legislators, Judges, and Government Representatives in Amman in February 2011). It also continues to invest in campaigns to discover and prosecute cases of copyright infringement. The number of domestic and international patent and other applications has substantially increased, as has the number of cases brought before courts. Table B.8 shows these increases.

While it is clear that Jordan has gone a long way toward demonstrating to potential trading partners that it has improved its ability to protect IPR, the impact on the domestic market, especially in terms of poverty and unemployment, is not yet clear.

4.1.4 Discussion of the Increase in Protection

The question of whether or not a country, especially a developing country, should increase its IPR protection has been well debated in the literature. Supporters of the adoption of increased IPR protection point to its many potential benefits. Increased protection increases the attractiveness of a country to foreign investors, especially in those instances when foreign firms are looking to relocate some of their production processes. As noted by Parello (2008), when costs of production are low and local skill is high, foreign companies wishing to move production to a cheaper location are more likely to move their production to a country with higher protection than to a similar alternative. Rhetoric among world leaders and international institutions extol the virtues of strengthened IPR protection, arguing that improved protection leads to gains from international cooperation and improved domestic innovation. They also provide incentives to innovate, as the promise of protection, perhaps even that enacted for the benefit of foreign companies, might entice domestic innovators who hope to benefit from the short-term monopoly power offered by increased protection. Foreign companies also tend to prefer environments in which intellectual property is well-protected, despite in general relying on internal structures to

reduce their risk. Despite having fairly good trade-secrets protection, improved IPR regulations signals to foreign companies that Jordan is serious about protecting their intellectual property should internal structures fail (USAID 1995, 2004, 2007).

On the other hand, many authors argue that increased IPR protection could have potential detrimental impacts for developing countries. Braga (1989) argues that in developing countries, IPR protection sacrifices the interests of society at large in favor of small, private interests. Often, these societal interests are lower prices and sometimes, though less often, the increased quality of certain goods that result from better protection. Chen (2005), summarizing Helpman (1993), argues that, in developing countries, IPR protection has detrimental effects through adverse terms-of-trade effects and a dependence upon the rate of innovation in the more developed countries. Maskus (2000) and Acemoglu (2006) argue that for very low levels of development, high IPR protection is beneficial, but, as a country begins to develop, high IPR protection becomes potentially harmful. There is also a large subset of literature devoted to the debate about the appropriateness of tying policies that advance the interests of developed economies to aid and support given to developing economies. Many in this debate believe that it is harmful to developing countries to impose a developed country-style growth model or to expect a similar pattern of growth.

In Jordan, proponents of both viewpoints abound. There is also the further consideration of the role that culture and religion play in the views toward the adoption of increased levels of IPR protection.

Supporters of increased IPR protection in Jordan believe that it will help prevent brain drain and turn Jordan into a center of technological innovation. Other governments in MENA have found that foreign investment was stymied by their reputations as piracy havens. Similarly, Jordan was viewed as a weak protector of IPR, undermining its efforts to attract foreign investment. By bringing Jordans IPR standards up to the international norm, supporters hope to make the country much more attractive to foreign investors (USAID 1995, 2004, 2007).

However, support for IPR protection in Jordan is neither entirely new nor uniquely Western. In the 1991 National Charter, Jordanian political forces express a belief in the importance of IPR protection, stating: “Copyright must be respected. Legislation protecting copyright and patents must be updated (VI.1.8).” Even before its push for WTO membership, Jordan was looking to

improve the level of protection. Reasons for this can also be found in the National Charter, which indicates a desire for Jordan to become an innovative hub:

"There must be a clear and well-defined development strategy based on the concept of self-reliance, release of the innovating spirit in society...development of the national productive base... (IV.1.2)"

"Science and technology have a central role in the development of society, as well as in solving social and economic problems, strengthening Jordanian and Arab security, enabling society to deal with changing conditions, and contributing to world civilization (VI.3)."

"A clear political decision and national will must exist to acquire, transfer, develop, and utilize technology to meet the country's needs on the basis of careful planning which relies on indigenous institutions and on an advanced system of education (VI.3.1)."

"The Jordanian economy must be based on respect for private ownership and encouragement of private enterprise (IV.1.1)."

The changes in protection that have already been implemented have catapulted Jordan from the bottom to the top of the IPR rankings in the region. Whereas Jordan used to have one of the lowest levels of IPR protection in the region, they are now regarded as a regional leader in protection, according to the USAID (2004). Within Jordan's own government, the perception of IPR is often positive: "'Jordan is now regarded as a regional leader in the enforcement of intellectual property laws.' - Mamoun Th. Talhouni, Director General, Department of the National Liberty, Jordan (USAID 2004)."

"'Jordan's success in promoting intellectual property rights has helped legitimate businesses capitalize on their IP assets and operate without fear of illegal competition,' says Murad Bushnaq, chairman of [Jordan Intellectual Property Association] (USAID 2004)."

These changes, and the better business environment they endeavor to create, are seen as solutions for many of the economic issues Jordan has been struggling under for the last twenty years, including unemployment, stagnant macroeconomic growth, and inflation. Additionally, consumers of goods, while hurt by the higher prices experienced due to reduced access to counterfeited goods, should also benefit from the elimination of potentially harmful counterfeited goods, especially in the case of the pharmaceutical industry.

Despite the stated benefits of increased IPR protection, there are still forces against the

increase in protection. As USAID points out (1995), in recent history, Jordan has been a consumer of intellectual property, not a producer. As a result, much of Jordanian society views IPR protection as a benefit accruing only to those who create the intellectual property, the foreign firms. These firms then remove revenue from Jordan, but do not necessarily invest or provide new products. This view certainly undermines efforts to educate the population on potential benefits of protection.

Additionally, as Dajani (2007) and Nesheiwat (2012) note, many in Jordan do not believe piracy to be theft, and many more believe that piracy is essential to their livelihoods. This can be seen in the prevalence of shops and stalls selling pirated software and multimedia, even on main streets in the large cities. There is a religious element, too. Both Dajani and Nesheiwat argue that many interpretations in Islam view property as communal, and so intellectual property should also be communal. Additionally, much Islamic law is interpreted to allow an activity unless it is expressly forbidden, and no one legal opinion is seen to be superior to another opinion. As a result, as piracy is not everywhere expressly forbidden, there is no real consistency to belief about piracy as theft, and different areas might have different approaches.

Within the National Charter of Jordan, despite its express promotion of increased protection, it also explicitly states that "...natural resources and strategic projects must be the property of the state (IV.1.1)."

Nesheiwat (2012) argues that Jordan should only expect to see foreign investment gains related to increased IPR protection if the investment is sensitive to IPR. Since much of the FDI into Jordan comes from Arab countries that find themselves in similar situations with regard to their intellectual property protection, it would be reasonable to assume that more stringent IPR laws would have a negligible effect on these flows (Nesheiwat 2010). Additionally, Nesheiwat argues that since Jordanian imports are not very dependent upon intellectual property, it is not clear that the benefits are as considerable as claimed (Nesheiwat 2010).

A 2010 survey of students at the University of Jordan conducted by Ferris Nesheiwat (2012) reveals more about local perceptions of IPR protection, at least among educated young adults in Amman. 90% of survey respondents admit to purchasing counterfeit products, with 53% admitting to being willing to continue buying counterfeit products. However, this appears to be motivated more by price than by religious beliefs or other social norms, as 64% said that they

would not purchase counterfeited products if they could afford to purchase an original and 72% believe that counterfeit products are ethical because they allow individuals with limited incomes access to goods. However, only 29% believe that counterfeit products are prohibited by religion, and while price seems to be the primary motivator, religious edicts appear to be a stronger deterrent than state law: 17% of respondents would continue purchasing counterfeit products if counterfeits were prohibited by religion, compared to 35% who would continue to purchase if counterfeits were prohibited by state law. Despite this, 75% believe that counterfeit products intrude on the rights of companies (though 64% claim not to care about those companies' losses), 49% feel uncomfortable when buying counterfeit products, and 54% believe that counterfeit products harm people. It should be noted that this survey does not include older consumers or consumers in less populated areas. It also focused primarily on products such as software and books rather than pharmaceutical goods. It does seem to demonstrate, however, that while social and religious norms help to explain the historical aversion to IPR protection in Jordan and neighboring countries, the decision to purchase a copy instead of an original is driven by price. Similar surveys of business owners in Lebanon demonstrate that younger respondents are more likely to view IPR protection as important (CRI 2009).

While the implications of Jordan's rapid increase in protection are not yet fully known, the international community and Jordanian government appear to believe that the move was and will continue to be beneficial for Jordan's growth. As a result, the Jordanian government is continuing to invest in improving understanding of the laws and training in proper enforcement.

4.2 IPR Protection in Comparison Countries

4.2.1 Egypt

Egypt has had a longer history of IPR protection than many of the other countries in the region, signing the Berne Convention in 1997, and becoming part of the WTO and a TRIPS signatory in 1995. Historically, its level of protection has exceeded that of Jordan, attracting musicians from Jordan who wish to have protection of their art not traditionally offered in Jordan. Despite this legislation and well-publicized seizures of counterfeit goods, Egypt's record of enforcement is poor, and much of the international community does not trust that it will

consistently enforce IPR protection laws (USAID 1995).

Egypt's protection of IPR was more substantial to that of Jordan's prior to 2000. Like Jordan, however, Egypt also began to increase the number of IPR protection laws in accordance with TRIPS between 1995 and 2002. Following this, like in Jordan, Egypt saw a noticeable increase in the number of patents and trademarks filed. The international consensus seems to be that, like in much of the rest of the Middle East, the laws are sound, but the enforcement is lacking. As evidence of this, Egypt was placed on the Priority Watch List of the US Trade Representative in 2003, remaining on the list until 2005 (Al Dajani 2007, Lewis 2008).

Egypt's decision to increase its protection to bring it in line with international standards also appears to have been in response to a political desire to remain an attractive trading and investment partner for Western countries, particularly the US. Its IPR protection prior to this change, while not as high as that of Iraq, seemed to be sufficient for the needs and preferences of its residents. However, as Egypt tried (and tries) to become a more important international player, it felt that increasing its standards served as an important signal of its potential to be so. That being said, Egypt has fallen behind many of the other countries in the region with regard to its IPR protection. Confounded by domestic tensions, Egypt began to fall in the international rankings for IPR protection between 2010 and 2015. As it has stabilized, its level of protection has begun to improve again. As with many of the other countries in the region, awareness and enforcement of IPR laws continue to be an area of complaint for many foreign companies, including and especially pharmaceutical companies, trying to do business in Egypt (USEBC 2011, US Dept of Commerce 2017).

4.2.2 Iraq

While Jordan, and many of the rest of the MENA countries, has followed the trend of increasing IPR protection, Iraq has followed a much different trajectory, with a drastic downturn in its protection of IPR since the early 2000s. Iraq and Jordan have much in common, including their historical timeline and culture, but they also differ quite substantially in terms of their resource endowments. Jordan's history has been much more stable than Iraqs. These economic differences may have driven institutional divergence that can be used as a framework with which to view this unexpected difference in IPR protection.

Between 1960 and 1995, Iraq had a noticeably higher IPR protection index than Jordan (on a scale from 0-5, Iraq averaged 2.3 from 1960-1995, whereas Jordan averaged just 1.6). However, beginning in 2000, when the US ramped up its interest in both countries, Iraq experienced a falling IPR protection level, from 2.12 to 1.78 in 2005 and continuing this trend through 2011, and Jordan experienced a rapid jump in IPR protection, from 1.08 to 3.43 in 2005. This divergence in trajectory for the two countries might be due to a number of different factors. The companies entering Iraq and the local Iraqi tribes might find it in their mutual best interest to arrange their own protection in contracts without the intervention of the government. Alternatively, it might be the case that the financial hurdle that must be overcome to enter into the oil market in Iraq is such that the companies do not face threats to their intellectual property and so do not demand a higher level of protection. The government of Iraq has also been very involved in the oil sector, and so unofficial arrangements with the government may trump official law in many cases. Finally, the war in Iraq certainly had a detrimental impact on the level of IPR protection and enforcement.

The current Iraqi constitution, put in place by the Coalition Provisional Authority in 2003, was constructed with little input from Iraqi law-makers. It aimed to mediate some of the sectarian violence predating the constitution by redistributing power, often towards the Shia and politically powerful Kurds. Clauses regarding the ownership of oil fields were vague, allowing Kurdistan additional power and providing an avenue for local leadership to operate independently of and often in direct opposition to the federal government. The IPR laws put in place by the Coalition Provisional Authority were designed to help bring Iraq into compliance with TRIPS and facilitate its bid for WTO membership. These laws have not been repealed, so, legally, foreigners are treated the same as Iraqi citizens in their business dealings and are allowed to file for IPR protection, a notable change from the law prior to 2003, which only offered protection to Iraqi citizens. However, these laws are not often utilized, with the preexisting laws being enforced more often than not. Historically, there has been an overall lack of respect for and confidence in the Iraqi laws on the part of the Iraqi populace due to their limited staying-power and to the speed with which they were dissolved by the US. For much of Iraq's recent history, laws were suspended due to states of emergency, so the population has been disenfranchised and retains little regard for legal statutes. Implementing Western politicized laws is unlikely to change behavior among

the population. In Iraq, the powerful players are not necessarily in the federal government. The government put in place by the US in the early 2000s has very little local legitimacy, and so companies wanting to enter into Iraq must court those with local power as well as federal power. While many in Iraq feel as if the federal government lacks some level of legitimacy, it is the federal government that enters into profit-sharing agreements with and awards no-bid contracts to oil companies. However, regional governments can enter into agreements with foreign entities, too, and these agreements are often seen as stronger than the federal ones (Al Dajani 2007, ITA 2015).

4.2.3 Lebanon

Surveys of individuals involved in law and business in Lebanon indicate that perceptions of IPR in Lebanon are favorable, especially among younger demographics. 95% of those surveyed believed that IPR protection was important for promoting investment in Lebanon, with higher agreement in the younger age brackets. However, a similarly high percentage, 97%, believe that knowledge of IPR laws in Lebanon is average or below average, with 45% believing that the population often or always resists enforcement of IPR laws. That being said, most respondents believed that IPR infringement leads to moderate to substantial economic losses. In general, respondents believed that government policies were slightly ineffective, and satisfaction with government policies is low. Finally, most respondents believed that implementing IPR laws with the purpose of facilitating WTO participation benefited Lebanon and other countries equally, that joining the WTO is important for Lebanons growth and development, and that improving IPR protection is essential for joining the WTO (CRI 2009).

As of today, Lebanon is not a member of the WTO. However, its IPR laws are generally consistent with TRIPS standards. Despite the adequacy of the laws, enforcement and understanding of the laws is poor, including and especially with regard to multimedia, software, and pharmaceuticals. Lebanon has spent considerable time on the US Trade Representative Priority Watch List (US Dept of Commerce 2017, Al Dajani 2007).

4.2.4 Morocco

Like many of the other countries in the region and developmentally similar countries throughout the world, Morocco's protection of IPR prior to 1995 was relatively low when

compared to that of more developed economies. However, with the passing of TRIPS in 1995, Morocco increased its standards, earlier than many of the other countries in the region. In June 2004, Morocco signed a Free Trade Agreement with the US. As part of this agreement, Morocco further increased its standards of protection, beyond that required by TRIPS. This increase in protection was encouraged by the US as a means of supporting economic development in Morocco. In Morocco, these increases were, at first, often seen as obligatory. However, many business and government leaders in Morocco now see the costs of increasing protection as transitory and worth the potential benefits that can accrue (Aloui 2009).

Despite the increasingly positive perception of IPR protection, enforcement of IPR standards in Morocco is poor and inconsistent. US pharmaceutical companies have been supportive of the increased laws in the pharmaceutical sector but remain concerned about the length of time it has taken to implement the new laws. US businesses also argue that the extent of coverage is not as complete as it could be. However, while foreign businesses frequently list IPR protection of an area of interest when deciding whether or not to invest in Morocco, they often list it as a secondary concern. The biggest complaint about the standards in Morocco is that enforcement is lax or inadequate. With a few exceptions, the extent of legal coverage appears to be suitable for most foreign businesses (UNICJRI 2014, US ITC 2004, Aloui 2007).

4.2.5 Syria

Various trade and other restrictions have been levied against Syria by the US and other countries since 1974. The US has had sanctions in place against Syria since 2004. These economic restrictions have prevented Syria from effectively using international trade as a development tool and have almost certainly contributed to the lack of IPR enforcement in the country. While US and EU firms are not prohibited from protecting and enforcing their IPR in Syria, they are required to abide by the constraints of the sanctions.

The level of protection in Syria has been and continues to be minimal. Between 2002 and 2011, Syria joined a series of international agreements and enacted a series of laws designed to improve protection, including ensuring protection for well-known trademarks and removing the requirement that firms boycott Israel. With the support of the UN Development Project, Syria became an observer in the World Intellectual Property Organization. However, despite

international support, Syria has not been able to develop its legal infrastructure such that it is able to enforce the new laws, and protection remains almost non-existent. In light of the recent sanctions and violence, improving IPR protection is a low priority for Syria today (US State Dept 2011, Balloch et al 2015).

4.2.6 Tunisia

As a member of the WTO, Tunisia signed TRIPS in 1995, though it has a signatory of a number of international IPR treaties as early as the Berne Convention in 1887, the Lisbon Agreement in 1958, and the Patent Cooperation Treaty in 1970 (UNICRI 2014). The Tunisian government has taken more active steps to increase protection since 2005, reflecting shifting opinions in the country with regard to IPR. Increasingly, as in other countries in the region, businesses and governmental agencies consider IPR more than a legal requirement of continued international participation; they are beginning to view it as an incentive to foster domestic innovation and economic development. As a result, there has been improvement in understanding and enforcement of the IPR laws (Abdel-Latif 2014).

In 2014, Tunisia adopted a new constitution. This new constitution explicitly guarantees the protection of intellectual property, reflecting the increasingly common belief in the country that doing so will foster innovation and development. While enforcement is still somewhat weak in comparison to that of more developed economies, it is notable in its improvement (Abdel-Latif 2014).

4.2.7 Yemen

Protection of IPR in Yemen is very weak. While it has acceded to a number of international treaties (the Paris Convention in 2006 and the Berne Convention in 2008), its existing laws and standards as of 2012 were not considered sufficient to be in compliance with TRIPS. Since 2012, Yemen has instituted additional changes and became a WTO, and thus TRIPS, signatory in 2014. However, the number of IPR cases heard by courts in Yemen is very low, and enforcement is poor and lagging (US Dept of State 2012).

Despite the few laws and poor enforcement, it appears that elements of the Yemeni government recognize improved protection of IPR as a worthwhile endeavor. Mahmoud

Al-Naqeeb, the 2016 Ministry Advisor of Intellectual Property and Consumer Protection Affairs, argued in a 2012 study that improved domestic protection of IPR would encourage innovation and production, and that this protection of ownership would lead to economic growth. He noted that Yemen's accession to international agreements would increase confidence among international investors. Finally, he stated that Yemen has a wealth of cultural knowledge, and protection of IPR was necessary not only for economic development, but also for social development (Al-Arashi 2012).

Yemen's recent and ongoing political instability has made questions of IPR protection of secondary importance, however.

4.3 Brief Economic Overview of Comparison Countries

Jordan has little in the way of natural resources, and is energy, food, and water poor. Its biggest imports are oil and petroleum, with sizable imports of grain. Its biggest exports are textiles, potash, and pharmaceuticals, among others. Services and tourism comprise the greatest component of its domestic economy, which is also marked by relatively large government expenditure and significant remittances. Despite 14% of the population living below the poverty rate and a Gini coefficient of 0.39, Jordan is regarded as having some of the least inequality in the region. Jordan is a small country of a little over 10 million people (including refugees), 84% of whom live in urban areas, and 17% of whom are unemployed (though unofficial estimates are much higher, at 30%).

Egypt is significantly larger than Jordan, with a little over 97 million people, 43% of whom live in urban areas and 95% of whom live within 20 kilometers of the Nile River, and an unemployment rate of 12%. Egypt is much better endowed with natural resources, and agriculture (in addition to hydrocarbons, tourism, and pharmaceuticals) is one of its main industries. Egypt's primary exports are crude oil and petroleum products, fruits and vegetables, and textiles. Its primary imports are machinery and foodstuffs. Poverty and unemployment have been major economic issues of late. Its inequality, as measured by a Gini coefficient of 0.30, is relatively low, however.

Iraq's recent history, like much of that of the rest of the region, has been defined by war.

Despite this, Iraq has ample petroleum and natural gas deposits and uses those deposits to its advantage, though this also means that it is subject to the volatility of the oil market. The Iraqi economy is primarily state-run, in contrast to the mostly market-driven economies of the rest of the comparison countries, and almost entirely dependent upon oil. The vast majority of its exports is crude oil. Its primary imports are food and medicine. Iraq has a population of a little over 39 million, 70% of whom live in urban areas and 16% of whom are unemployed.

Lebanon's history, while punctuated by periods of political turmoil, has been one of relative prosperity due to its position as a regional trading post on the Mediterranean Sea and financial center. Lebanon is small, with a population of a little more than 6 million, but it has natural resources, arable land, and easily accessible ports. 88% of the population lives in urban areas, many of whom live along the coast. The market economy is open to investment, though restricted by corruption. The main sectors include banking and tourism. Commodity exports include metals, chemicals, and fruit and vegetables. Commodity imports include petroleum products, cars, medicine, and textiles.

Morocco, while small in geographic size, has a population of just under 34 million, 61% of whom live in urban areas, with an unemployment rate of 9% and a Gini coefficient of 0.41. Like in Jordan, remittances are substantial. Agriculture, tourism, and textiles are among the most important sectors of the economy. Dominant exports include textiles, automobiles, petroleum products, and fruits and vegetables. Dominant imports include crude oil, textiles, and grains.

Syria's recent history has been marked by violence, and it is currently embroiled in a humanitarian crisis. Syria has a population of a little over 18 million, 59% of whom live in urban areas. Despite the economic turmoil resulting from its current crisis, Syria exports crude oil, minerals, and fruits and vegetables and imports machinery, foodstuffs, and chemicals.

Tunisia is a small country with a population of over 11 million, 67% of whom live in urban areas and 13% of whom are unemployed, with a Gini coefficient of 0.40. The economy is relatively diverse, with textiles, food products, and petroleum products the dominant exports and textiles and machinery the dominant imports.

Yemen has a population of a little more than 28 million, 36% of whom live in urban areas and 34% of whom are unemployed. Yemen is also experiencing a severe humanitarian crisis, limiting imports and damaging productive capacity. Oil and gas were essential components of the

Yemeni economy prior to the crisis, and still make up the largest portion of exports. Yemen's primary imports are food and live animals.

4.4 Relating the Jordanian Experience to the Model

The general model looks at the importance of the market structure, distribution of consumer incomes, and institutions in understanding incentives to increase or decrease the level of protection. It assumes a single foreign firm entering a market and either a single domestic firm or a competitive domestic fringe attempting to imitate that product. The quality of the imitated product is determined by the level of IPR protection. Consumers choose to purchase either the foreign or the domestic good (or, in the case of the single domestic firm, no good at all) depending upon their level of income. As the distribution of income changes, so do the relative sizes of the demands for the foreign and domestic goods. The government then balances the utilities earned by the consumers of the goods and the profits earned by the firms depending upon the institutions and preferences of the country. If the preference for domestic actors is sufficiently high, then the government will always choose the level of protection that most benefits them, pushing protection down towards its minimum. If the preference for foreign actors is sufficiently high, then the incentive to protect will be magnified, encouraging the government to push its level of protection upward.

The extension allows for the federal government and local governments to respond to slightly different incentives. The local governments balance the interests of the consumers and firms in their own localities. The federal government balances the interests of the local governments with its external obligations or interests. This allows for local deviation in the level of protection, limited by the amount of autonomy enjoyed by the local governments.

The incentives to increase (or decrease) protection as described by the model are most easily seen by looking at the Jordanian pharmaceuticals industry. Pharmaceuticals are sensitive to intellectual property, and the quality of pharmaceutical goods is differentiated by the ability of an imitating firm to effectively copy the good. Additionally, pharmaceuticals are one of Jordan's most important industries, and so the effect of changes in preferences will have a noticeable impact on the government's objective function. This is therefore a market in which the quality of goods is

vertically differentiated, a foreign firm is introducing a good with intellectual property, and domestic firms are imitating to the best of their abilities, limited by the level of IPR protection.

It should be noted that many of the foreign firms entering the market appear to be doing so in order to take advantage of the distributional networks maintained by the domestic firms rather than producing their proprietary goods in Jordan (Nesheiwat 2010). According to Amwal Invest (2010), 70% of sales in the pharmaceutical sector in Jordan are designated for export. As discussed in Chapter 3, this puts additional upward pressure on protection, beyond that called for by the domestic market, due to the interests of the foreign firm and the potential benefits, such as local employment, that come from foreign firms choosing to locate in Jordan. However, as domestic firms also export, this puts downward pressure on protection, as decreasing protection can have benefits for the domestic firms.

Much of Jordan's GDP is derived from remittances, often from oil-rich countries. These remittances are variable as they are linked to the health of the oil industry. Additionally, Jordan has no oil and very little in the way of other exportable resources of its own. The pharmaceutical industry is strong relative to both other domestic industries and pharmaceutical industries elsewhere in the region. Therefore, Jordan has put emphasis on it, and on other high-skill industries, in forming its development and growth policies.

Figure 4.3 shows Jordan's formal IPR protection (as described by the GP Index), and Figure 4.4 shows Jordan's de facto IPR protection (as described by the WEF measure of IPR) as compared to the group of comparison countries. Jordan is depicted in red while the other countries are depicted in blue. The depiction of formal protection clearly shows Jordan as the lowest protector prior to 2000. Beginning in 2000, however, Jordan swiftly adopts one of the highest levels of protection in the group, becoming, and remaining, the highest protector in 2008, both for formal and for de facto protection.

4.4.1 Market Structure

The pharmaceutical industry in Jordan consists of about a dozen firms, almost all of which are headquartered or fully located in the Amman governorate. Of these firms, very few, only two or three, have any capacity for research and development. Most of the companies in this sector produce generics. In the last few years, there has been some consolidation of the Jordanian

Figure 4.3: Formal IPR Protection in Comparison Countries

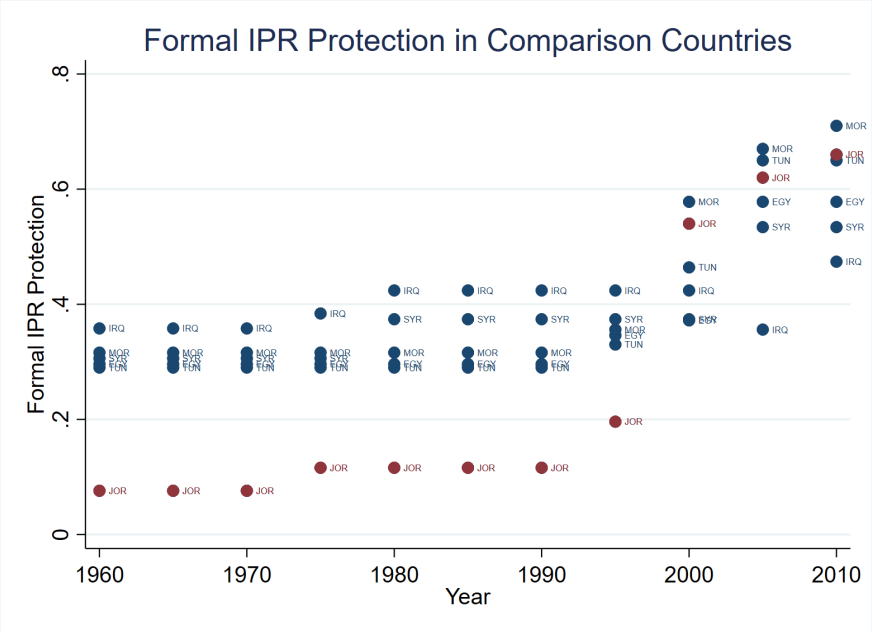


Figure 4.4: De Facto IPR Protection in Comparison Countries

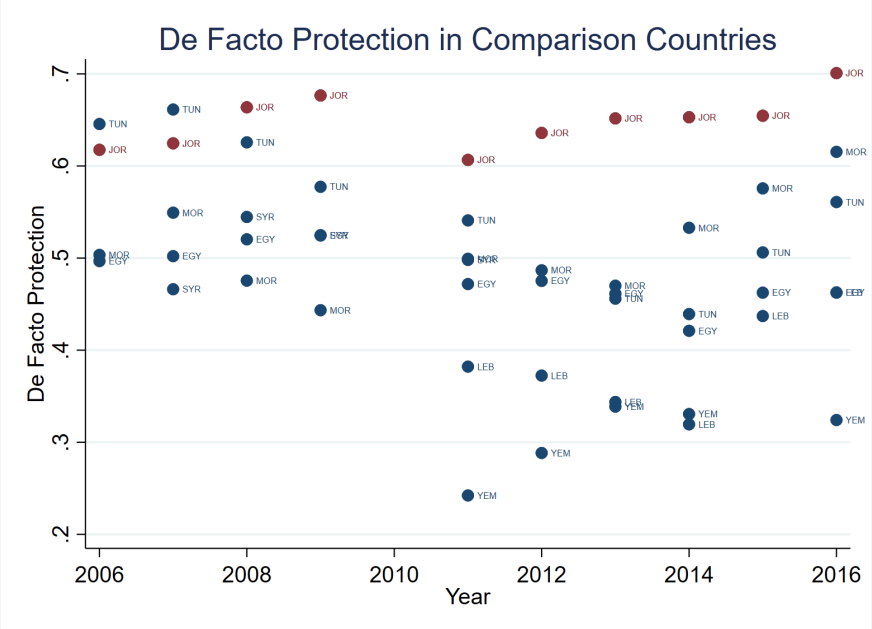
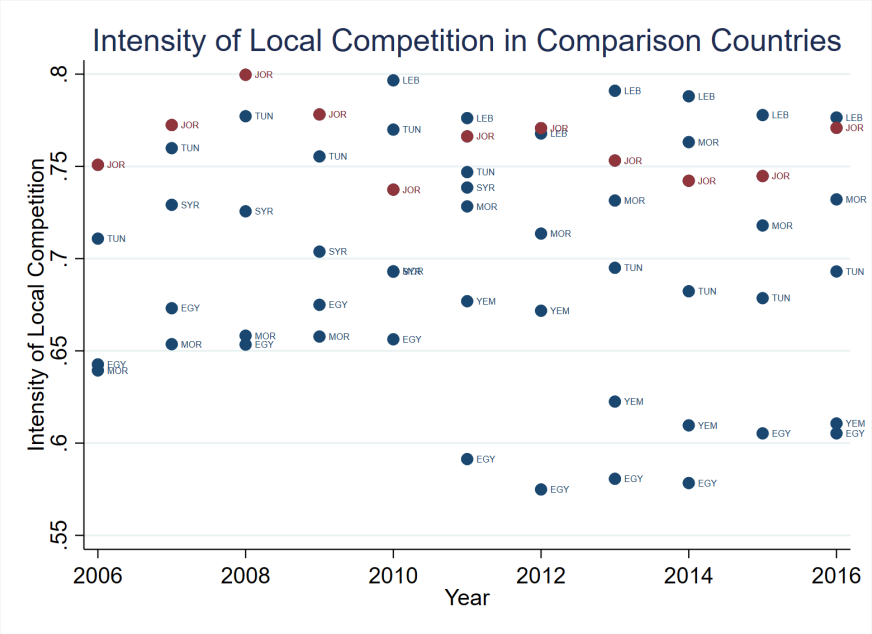


Figure 4.5: Intensity of Local Competition in Comparison Countries



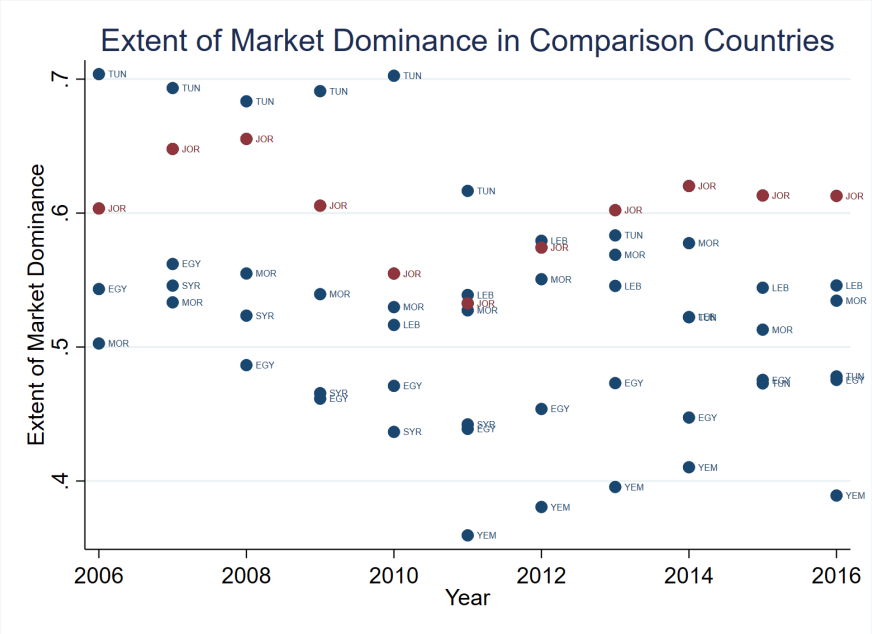
companies, reducing somewhat the number of companies operating in the sector. Still, the number of domestic firms suggests that the sector is most analogous to the model in which there is a competitive domestic fringe.

Survey measures from the World Economic Forum confirm that the case of Jordan is most analogous to a competitive domestic fringe over the time period covered by the de facto IPR protection. A higher score for the intensity of local competition represents an increased amount of competition. Similarly, higher scores for the extent of market dominance indicate more firms participating in a market. Jordan scores toward the top of the comparison countries in both these measures, indicating not only that it is best described as a competitive domestic fringe but also that this can partly explain its relatively low IPR protection, especially before 2000. This can be seen in Figures 4.5 and 4.6, in which Jordan is red and the comparison countries are blue.

In the case of a competitive domestic fringe, the domestic firms compete their prices down to marginal cost, yielding zero economic profits. As the type of the indifferent consumer is unchanging in protection, the demand for the foreign and domestic goods is unchanging in protection. Since the price of the domestic good is equal to the marginal cost, the domestic price is unchanging in protection.

An increase in IPR protection affects the government's objective function through three

Figure 4.6: Extent of Market Dominance in Comparison Countries



avenues: it decreases surplus from the consumption of the domestic good, it decreases surplus from the consumption of the foreign good, and it increases the profit of the foreign firm. Because the ability of domestic firms to imitate is decreasing in protection, as protection rises, the quality of the domestic good falls, decreasing surplus from the consumption of the domestic good. The price of the foreign good rises in protection, which transfers surplus from the consumers of the foreign good to the foreign firm.

The diminished consumer surplus from increased protection provides incentive for governments to reduce protection, whereas the increased foreign profit from increased protection provides incentive for governments to increase protection. The final decision will therefore depend upon the institutions, upon how much the government cares for the needs of the consumers traded-off with the needs of the foreign firm. Before 2000, the Jordanian government cared relatively less for the needs of the foreign firms, so the incentive to reduce protection coming from the consumers of both the foreign and domestic goods dominated the incentive to increase protection coming from the foreign firm. This helps to explain the low protection prior to 2000 - the Jordanian government was responding to the interests of the consumers made worse off by high protection. After 2000, the Jordanian government had increased preference for the foreign firms, and thus there was increased incentive to raise protection.

In the case of a single domestic firm, the domestic firm prices above marginal cost, and as a result, the market is not covered. A portion of consumers chooses not to purchase either the foreign or the domestic good. This both reduces the size of the demand for the domestic good and increases the profit of the domestic firm. As a result, the detrimental impact on consumers of the domestic good of an increase in protection is diminished. At the same time, for sufficiently low levels of protection, small increases in protection lead to increases in the foreign price, which allows the domestic firm to increase its price by a higher percent than its loss in consumers. This benefit accruing to the domestic firm puts upward pressure on the level of protection. For those comparison countries with more monopolized markets, this suggests that the level of protection should be higher than that in more competitive markets, especially if the overall level of protection is already relatively low.

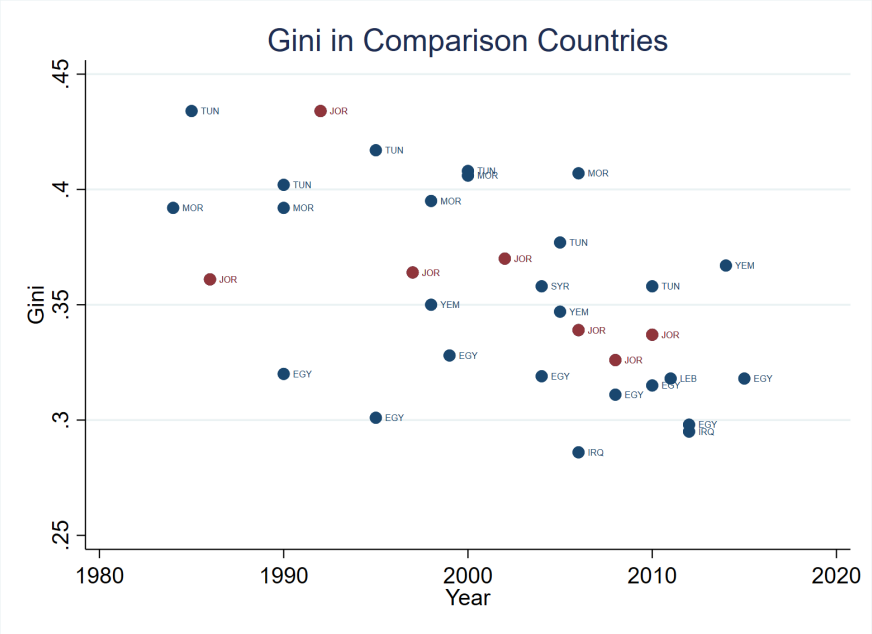
4.4.2 Distribution of Income

Though Jordan's Gini coefficient has vacillated somewhat over time, it tends to be low relative to international standards, indicative of relatively low income inequality. Compared to other countries in the region, Jordan has relatively similar consumption and living conditions across income brackets, and access to water and healthcare is relatively consistent (UNDP 2015). A measure of a Gini coefficient is not available for every year in the analysis, but using other qualitative descriptions, it would appear that Jordan has relatively low inequality when compared to other countries in the region, especially countries with oil or other exportable resources controlled by a small percentage of the population. Additionally, Jordan sees very little difference in inequality between urban and rural centers, and inequality when measured by consumption is lower than inequality when measured by income (UNDP 2015). All of this suggests that there is very little income-based difference in consumption patterns.

Figure 4.7 shows not only that Jordan's Gini coefficient has vacillated, but also that the Gini coefficients for the comparison countries have vacillated. It also shows the inconsistency with which Gini has been recorded for these countries. These two things together suggest that the Gini coefficient may not be the best measure of inequality for the region, despite its usefulness in measuring the shape of the income distribution.

In the model, inequality is described by a distribution of income, assumed to be Weibull. The

Figure 4.7: Gini in Comparison Countries



Weibull distribution can be used to obtain a Gini coefficient, but the impact of inequality is examined by changing its shape parameter. As the shape parameter increases, the distribution becomes increasingly concentrated about the mode, reducing the Gini coefficient (decreasing inequality).

In a competitive domestic fringe, as inequality falls, so too does the type of the indifferent consumer. This means that the size of the demand for the foreign good rises. It also puts downward pressure on the price of the foreign good. As a result, the size of the utility from the consumption of the foreign good rises. Because the type of the indifferent consumer falls and the market is assumed to be covered, the size of the demand for the domestic good falls. Therefore, the importance of the consumers of the domestic good in the government's objective function falls relative to that of the consumers of the foreign good.

Given this, as inequality decreases, an increase in protection will have a larger negative impact on consumer utility than it would under higher income inequality. The more equal the income distribution, therefore, the more substantial the incentive to keep protection low in the case of a competitive domestic fringe. In the case of Jordan, because it has relatively low inequality, there is much pressure to keep protection low. Prior to 2000, when there was less weight on the interests of the foreign firms, Jordan's regionally low level of protection reflected

this. After 2000, when there was much more weight placed on the foreign firms, there was an incentive to increase protection despite relatively large benefit to domestic consumers of low protection, reflected in the higher level of protection.

In the case of a single domestic firm, as inequality decreases, more of the market is covered, and more of the market consumes the foreign good. The price of both goods falls, but this fall in price and the increased portion of the market consuming the foreign good mean that the profit of the domestic firm also falls as inequality decreases. So when inequality is relatively low under a single domestic firm, consumer welfare from the consumption of both goods is somewhat larger, putting downward pressure on IPR protection, but the damage to the domestic firm of reducing protection is also larger, putting upward pressure on protection. When inequality is relatively high under a single domestic firm, the benefits to the domestic firm are more substantial and the costs to the consumers of the domestic good are less substantial, putting upward pressure on the level of protection.

4.4.3 Local Government

When the model is extended to local governments, it helps to explain some of the difference between formal protection and the reality of protection. In the extension with local governments, the local governments are responsive to consumers of the domestic and foreign goods, as in the base model. Unlike the base model, however, they do not trade off the well-being of foreign and domestic actors. Instead, they obtain some benefit from the foreign firm, which can be understood to be smaller than the size of the foreign profit, like taxes or a profit-sharing agreement, or larger than the size of the foreign profit, like benefit from improved infrastructure or employment. The local governments then choose their deviation from the federal standard based on these interests and their ability to deviate, which is limited by the level of autonomy. Local governments incur a cost for deviating downward.

The federal governments determine their standard by looking at the desired deviations of the localities and the benefit the federal government gets from the foreign firms. This can be perceived as taxes, profit-sharing agreements, or internationally-required standards. The interests of the localities are weighed based on preferences for each of the localities. The choice of federal standard is also impacted by the level of local autonomy. If local governments have no freedom to

deviate in their formation or enforcement of policies, then the federal government will choose the level of protection that minimizes the weighted average of deviations. If the local governments have complete autonomy, the federal government will choose a higher level of protection, influenced by its own interests and the ability of local governments to deviate optimally.

Jordan's governorates are governed by appointment, so there is little ability to deviate from the federal standard. However, its population is concentrated in the north, and governorates have very different dominant industries. The governorates of Irbid and Amman are arguably the most sensitive to issues of intellectual property. Irbid is home to qualified industrial zones, which receive preferential treatment in international trade to facilitate trade with Jordan. Amman's largest industries include medical tourism, commerce, and pharmaceuticals. The federal government is also seated in Amman. Many of the western and southern governorates are dominated by tourism and agriculture, neither of which is particularly sensitive to intellectual property. On the whole, Jordan's biggest industries are tourism, clothing, potash, and pharmaceuticals.

The relative lack of autonomy means that the federal standard more closely reflects the interests of the federal government vis-a-vis its international obligations and the interests of the localities with the largest concentration of people and IPR-sensitive industries. As a result, it is reasonable to expect that the needs of the firms in Amman have provided incentive to increase protection, with this incentive intensifying after 2000.

4.5 Conclusion

Jordan provides an interesting study of the incentives facing the government to either increase or decrease IPR protection. Prior to 2000, Jordan had one of the lowest levels of IPR protection in MENA and among countries with similar legal and religious institutions. Between 1995 and 2005, its level of protection jumped markedly. While all countries in the region that signed on to TRIPS had a similar jump in protection, Jordan's was notable in its size. Additionally, during this period, Jordan moved from one of the lowest protectors of IPR to one of the highest.

A model of incentives facing the government helps to answer three questions: 1) Why was Jordan's level of protection so low prior to 2000? 2) Why did Jordan's level of IPR protection jump so significantly in 2000? and 3) Why has Jordan's level of protection been so (relatively)

high since 2000? Jordan fits the version of the model with a competitive domestic fringe and has consistently low inequality, relative to the rest of the region. Prior to 2000, these two things, combined with relatively low emphasis placed on the interests of foreign firms help to explain why the pressure to reduce protection was so low. Between 1994 and 2000, the government actively changed its preferences toward the interests of foreign firms in order to encourage economic growth. This helps to explain why the jump in protection was so high - in addition to the necessary legal changes that accompany accession to WTO, Jordan placed increased weight on the foreign firms, increasing the incentive to protect. This persistent preference for the interests of foreign firms helps to explain why Jordan has remained one of the stronger protectors of IPR since 2000.

CHAPTER 5: CONCLUSION

This paper has laid out a model for understanding the incentives facing governments in determining their optimal levels of IPR protection. Understanding that international pressure and historical institutions play a dominant role in determining the level of IPR protection, this paper attempts to understand the importance of market structure, institutions, and the shape of the consumer income distribution.

The model introduced in this paper shows that, in the case of the competitive domestic fringe, higher levels of protection benefit only the foreign firm and hurt all consumers (the domestic firms are ultimately unaffected). In the case of a single domestic firm, higher levels of protection benefit the foreign firm and the consumers of the foreign good but hurt the consumers of the domestic good. Higher protection first benefits then hurts the domestic firm. The government then faces a trade-off between the domestic and foreign actors, and it chooses its level of protection based on this trade-off. As the distribution of income changes to become more unequal, that is, as there is increasing weight on the consumers of the poorest type, the model shows that the government faces increased downward pressure on the level of protection, all else equal.

Additionally, there appears to be some divergence between formal and de facto protection. One possible explanation for this divergence is the autonomy of local governments. While the federal government must take into account the interests of all its localities as well as its international obligations, local governments are better able to respond to the needs of their own citizens only. It may be the case, therefore, that some localities may prefer relatively high levels of protection while others prefer relatively low. If local authorities have sufficient autonomy to enforce IPR laws, then it may be the case that they diverge from the federal government standard, either above or below. The extension to the model demonstrates the impact that this has on the federally-chosen standard. As the level of autonomy increases, the federal government becomes more responsive to outside influences. With less autonomy, it chooses a standard that better minimizes the weighted average of the chosen deviations of the localities. As the norm in

developed economies is to protect, this extension paints a better picture of an avenue for explaining the divergence between formal and de facto protection in developing economies.

Finally, the pharmaceutical sector in Jordan provides a compelling case study for the model. Jordanian governorates have little real autonomy, so the federal government acts in lieu of the local governments, choosing a standard that balances the (weighted) interests of its localities and its international objectives. The drastic increase in protection around 2000 comes from a clear shift in priorities on the part of the government, analogous to the shift in weight from the domestic interests to the foreign interests in the model. The distribution of income and market structure help to explain why protection in Jordan was relatively low prior to 2000, and the persistent preference for foreign actors helps to explain why the protection has been so high after 2000. For a country with few other means of economic growth, IPR protection has been wielded as a tool for creating continued growth through policies designed to favor foreign companies, despite historical aversion to IPR protection.

The model in its current form is inherently simplistic in its conception of the choice of IPR protection. It is this way with the intention of highlighting the role of very specific influences on government behavior in order to better understand the incentives facing governments. In an international system pushing for homogenized and stringent IPR legislation, understanding these incentives can better help policymakers understand failure to adopt or enforce certain laws and pressures to relax IPR requirements.

APPENDIX A: EXPLANATION OF MODEL RESULTS

A.1 General Model

Consumers are distributed according to $h(x)$ along $[0, b]$, and the distribution of consumers is assumed to be log-concave. Assuming that the quality of the foreign good is determined exogenously and that the quality of the domestic good is determined by the level of IPR protection, α, the quality of the domestic good is given by $\mu^D = (1-\alpha)\mu^F$ and the indifferent consumer is given by:

$$\hat{x} = \frac{p^F - p^D}{\mu^F - \mu^D} = \frac{p^F - p^D}{\alpha\mu^F}$$

The functions $\lambda(\hat{x}) = \frac{1-H(\hat{x})}{h(\hat{x})}$ and $\Lambda(\hat{x}, x_L) = \frac{H(\hat{x})-H(x_L)}{(1-\alpha)h(\hat{x})+\alpha h(x_L)}$ will be suppressed to λ and Λ throughout the appendix for ease of reading.

A.1.1 Competitive Domestic Fringe

Levels

In the competitive domestic fringe, domestic firms compete prices down to marginal cost. Since marginal cost is assumed to be zero, $p^D = 0$. Therefore,

$$\hat{x} = \frac{p^F}{\alpha\mu^F}$$

and

$$\frac{d\hat{x}}{dp^F} = \frac{1}{\alpha\mu^F} > 0$$

The indifferent type, x_L is given by $x_L = \frac{p^D}{\mu^D} = \frac{0}{(1-\alpha)\mu^F} = 0$. The market is covered in the case of a competitive domestic fringe with marginal cost zero.

The demand for the foreign firm is $1 - H(\hat{x})$ and the demand for the domestic firm is $H(\hat{x})$.

The foreign firm solves:

$$\max_{p^F} \int_{\hat{x}}^{b} p^F h(x)dx = (1 - H(\hat{x}))p^F$$

$$0 = (1 - H(\hat{x})) + p^F(-h(\hat{x})\frac{d\hat{x}}{dp^F})$$

$$p^F = \frac{1 - H(\hat{x})}{h(\hat{x})}\alpha\mu^F = \alpha\mu^F\lambda$$

This gives $\hat{x} = \frac{p^F}{\alpha\mu^F} = \frac{\alpha\mu^F\lambda}{\alpha\mu^F} = \lambda$.

Following this, the profit of the domestic firm is $\pi^D = 0$ and the profit of the foreign firm is $\pi^F = \alpha\mu^F\lambda(1 - H(\hat{x}))$.

The consumer utility from the consumption of the domestic good is given by (using integration by parts):

$$CU^D = \int_0^{\hat{x}} (x\mu^D - p^D)h(x)dx = \int_0^{\hat{x}} (1-\alpha)\mu^F x h(x)dx$$

$$CU^D = (1-\alpha)\mu^F[\lambda H(\hat{x}) - \int_0^{\hat{x}} H(x)dx]$$

where the integral term is the expected type of the consumer given that the consumer purchases the domestic good. Consumer utility from the consumption of the domestic good must be greater than or equal to zero (otherwise the consumers would choose not to purchase), therefore, $\lambda H(\hat{x}) \geq \int_0^{\hat{x}} H(x)dx$.

The consumer utility from the consumption of the foreign good is given by (using integration by parts):

$$CU^F = \int_{\hat{x}}^b (x\mu^F - p^F)h(x)dx = \mu^F \int_{\hat{x}}^b xh(x)dx - p^F \int_{\hat{x}}^b h(x)dx$$

$$CU^F = \mu^F[b - \lambda H(\hat{x}) - \int_{\hat{x}}^b H(x)dx] - p^F(1 - H(\hat{x}))$$

$$CU^F = \mu^F[\int_0^{\hat{x}} 1dx - \hat{x}H(\hat{x}) + \int_{\hat{x}}^b (1 - H(x))dx] - \alpha\mu^F\lambda(1 - H(\hat{x}))$$

$$CU^F = \mu^F[(1-\alpha)\lambda(1 - H(\hat{x})) + \int_{\hat{x}}^b (1 - H(x))dx]$$

where the integral term is the expected type of the consumer given that the consumer purchases the foreign good.

Comparative Statics

Given that $\lambda(x) = \frac{1-H(x)}{h(x)}$ and that, for log-concave functions, $f(x)f"(x) - (f'(x))^2 \leq 0$:

$$\frac{d\lambda(x)}{dx} = \frac{-h(x)h(x) - (1-H(x))h'(x)}{(h(x))^2} = \frac{H(x)h'(x) - (h(x))^2 - h'(x)}{(h(x))^2} < 0$$

Given this,

$$\frac{\partial \hat{x}}{\partial \alpha} = \frac{d\lambda}{d\hat{x}}\frac{\partial \hat{x}}{\partial \alpha}$$

and so $\frac{\partial \hat{x}}{\partial \alpha} = 0$ and $\frac{\partial \lambda}{\partial \alpha} = 0$.

The sizes of the demands for the foreign and domestic goods are unchanging in protection:

$$\frac{\partial(1 - H(\hat{x}))}{\partial \alpha} = -h(\hat{x})\frac{\partial \hat{x}}{\partial \alpha} = 0$$

$$\frac{\partial H(\hat{x})}{\partial \alpha} = h(\hat{x})\frac{\partial \hat{x}}{\partial \alpha} = 0$$

The foreign price is increasing in protection, and so the foreign profit is also increasing in protection:

$$\frac{dp^F}{d\alpha} = \mu^F\lambda + \alpha\mu^F\frac{\partial \lambda}{\partial \alpha} = \mu^F\lambda > 0$$

$$\frac{\partial \pi^F}{\partial \alpha} = \alpha\mu^F\lambda(-h(\hat{x})\frac{\partial \hat{x}}{\partial \alpha}) + \mu^F(1 - H(\hat{x}))[\lambda + \alpha\frac{\partial \lambda}{\partial \alpha}] = \mu^F\lambda(1 - H(\hat{x})) > 0$$

Intuitively, the utility from the consumption of the domestic good should not vary with protection, as the neither the domestic demand nor the domestic price varies with protection. This then refines the condition from earlier, $\frac{\partial CU^D}{\partial \alpha} = 0$, and requires that the two terms be equal: $\lambda H(\hat{x}) = \int_0^{\hat{x}} H(x)dx$.

$$\frac{\partial CU^D}{\partial \alpha} = 0 = -\mu^F(\lambda H(\hat{x}) - \int_0^{\hat{x}} H(x)dx) + (1-\alpha)\mu^F(\frac{\partial \lambda}{\partial \alpha}H(\hat{x}) + \lambda h(\hat{x})\frac{\partial \hat{x}}{\partial \alpha} - H(\hat{x})\frac{\partial \hat{x}}{\partial \alpha})$$

$$\frac{\partial CU^D}{\partial \alpha} = 0 = -\mu^F(\lambda H(\hat{x}) - \int_0^{\hat{x}} H(x)dx)$$

Therefore, $\lambda H(\hat{x}) = \int_0^{\hat{x}} H(x)dx$.

Intuitively, the utility from the consumption of the foreign good should fall by the same

amount as the profit of the foreign firm rises when the level of protection changes:

$$\frac{\partial CU^F}{\partial \alpha} = \mu^F[-\lambda(1-H(\hat{x})) + (1-\alpha)(\frac{\partial \lambda}{\partial \alpha}(1-H(\hat{x})) - \lambda h(\hat{x})\frac{\partial \hat{x}}{\partial \alpha}) - (1-H(\hat{x}))\frac{\partial \hat{x}}{\partial \alpha}]$$

$$\frac{\partial CU^F}{\partial \alpha} = -\mu\lambda(1-H(\hat{x})) < 0$$

The government's optimal choice of protection therefore depends wholly upon the institutions:

$$\frac{\partial G}{\partial \alpha} = \rho[\frac{\partial CU^D}{\partial \alpha} + \frac{\partial CU^F}{\partial \alpha} + \frac{\partial \pi^D}{\partial \alpha}] + (1-\rho)[\frac{\partial \pi^F}{\partial \alpha}]$$

$$\frac{\partial G}{\partial \alpha} = \rho(-\mu^F\lambda(1-H(\hat{x}))) + (1-\rho)\mu^F\lambda(1-H(\hat{x})) = (1-2\rho)\mu^F\lambda(1-H(\hat{x}))$$

Therefore, if $\rho > \frac{1}{2}$, the government will choose a complete *lack* of protection of IPR, and, for $\rho < \frac{1}{2}$, the government will choose to protect IPR completely.

A.1.2 Single Domestic Firm

Levels

In the case of the duopoly, both the foreign and domestic firms choose their prices, and the domestic firm chooses its quality. The quality of the foreign good is taken to be exogenous. As before, the indifferent consumer is given by $\hat{x} = \frac{p^F - p^D}{\mu^F - \mu^D}$ and the low-type consumer is given by $x_L = \frac{p^D}{\mu^D} \geq 0$. The timing is as follows: the government chooses the level of protection, the foreign firm chooses its price taking its quality as exogenous, the domestic firm chooses its price and quality, and then consumers choose to purchase the foreign good, the domestic good, or neither good.

The domestic firm takes p^F, μ^F, and α as given and chooses p^D and μ^D:

$$\max_{p^D, \mu^D} \int_{x_L}^{\hat{x}} p^D h(x)dx \;\; st \;\; \mu^D \leq (1-\alpha)\mu^F$$

$$0 = (H(\hat{x}) - H(x_L)) + p^D(h(\hat{x})(\frac{-1}{\mu^F - \mu^D}) - h(x_L)(\frac{1}{\mu^D}))$$

$$0 = p^D(h(\hat{x})(\frac{p^F - p^D}{(\mu^F - \mu^D)^2}) - h(x_L)(\frac{-p^D}{(\mu^D)^2})) + \gamma$$

$$0 \geq \mu^D - (1-\alpha)\mu^F$$

If the constraint does not bind, then $\gamma = 0$. For this to be true, either $p^D = 0$ or

$$h(\hat{x})(\frac{p^F - p^D}{(\mu^F - \mu^D)^2}) = -h(x_L)(\frac{-p^D}{(\mu^D)^2})$$

If $p^D = 0$, then it must be true that, from the first of the first order conditions, $H(\hat{x}) = H(x_L)$, which would require that $\hat{x} = x_L$, meaning only one firm would participate in the market. The second option is impossible - both $h(\hat{x})$ and $h(x_L)$ must be positive, the second term on the right hand side must be positive if $p^D \neq 0$, and the second term on the left hand side must be positive or zero. Therefore, in order to have two firms in the market, it must be assumed that the constraint must bind and $\mu^D = (1-\alpha)\mu^F$.

Assuming that the constraint binds and that two firms participate in the market,

$$p^D = \frac{H(\hat{x}) - H(x_L)}{(1-\alpha)h(\hat{x}) + \alpha h(x_L)}\alpha(1-\alpha)\mu^F = \alpha(1-\alpha)\mu^F\Lambda$$

The foreign firm solves:

$$\max_{p^F} \int_{\hat{x}}^{b} p^F h(x)dx$$

$$0 = (1 - H(\hat{x})) + p^F(-h(\hat{x})\frac{1}{\mu^F - (1-\alpha)\mu^F})$$

$$p^F = \frac{1 - H(\hat{x})}{h(\hat{x})}\alpha\mu^F = \alpha\mu^F\lambda$$

The indifferent consumer can therefore be characterized as $\hat{x} = \lambda - (1-\alpha)\Lambda$ and the low-type consumer can be characterized as $x_L = \alpha\Lambda$. The indifferent consumer is of a higher type than the low-type consumer, so $\hat{x} > x_L$ and therefore $\lambda > \Lambda$. This also means that $H(\hat{x}) > H(x_L)$, so $\Lambda > 0$, and the market is not covered.

The demand for the foreign good is given by $1 - H(\hat{x})$ and the demand for the domestic good is given by $H(\hat{x}) - H(x_L)$. The profit earned by the foreign firm is therefore $\pi^F = \alpha\mu^F\lambda(1 - H(\hat{x}))$ and the profit earned by the domestic firm is $\pi^D = \alpha(1-\alpha)\mu^F\Lambda(H(\hat{x}) - H(x_L))$.

The consumer utility from the consumption of the foreign good is given by (using integration

by parts, as before):

$$CU^F = \int_{\hat{x}}^{b} (x\mu^F - p^F)h(x)dx = \mu^F[(1-\alpha)(\lambda-\Lambda)(1-H(\hat{x})) + \int_{\hat{x}}^{b}(1-H(x))dx]$$

The consumer utility from the consumption of the domestic good is given by (using integration by parts, as before):

$$CU^D = \int_{x_L}^{\hat{x}} (x\mu^D - p^D)h(x)dx = (1-\alpha)\mu^F[(\lambda-\Lambda)H(\hat{x}) - \int_{x_L}^{\hat{x}} H(x)dx]$$

where the integral terms are the expected types of the consumers purchasing the good.

Comparative Statics

Gaussian elimination was used to solve for $\frac{\partial \hat{x}}{\partial \alpha}$, $\frac{\partial x_L}{\partial \alpha}$, $\frac{\partial \lambda}{\partial \alpha}$, and $\frac{\partial \Lambda}{\partial \alpha}$. The four equations used were:

$$(1)\ \frac{\partial \hat{x}}{\partial \alpha} = \frac{\partial \lambda}{\partial \alpha} + \Lambda - (1-\alpha)\frac{\partial \Lambda}{\partial \alpha} \rightarrow \frac{\partial \hat{x}}{\partial \alpha} - \frac{\partial \lambda}{\partial \alpha} + (1-\alpha)\frac{\partial \Lambda}{\partial \alpha} = \Lambda$$

$$(2)\ \frac{\partial x_L}{\partial \alpha} = \Lambda + \alpha\frac{\partial \Lambda}{\partial \alpha} \rightarrow \frac{\partial x_L}{\partial \alpha} - \alpha\frac{\partial \Lambda}{\partial \alpha} = \Lambda$$

$$(3)\ \frac{\partial \lambda}{\partial \alpha} = A\frac{\partial \hat{x}}{\partial \alpha} \rightarrow -A\frac{\partial \hat{x}}{\partial \alpha} + \frac{\partial \lambda}{\partial \alpha} = 0$$

$$(4)\ \frac{\partial \Lambda}{\partial \alpha} = \frac{1}{D^2}[N + B\frac{\partial \hat{x}}{\partial \alpha} + C\frac{\partial x_L}{\partial \alpha}] \rightarrow -B\frac{\partial \hat{x}}{\partial \alpha} - C\frac{\partial x_L}{\partial \alpha} + D^2\frac{\partial \Lambda}{\partial \alpha} = N$$

where

$$A = \frac{H(\hat{x})h'(\hat{x}) - (h(\hat{x}))^2 - 1}{(h(\hat{x}))^2}$$

$$D = (1-\alpha)h(\hat{x}) + \alpha h(x_L)$$

$$N = [H(\hat{x}) - H(x_L)][h(\hat{x}) - h(x_L)]$$

$$B = (1-\alpha)((h(\hat{x}))^2 - H(\hat{x})h'(\hat{x})) + (1-\alpha)H(x_L)h'(\hat{x}) + \alpha h(\hat{x})h(x_L)$$

$$C = \alpha(H(\hat{x})h'(\hat{x}) - (h(x_L))^2) - \alpha H(\hat{x})h'(x_L) - (1-\alpha)h(\hat{x})h(x_L)$$

Gaussian elimination yielded either $A = \frac{A}{1-A}$ or $\frac{\partial \hat{x}}{\partial \alpha} = \frac{\partial \lambda}{\partial \alpha} = 0$. Since $A \neq 0$, the latter must be true. This gives:

$$\frac{\partial \hat{x}}{\partial \alpha} = 0$$

$$\frac{\partial \lambda}{\partial \alpha} = 0$$

$$\frac{\partial x_L}{\partial \alpha} = \frac{\Lambda}{1-\alpha} > 0$$

$$\frac{\partial \Lambda}{\partial \alpha} = \frac{\Lambda}{1-\alpha} > 0$$

From here, it can be seen that the size of the demand for the foreign good does not change in protection:

$$\frac{\partial (1 - H(\hat{x}))}{\partial \alpha} = -h(\hat{x})\frac{\partial \hat{x}}{\partial \alpha} = 0$$

and that the size of the demand for the domestic good is falling in protection:

$$\frac{\partial (H(\hat{x}) - H(x_L))}{\partial \alpha} = h(\hat{x})\frac{\partial \hat{x}}{\partial \alpha} - h(x_L)\frac{\partial x_L}{\partial \alpha} = -h(x_L)\frac{\Lambda}{1-\alpha} < 0$$

Both prices are rising in protection:

$$\frac{\partial p^F}{\partial \alpha} = \mu^F \lambda + \alpha \mu^F \frac{\partial \lambda}{\partial \alpha} = \mu^F \lambda > 0$$

$$\frac{\partial p^D}{\partial \alpha} = (1-2\alpha)\mu^\Lambda + \alpha(1-\alpha)\mu^F \frac{\partial \Lambda}{\partial \alpha} = (1-\alpha)\mu^F \Lambda > 0$$

Foreign profit is, predictably, rising in protection, and the utility from the consumption of the foreign good is falling. These two changes directly offset each other, as in the case of the competitive domestic fringe:

$$\frac{\partial \pi^F}{\partial \alpha} = \mu^F[(\lambda + \alpha\frac{\partial \lambda}{\partial \alpha})(1 - H(\hat{x})) - \alpha\lambda h(\hat{x})\frac{\partial \hat{x}}{\partial \alpha}] = \mu^F \lambda(1 - H(\hat{x})) > 0$$

$$\frac{\partial CU^F}{\partial \alpha} = \mu^F[(1-H(\hat{x}))(-(\lambda-\Lambda)+(1-\alpha)(\frac{\partial \lambda}{\partial \alpha} - \frac{\partial \Lambda}{\partial \alpha})) + (1-\alpha)(\lambda-\Lambda)(-h(\hat{x})\frac{\partial \hat{x}}{\partial \alpha}) - (1-H(\hat{x}))\frac{\partial \hat{x}}{\partial \alpha}]$$

$$\frac{\partial CU^F}{\partial \alpha} = -\mu^F \lambda(1 - H(\hat{x})) < 0$$

Domestic profit is first increasing then decreasing in protection:

$$\frac{\partial \pi^D}{\partial \alpha} = \alpha(1-\alpha)\mu\Lambda(h(\hat{x})\frac{\partial \hat{x}}{\partial \alpha} - h(x_L)\frac{\partial x_L}{\partial \alpha}) + (1-\alpha)\mu^F\Lambda(H(\hat{x}) - H(x_L))$$

$$\frac{\partial \pi^D}{\partial \alpha} = \mu^F\Lambda[-\alpha\Lambda h(x_L) + (1-\alpha)(H(\hat{x}) - H(x_L))]$$

Intuitively, the utility from the consumption of the domestic good is falling in protection, as the domestic price is rising, the quality of the domestic good is falling, and the demand for the domestic good is falling. The impact on the utility from the consumption of the domestic good of an increase in protection is given by:

$$\frac{\partial CU^D}{\partial \alpha} = \mu^F[-((\lambda-\Lambda)H(\hat{x}) - \int_{x_L}^{\hat{x}} H(x)dx) + (1-\alpha)((\frac{\partial \lambda}{\partial \alpha} - \frac{\partial \Lambda}{\partial \alpha})H(\hat{x}) + (\lambda-\Lambda)h(\hat{x})\frac{\partial \hat{x}}{\partial \alpha} - H(x_L)(\frac{\partial \hat{x}}{\partial \alpha} - \frac{\partial x_L}{\partial \alpha}))]$$

$$\frac{\partial CU^D}{\partial \alpha} = \mu^F[-\lambda H(\hat{x}) + \Lambda H(x_L) + \int_{x_L}^{\hat{x}} H(x)dx)] < 0$$

Since $H(\hat{x}) > H(x_L)$ and $\lambda > \Lambda$, $-\lambda H(\hat{x}) + \Lambda H(x_L) < 0$. By the intuition, therefore, $\lambda H(\hat{x}) > \Lambda H(x_L) + \int_{x_L}^{\hat{x}} H(x)dx$.

The government's optimal choice of protection is found by setting the following to zero:

$$\frac{\partial G}{\partial \alpha} = \rho[\frac{\partial CU^D}{\partial \alpha} + \frac{\partial CU^F}{\partial \alpha} + \frac{\partial \pi^D}{\partial \alpha}] + (1-\rho)[\frac{\partial \pi^F}{\partial \alpha}]$$

$$\frac{\partial G}{\partial \alpha} = \rho\mu^F[-\lambda + \Lambda H(x_L) + \int_{x_L}^{\hat{x}} H(x)dx + \Lambda((1-\alpha)(H(\hat{x}) - H(x_L)) - \alpha\Lambda h(x_L))] + (1-\rho)\mu^F\lambda(1-H(\hat{x}))$$

A.2 Application: Triangular Distribution

The PDF and CDF for the triangular distribution are:

$$h(x) = \frac{2}{b^2}(1-c)x + \frac{c}{b}$$

$$H(x) = \frac{1}{b^2}(1-c)x^2 + \frac{c}{b}x$$

for which the support is $[0, b]$. The parameter $c \in (1, 2]$ controls the slope, with $c = 1$ representing a uniform distribution.

A.2.1 Competitive Domestic Fringe

Indifferent type, $\hat{x}$, and its comparative statics:

$$\hat{x} = \lambda = \frac{1 - H(\hat{x})}{h(\hat{x})}$$

$$\hat{x} = \frac{1 - \frac{1}{b^2}(1-c)\hat{x}^2 - \frac{c}{b}\hat{x}}{\frac{2}{b^2}(1-c)\hat{x} + \frac{c}{b}}$$

$$\hat{x} = \frac{-bc \pm b\sqrt{c^2 + 3 - 3c}}{3(1-c)}$$

On the domain of c, $c \in (1, 2]$, the radical term is always positive. The radical term is maximized at $c = 2$ and minimized at $c = \frac{3}{2}$. Since b is analogous to the highest-type consumer, it must be the case that $\hat{x} < b$. Therefore, it is enough to test $c = \frac{3}{2}$ and $c = 2$ to find the sign preceding the radical term. For both $c = \frac{3}{2}$ and $c = 2$, adding the radical term gave $\hat{x} > b$. Therefore, the radical term must be subtracted. Therefore:

$$\hat{x} = \frac{b}{3(c-1)}(c - \sqrt{c^2 + 3 - 3c})$$

To see how the type of the indifferent consumer changes with c, the same trick can be used.

$$\frac{\partial \hat{x}}{\partial c} = \frac{\partial \lambda}{\partial c} = \frac{b}{3(c-1)}[\frac{c - \sqrt{c^2 + 3 - 3c}}{1-c} + 1 - \frac{2c-3}{2\sqrt{c^2 + 3 - 3c}}]$$

At $c = \frac{3}{2}$, $\frac{\partial \hat{x}}{\partial c} < 0$. At $c = 2$, $\frac{\partial \hat{x}}{\partial c} < 0$. As c increases from 1 to 2, $\frac{\partial \hat{x}}{\partial c}$ first decreases then increases but is always negative.

$$\frac{\partial \hat{x}}{\partial b} > 0$$

Foreign and domestic demands, $1 - H(\hat{x})$ and $H(\hat{x})$, comparative statics:

$$\frac{\partial (1 - H(\hat{x}))}{\partial c} = -h(\hat{x})\frac{\partial \hat{x}}{\partial c} > 0$$

$$\frac{\partial (1 - H(\hat{x}))}{\partial b} = -h(\hat{x})\frac{\partial \hat{x}}{\partial b} < 0$$

$$\frac{\partial H(\hat{x})}{\partial c} = h(\hat{x})\frac{\partial \hat{x}}{\partial c} < 0$$

$$\frac{\partial H(\hat{x})}{\partial b} = h(\hat{x})\frac{\partial \hat{x}}{\partial b} > 0$$

Foreign and domestic prices, p^F and p^D, comparative statics:

$$\frac{\partial p^F}{\partial c} = \alpha \mu^F \frac{\partial \lambda}{\partial c} < 0$$

$$\frac{\partial p^F}{\partial b} = \alpha \mu^F \frac{\partial \lambda}{\partial b} > 0$$

$$p^D = 0$$

Foreign and domestic profits, π^F and π^D, and comparative statics:

$$\pi^F = \alpha \mu^F (1 - H(\hat{x}))$$

$$\pi^F = \alpha \mu^F \frac{b(c - \sqrt{c^2 + 3 - 3c})}{27(c-1)^2}(-c^2 + 6c - 6 + c\sqrt{c^2 + 3 - 3c})$$

$$\frac{\partial \pi^F}{\partial c} < 0$$

$$\frac{\partial \pi^F}{\partial b} > 0$$

$$\pi^D = 0$$

Consumer utility from the consumption of the foreign and domestic goods, CU^F and CU^D, comparative statics:

$$\frac{\partial CU^F}{\partial c} = (1-\alpha)\mu^F[\lambda \frac{\partial (1 - H(\hat{x}))}{\partial c} + (1 - H(\hat{x}))\frac{\partial \lambda}{\partial c}] - \mu^F(1 - H(\hat{x}))\frac{\partial \lambda}{\partial c} > 0$$

$$\frac{\partial CU^F}{\partial b} < 0$$

$$\frac{\partial CU^D}{\partial c} = (1-\alpha)\mu^F[\lambda h(\hat{x})\frac{\partial \hat{x}}{\partial c} - H(\hat{x})\frac{\partial \hat{x}}{\partial c} + H(\hat{x})\frac{\partial \lambda}{\partial c}] < 0$$

$$\frac{\partial CU^D}{\partial b} > 0$$

The government objective function comparative statics:

$$\frac{\partial G}{\partial c} = -\alpha\mu^F\rho(1 - H(\hat{x}))\frac{\partial \hat{x}}{\partial c} > 0$$

$$\frac{\partial G}{\partial b} = -\alpha\mu^F\rho(1 - H(\hat{x}))\frac{\partial \hat{x}}{\partial b} < 0$$

$$\frac{\partial^2 G}{\partial \alpha \partial c} = -\mu^F\rho(1 - H(\hat{x}))\frac{\partial \hat{x}}{\partial c} > 0$$

$$\frac{\partial^2 G}{\partial \alpha \partial b} = -\mu^F\rho(1 - H(\hat{x}))\frac{\partial \hat{x}}{\partial b} < 0$$

A.3 Application: Weibull Distribution

The PDF and CDF for the Weibull distribution are:

$$h(x) = \frac{c}{b}(\frac{x}{b})^{c-1}\exp[-(\frac{x}{b})^c]$$

$$H(x) = 1 - \exp[-(\frac{x}{b})^c]$$

for $x \geq 0$. The parameter $b \in (0, \infty)$ controls the scale, and the parameter $c \in (0, \infty)$ controls the shape. The PDF of the Weibull distribution is only log-concave for $c \geq 1$; however, the CDF is log-concave for all c, so the Weibull distribution can be used.

Since the estimate of c for most countries is below Euler's constant, comparative statics will assume that c is below Euler's constant.

A.3.1 Competitive Domestic Fringe

Indifferent type, $\hat{x}$, and its comparative statics:

$$\hat{x} = \lambda = \frac{1 - H(\hat{x})}{h(\hat{x})} = \frac{\exp[-(\frac{\hat{x}}{b})^c]}{\frac{c}{b}(\frac{\hat{x}}{b})^{c-1}\exp[-(\frac{\hat{x}}{b})^c]} = \frac{b}{c}(\frac{\hat{x}}{b})^{1-c}$$

$$\hat{x} = \frac{b^c}{c}\hat{x}^{1-c} \rightarrow \hat{x} = \frac{b}{c^{\frac{1}{c}}} = \lambda$$

$$\frac{\partial \hat{x}}{\partial c} = bc^{-\frac{1}{c}-2}(\ln c - 1) < 0 \text{ for } c < e$$

$$\frac{\partial \hat{x}}{\partial b} = (\frac{1}{c})^{\frac{1}{c}} > 0$$

Foreign demand, $1 - H(\hat{x})$, and its comparative statics:

$$1 - H(\hat{x}) = \exp[-(\frac{\hat{x}}{b})^c] = \exp[-\frac{1}{c}]$$

$$\frac{\partial(1 - H(\hat{x}))}{\partial c} = \frac{1}{c^2}\exp[-\frac{1}{c}] > 0$$

$$\frac{\partial(1 - H(\hat{x}))}{\partial b} = 0$$

Domestic demand, $H(\hat{x})$, and its comparative statics:

$$H(\hat{x}) = 1 - \exp[-(\frac{\hat{x}}{b})^c] = -\exp[-\frac{1}{c}]$$

$$\frac{\partial H(\hat{x})}{\partial c} = -\frac{1}{c^2}\exp[-\frac{1}{c}] < 0$$

$$\frac{\partial H(\hat{x})}{\partial b} = 0$$

Foreign and domestic prices, p^F and p^D, and their comparative statics:

$$p^F = \alpha\mu^F\lambda = \alpha\mu^F bc^{-frac1c}$$

$$\frac{\partial p^F}{\partial c} = \alpha\mu^F bc^{-\frac{1}{c}-2}(\ln c - 1) \text{ for } c < e$$

$$\frac{\partial p^F}{\partial b} = \alpha\mu^F c^{-\frac{1}{c}} > 0$$

$$p^D = 0$$

Foreign and domestic profits, π^F and π^D, and their comparative statics:

$$\pi^F = \alpha\mu^F\lambda(1 - H(\hat{x})) = \alpha\mu^F b(\frac{1}{c})^{\frac{1}{c}}\exp[-\frac{1}{c}]$$

$$\frac{\partial \pi^F}{\partial c} = \alpha\mu^F bc^{-\frac{1}{c}-2}\exp[-\frac{1}{c}]\ln c < 0 \text{ for } c < e$$

$$\frac{\partial \pi^F}{\partial b} = \alpha\mu^F(\frac{1}{c})^{\frac{1}{c}}\exp[-\frac{1}{c}] > 0$$

$$\pi^D = 0$$

Utility from the consumption of the foreign good, CU^F, and its comparative statics (t represents the top type consumer):

$$CU^F = \mu^F[(1-\alpha)\lambda(1-H(\hat{x})) + \int_{\hat{x}}^{t}(1-H(x))dx]$$

$$CU^F = \mu^F[(1-\alpha)b(\frac{1}{c})^{\frac{1}{c}}\exp[-\frac{1}{c}] + \int_{\hat{x}}^{t}\exp[-(\frac{x}{b})^c]dx]$$

$$\frac{\partial CU^F}{\partial c} = \mu^F bc^{-\frac{1}{c}-2}\exp[-\frac{1}{c}](1-\alpha\ln c) > 0 \text{ for } c < e$$

$$\frac{\partial CU^F}{\partial b} = -\alpha\mu^F(\frac{1}{c})^{\frac{1}{c}}\exp[-\frac{1}{c}] < 0$$

Utility from the consumption of the domestic good, CU^D, and its comparative statics:

$$CU^D = (1-\alpha)\mu^F[\lambda H(\hat{x}) - \int_0^{\hat{x}} H(x)dx]$$

$$CU^D = (1-\alpha)\mu^F[b(\frac{1}{c})^{\frac{1}{c}}(1-\exp[-\frac{1}{c}]) - \int_0^{\hat{x}}(1-exp[-(\frac{x}{b})^c])dx]$$

$$\frac{\partial CU^D}{\partial c} = -(1-\alpha)\mu^F bc^{-\frac{1}{c}-2}\exp[-\frac{1}{c}] < 0$$

$$\frac{\partial CU^D}{\partial b} = 0$$

The impact on the government objective function of an increase in c (assuming $c < e$) depends on institutions:

$$\frac{\partial G}{\partial c} = \alpha\mu^F bc^{-\frac{1}{c}-2}\exp[-\frac{1}{c}](\rho(1-\ln c) + (1-\rho)\ln c)$$

For $\frac{\rho}{1-\rho} > \frac{-\ln c}{1-\ln c}$, the government objective function is increasing in c, and vice versa. The optimal choice of protection follows a similar pattern: for $\frac{\rho}{1-\rho} > \frac{-\ln c}{1-\ln c}$, the incentive to protect is increasing in c, and vice versa.

The impact on the government objective function of an increase in b is similarly dependent upon institutions, but the relationship is more straightforward as only the consumer utility from

the consumption of the foreign good and the foreign firm's profits are impacted by b:

$$\frac{\partial G}{\partial b} = (1-2\rho)\alpha\mu^F(\frac{1}{c})^{\frac{1}{c}}\exp[-\frac{1}{c}]$$

For $\rho < \frac{1}{2}$, the government objective function is increasing in b, and vice versa. That is, if the government cares more for the foreign actor than for the domestic actors, its objective function rises in b. The optimal choice of protection follows a similar pattern: if the government cares more for the foreign actor than the domestic actors, $\rho < \frac{1}{2}$, then the incentive to protect is increasing in b.

A.3.2 Single Domestic Firm

Solving for $\hat{x}$, x_L, $\lambda(\hat{x})$, and $\Lambda(\hat{x}, x_)$ explicitly is not possible; however, solving for the comparative statics is. To solve for the impacts of a change in c, the following equations were used:

$$(1)\ \ \frac{\partial \hat{x}}{\partial c} - \frac{\partial \lambda}{\partial c} + (1-\alpha)\frac{\partial \Lambda}{\partial c} = 0$$

$$(2)\ \ \frac{\partial x_L}{\partial c} - \alpha\frac{\partial \Lambda}{\partial c} = 0$$

$$(3)\ \ \frac{1}{c}(\frac{\hat{x}}{b})^{1-c}\ln(\frac{\hat{x}}{b})\frac{\partial \hat{x}}{\partial c} + \frac{\partial \lambda}{\partial c} = -\frac{b}{c^2}(\frac{\hat{x}}{b})^{1-c}$$

$$(4)\ \ (NA-DE)\frac{\partial \hat{x}}{\partial c} + (NB+DF)\frac{\partial x_L}{\partial c} + D^2\frac{\partial \Lambda}{\partial c} = -\frac{1}{c}ND$$

In which:

$$N = \hat{x}x_L(\exp[(\frac{\hat{x}}{b})^c] - \exp[(\frac{x_L}{b})^c])$$

$$D = c((1-\alpha)(\frac{\hat{x}}{b})^c x_L\exp[(\frac{x_L}{b})^c] + \alpha(\frac{x_L}{b})^c\hat{x}\exp[(\frac{\hat{x}}{b})^c])$$

$$A = (1-\alpha)(\frac{x_L}{b})(\frac{\hat{x}}{b})^c\exp[(\frac{x_L}{b})^c]\ln(\frac{\hat{x}}{b}) + \alpha(\frac{x_L}{b})^c\exp[(\frac{\hat{x}}{b})^c](1+(\frac{\hat{x}}{b})^{c+1}\ln(\frac{\hat{x}}{b}))$$

$$B = \alpha(\frac{\hat{x}}{b})(\frac{x_L}{b})^c\exp[(\frac{\hat{x}}{b})^c]\ln(\frac{x_L}{b}) + (1-\alpha)(\frac{\hat{x}}{b})^c\exp[(\frac{x_L}{b})^c](1+(\frac{x_L}{b})^{c+1}\ln(\frac{x_L}{b}))$$

$$E = x_L(\exp[(\frac{\hat{x}}{b})^c](1+(\frac{\hat{x}}{b})^{c+1}\ln(\frac{\hat{x}}{b})) - \exp[(\frac{x_L}{b})^c])$$

$$F = \hat{x}(\exp[(\frac{x_L}{b})^c](1+(\frac{x_L}{b})^{c+1}\ln(\frac{x_L}{b})) - \exp[(\frac{\hat{x}}{b})^c])$$

In the case of a single domestic firm, $\hat{x} = \lambda - (1-\alpha)\Lambda$, therefore, since $\Lambda > 0$, $\hat{x} < \lambda = \frac{b}{c}(\frac{\hat{x}}{b})^{1-c}$. This gives an upper bound for $\hat{x}$: $\hat{x} < b(\frac{1}{c})^{\frac{1}{c}}$. If $c < 1$, there is a mass of consumers at $x = 0$. Therefore, it is assumed that $c \in (1, e]$. This assumption is supported by the data, as all but a very few observations have a shape parameter in this range. Assuming $c \in (1, e]$ leads to $x_L < \hat{x} < b$. This makes it possible to sign the partial derivatives with respect to c:

$$\frac{\partial \hat{x}}{\partial c} < 0, \;\; \frac{\partial x_L}{\partial c} < 0, \;\; \frac{\partial \lambda}{\partial c} < 0, \;\; \frac{\partial \Lambda}{\partial c} < 0$$

The same process was used to solve for the impacts of a change in b:

$$(1) \;\; \frac{\partial \hat{x}}{\partial b} - \frac{\partial \lambda}{\partial b} + (1-\alpha)\frac{\partial \Lambda}{\partial b} = 0$$

$$(2) \;\; \frac{\partial x_L}{\partial b} - \alpha \frac{\partial \Lambda}{\partial b} = 0$$

$$(3) \;\; -\frac{1-c}{c}(\frac{\hat{x}}{b})^{-c}\frac{\partial \hat{x}}{\partial b} + \frac{\partial \lambda}{\partial b} = (\frac{\hat{x}}{b})^{1-c}$$

$$(4) \;\; (NJ - DE)\frac{\partial \hat{x}}{\partial b} + (NK + DF)\frac{\partial x_L}{\partial b} + D^2\frac{\partial \Lambda}{\partial c} = -DG - NI$$

In which:

$$N = \hat{x}x_L(\exp[(\frac{\hat{x}}{b})^c] - \exp[(\frac{x_L}{b})^c])$$

$$D = c((1-\alpha)(\frac{\hat{x}}{b})^c x_L \exp[(\frac{x_L}{b})^c] + \alpha(\frac{x_L}{b})^c \hat{x} \exp[(\frac{\hat{x}}{b})^c])$$

$$E = x_L(\exp[(\frac{\hat{x}}{b})^c](1 + c(\frac{\hat{x}}{b})^c) - \exp[(\frac{x_L}{b})^c])$$

$$F = \hat{x}(\exp[(\frac{x_L}{b})^c](c(\frac{\hat{x}}{b})^c - 1) + \exp[(\frac{\hat{x}}{b})^c])$$

$$G = \frac{c}{b}\hat{x}x_L((\frac{\hat{x}}{b})^c - (\frac{x_L}{b})^c)$$

$$I = -\frac{c^2}{b}[(1-\alpha)(\frac{\hat{x}}{b})^c x_L \exp[(\frac{x_L}{b})^c](1 + (\frac{x_L}{b})^c) + \alpha(\frac{x_L}{b})^c \hat{x} \exp[(\frac{\hat{x}}{b})^c](1 + (\frac{\hat{x}}{b})^c)]$$

$$J = c[(1-\alpha)c(\frac{x_L}{\hat{x}})(\frac{\hat{x}}{b})^c \exp[(\frac{x_L}{b})^c] + \alpha(\frac{x_L}{b})^c \exp[(\frac{\hat{x}}{b})^c](1 + (\frac{\hat{x}}{b})^c)]$$

$$K = c[(1-\alpha)(\frac{\hat{x}}{b})^c \exp[(\frac{x_L}{b})^c](1 + (\frac{x_L}{b})^c) + \alpha c(\frac{\hat{x}}{x_L})(\frac{x_L}{b})^c \exp[(\frac{\hat{x}}{b})^c]]$$

Given that $x_L < \hat{x} < b$, it can be shown that:

$$\frac{\partial \hat{x}}{\partial b} > 0, \quad \frac{\partial x_L}{\partial b} > 0, \quad \frac{\partial \lambda}{\partial b} > 0, \quad \frac{\partial \Lambda}{\partial b} > 0$$

APPENDIX B: ADDITIONAL TABLES

Table B.1: Regressions on Formal and De Facto IPR Protection

	(1) GP Index	(2) GP Index	(3) GP Index	(4) WEF IPR	(5) WEF IPR	(6) WEF IPR
Log GDP per capita	0.374***	0.372***	0.330***	0.550***	0.553***	0.768***
	(0.0426)	(0.0364)	(0.0472)	(0.0530)	(0.0536)	(0.0671)
Gini Coefficient	-2.133***	-1.526**	-0.445	-0.654	-0.724	-1.134
	(0.627)	(0.516)	(0.597)	(0.804)	(0.812)	(1.113)
Political Constraints	0.332	0.147	-0.145	0.281	0.297	0.0271
	(0.215)	(0.182)	(0.169)	(0.248)	(0.247)	(0.216)
Constant	0.552	-0.550	-0.409	-0.981	-0.750	-1.906**
	(0.496)	(0.411)	(0.507)	(0.575)	(0.590)	(0.657)
Year FE	No	Yes	Yes	No	Yes	Yes
Region FE	No	No	Yes	No	No	Yes
Observations	380	380	380	718	718	718
Adjusted R^2	0.461	0.699	0.753	0.592	0.594	0.694

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table B.2: Regressions on Formal and De Facto IPR Protection

	(1) GP Index	(2) GP Index	(3) GP Index	(4) WEF IPR	(5) WEF IPR	(6) WEF IPR
Log GDP per capita	0.374***	0.372***	0.330***	0.550***	0.553***	0.768***
	(0.0426)	(0.0364)	(0.0472)	(0.0530)	(0.0536)	(0.0671)
Gini Coefficient	-2.133***	-1.526**	-0.445	-0.654	-0.724	-1.134
	(0.627)	(0.516)	(0.597)	(0.804)	(0.812)	(1.113)
Political Constraints	0.332	0.147	-0.145	0.281	0.297	0.0271
	(0.215)	(0.182)	(0.169)	(0.248)	(0.247)	(0.216)
Constant	0.552	-0.550	-0.409	-0.981	-0.750	-1.906**
	(0.496)	(0.411)	(0.507)	(0.575)	(0.590)	(0.657)
Year FE	No	Yes	Yes	No	Yes	Yes
Region FE	No	No	Yes	No	No	Yes
Observations	380	380	380	718	718	718
Adjusted R^2	0.461	0.699	0.753	0.592	0.594	0.694

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table B.3: Regressions on Formal IPR Protection in Developing Economies

	(1) GP Index	(2) GP Index	(3) GP Index	(4) GP Index
Log GDP per Capita	0.302**	0.238*	-0.878*	0.188*
	(0.111)	(0.102)	(0.379)	(0.0865)
Gini Coefficient	-1.917*	-1.122	-0.00657	-0.369
	(0.907)	(0.782)	(1.348)	(0.870)
Polity Score	0.0326*	0.0146	-0.0202	0.00231
	(0.0135)	(0.0120)	(0.0129)	(0.0130)
Constant	0.939	-0.00312	8.048*	0.251
	(1.020)	(1.026)	(3.163)	(0.800)
Year FE	No	Yes	No	Yes
Region FE	No	No	No	Yes
Country FE	No	No	Yes	No
Observations	221	221	221	221
Adjusted R^2	0.129	0.543	0.717	0.609

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table B.4: Regressions on De Facto IPR Protection in Developing Economies

	(1) WEF IPR	(2) WEF IPR	(3) WEF IPR	(4) WEF IPR
Log GDP per Capita	0.284***	0.281***	1.266**	0.374***
	(0.0769)	(0.0791)	(0.394)	(0.0933)
Gini Coefficient	1.852*	1.855*	1.896	2.809*
	(0.702)	(0.717)	(1.922)	(1.133)
Polity Score	-0.0289*	-0.0293*	-0.0238	-0.0146
	(0.0116)	(0.0116)	(0.0244)	(0.0119)
Constant	0.209	0.292	-7.891*	-0.607
	(0.683)	(0.710)	(3.260)	(0.848)
Year FE	No	Yes	No	Yes
Region FE	No	No	No	Yes
Country FE	No	No	Yes	No
Observations	405	405	405	405
Adjusted R^2	0.183	0.210	0.325	0.350

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table B.5: Regressions on De Facto IPR Protection in Developing Economies

	(1) WEF IPR	(2) WEF IPR	(3) WEF IPR	(4) WEF IPR	(5) WEF IPR	(6) WEF IPR
Log GDP per Capita	0.281***	0.330***	0.191*	0.266**	0.135	0.193
	(0.0791)	(0.0909)	(0.0747)	(0.0923)	(0.0700)	(0.0976)
Gini Coefficient	1.855*	0.827	1.173	0.459	1.084	0.742
	(0.717)	(0.799)	(0.714)	(0.817)	(0.644)	(0.770)
Polity Score	-0.0293*		-0.0224*		-0.00530	
	(0.0116)		(0.0101)		(0.00970)	
Consumer Tax		-1.191**		-0.925*		-0.711
		(0.438)		(0.392)		(0.385)
Local Competition			0.437***	0.396**		
			(0.103)	(0.130)		
Market Dominance					0.595***	0.497***
					(0.0945)	(0.106)
Constant	0.292	0.812	-0.818	-0.589	-0.419	-0.0390
	(0.710)	(0.810)	(0.715)	(0.940)	(0.611)	(0.817)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	405	300	405	300	405	300
Adjusted R^2	0.210	0.247	0.321	0.328	0.438	0.421

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table B.6: List of Included Countries

Both Formal and De Facto Measures			Formal Measure Only	De Facto Measure Only
1. Algeria	46. Iran	91. Spain	1. Central African Republic	1. Albania
2. Angola	47. Ireland	92. Sri Lanka	2. Congo, Rep.	2. Armenia
3. Argentina	48. Israel	93. Swaziland	3. Fiji	3. Azerbaijan
4. Australia	49. Italy	94. Sweden	4. Grenada	4. Bahrain
5. Austria	50. Jamaica	95. Switzerland	5. Iraq	5. Barbados
6. Bangladesh	51. Japan	96. Syria	6. Ivory Coast	6. Belize
7. Belgium	52. Jordan	97. Taiwan	7. Niger	7. Bhutan
8. Benin	53. Kenya	98. Tanzania	8. Papua New Guinea	8. Bosnia and Herzegovina
9. Bolivia	54. Liberia	99. Thailand	9. Somalia	9. Brunei Darussalam
10. Botswana	55. Lithuania	100. Trinidad and Tobago	10. Sudan	10. Cambodia
11. Brazil	56. Luxembourg	101. Tunisia	11. Togo	11. Cape Verde
12. Bulgaria	57. Madagascar	102. Turkey	12. USSR	12. Cote d'Ivoire
13. Burkina Faso	58. Malawi	103. Uganda		13. Croatia
14. Burundi	59. Malaysia	104. Ukraine		14. Timor-Leste
15. Cameroon	60. Mali	105. United Kingdom		15. Estonia
16. Canada	61. Malta	106. United States		16. Gambia
17. Chad	62. Mauritania	107. Uruguay		17. Georgia
18. Chile	63. Mauritius	108. Venezuela		18. Guinea
19. China	64. Mexico	109. Vietnam		19. Kazakhstan
20. Colombia	65. Morocco	110. Zambia		20. Kuwait
21. Congo, Dem. Rep.	66. Mozambique	111. Zimbabwe		21. Kyrgyzstan
22. Costa Rica	67. Myanmar			22. Laos
23. Cyprus	68. Nepal			23. Latvia
24. Czech Republic	69. Netherlands			24. Lebanon
25. Denmark	70. New Zealand			25. Lesotho
26. Dominican Republic	71. Nicaragua			26. Libya
27. Ecuador	72. Nigeria			27. Macedonia
28. Egypt	73. Norway			28. Moldova
29. El Salvador	74. Pakistan			29. Mongolia
30. Ethiopia	75. Panama			30. Montenegro
31. Finland	76. Paraguay			31. Namibia
32. France	77. Peru			32. Oman
33. Gabon	78. Philippines			33. Puerto Rico
34. Germany	79. Poland			34. Qatar
35. Ghana	80. Portugal			35. Serbia
36. Greece	81. Romania			36. Seychelles
37. Guatemala	82. Russia			37. Slovenia
38. Guyana	83. Rwanda			38. Suriname
39. Haiti	84. Saudi Arabia			39. Tajikistan
40. Honduras	84. Senegal			40. United Arab Emirates
41. Hong Kong	86. Sierra Leone			41. Yemen
42. Hungary	87. Singapore			
43. Iceland	88. Slovak Republic			
44. India	89. South Africa			
45. Indonesia	90. South Korea			

Table B.7: Deviation of De Facto IPR Protection from Formal IPR Protection

Country	GPI	WEF IPR	Deviation	Gini	Decentralization	Min γ	Max γ	γ out of bounds?
Australia	4.33	5.855	-0.02957	0.35285	0.367504	-0.31826	0.049245	
Austria	4.33	5.9275	-0.01921	0.301817	0.149384	-0.12937	0.020017	
Belgium	4.67	5.4575	-0.15436	0.2899	0.309464	-0.28904	0.020425	
Bolivia	2.915	1.8925	-0.31264	0.54372	0.694774	-0.40505	0.289721	
Canada	4.54	5.5675	-0.11264	0.3379	0.375886	-0.3413	0.034581	
Chile	4.58	3.76	-0.37886	0.51895	0.480421	-0.44007	0.040355	
Costa Rica	3.405	3.6525	-0.15921	0.4913	0.414648	-0.28238	0.132273	
Cyprus	3.31	4.535	-0.01414	0.312967	0.24868	-0.16463	0.084054	
Czech Republic	4.33	3.9125	-0.30707	0.26465	0.481861	-0.41729	0.064569	
Denmark	4.67	6.17	-0.05257	0.2777	0.376189	-0.35136	0.024828	
Finland	4.67	6.1975	-0.04864	0.27835	0.464347	-0.4337	0.030647	
France	4.67	5.89	-0.09257	0.31868	0.434165	-0.40551	0.028655	
Germany	4.67	6.1675	-0.05293	0.31824	0.384966	-0.35956	0.025408	
Iceland	3.78	5.82	0.075429	0.293783	0.725524	-0.5485	0.177028	
Israel	3.96	4.72	-0.11771	0.4194	0.45958	-0.36399	0.095593	
Italy	4.67	4.195	-0.33471	0.338883	0.4172	-0.38967	0.027535	
Jamaica	3.36	3.53	-0.16771		1	-0.672	0.328	
Japan	4.67	5.58	-0.13686	0.3211	0.482486	-0.45064	0.031844	
Jordan	3.2	4.52	0.005714		0.35439	-0.22681	0.12758	
Luxembourg	4.14	5.6675	-0.01836	0.313983	0.31514	-0.26094	0.054204	
Mauritius	2.57	4.0525	0.064929	0.3565	0.246437	-0.12667	0.119768	
Netherlands	4.67	5.97	-0.08114	0.296683	0.088169	-0.08235	0.005819	
New Zealand	3.68	5.8075	0.093643		0.542882	-0.39956	0.143321	
Norway	4.355	5.6775	-0.05993	0.278367	0.424119	-0.36941	0.054711	
Portugal	4.33	4.875	-0.16957	0.367767	0.329672	-0.2855	0.044176	
South Africa	3.815	5.205	-0.01943	0.639	0.161494	-0.12322	0.038274	
South Korea	4.33	4.7675	-0.18493		0.295967	-0.25631	0.03966	
Spain	4.33	4.6325	-0.20421	0.341683	0.469321	-0.40643	0.062889	
Sweden	4.54	5.99	-0.05229	0.2684	0.596942	-0.54202	0.054919	
Switzerland	4.28	6.23	0.034	0.335275	0.58598	-0.5016	0.084381	
Thailand	2.86	3.8375	-0.02379	0.40204	0.322829	-0.18466	0.138171	
Tunisia	3.25	4.3925	-0.0225	0.3677	0.430105	-0.27957	0.150537	
United Kingdom	4.54	5.7	-0.09371	0.348633	0.13037	-0.11838	0.011994	
Zambia	2.065	3.0475	0.022357	0.5512	0.385519	-0.15922	0.2263	
Brazil	3.43	3.2525	-0.22136	0.55208	0.228507	-0.15676	0.071751	-0.0646
Bulgaria	3.88	2.7275	-0.38636	0.33382	0.109909	-0.08529	0.02462	-0.30107
China	4.555	3.64	-0.391	0.4283	0.344922	-0.31422	0.030698	-0.07678
Colombia	3.43	3.3825	-0.20279	0.55625	0.295333	-0.2026	0.092735	-0.00019
El Salvador	3.56	3.13	-0.26486	0.45945	0.223142	-0.15888	0.064265	-0.10598
Greece	4.47	4.1475	-0.3015	0.346067	0.202887	-0.18138	0.021506	-0.12012
Honduras	2.995	3.1625	-0.14721	0.5563	0.22561	-0.13514	0.09047	-0.01207
Hungary	4.33	4.1925	-0.26707	0.292183	0.290627	-0.25168	0.038944	-0.01539
Indonesia	2.77	3.235	-0.09186		0.124874	-0.06918	0.055694	-0.02268
Ireland	4.67	5.545	-0.14186	0.324167	0.110823	-0.10351	0.007314	-0.03835
Kenya	3.22	3.0325	-0.21079	0.4851	0.320746	-0.20656	0.114185	-0.00423
Lithuania	3.88	3.6825	-0.24993	0.352067	0.046887	-0.03638	0.010503	-0.21354
Malta	3.58	4.27	-0.106		0	0	0	-0.106
Morocco	3.45	3.45	-0.19714	0.4072	0.269077	-0.18566	0.083414	-0.01148
Paraguay	2.89	2.1625	-0.26907	0.51605	0.411253	-0.2377	0.173549	-0.03137
Peru	3.34	2.5925	-0.29764	0.495967	0.09103	-0.06081	0.030222	-0.23683
Poland	3.94	3.51	-0.28657	0.338767	0.320622	-0.25265	0.067972	-0.03392
Romania	4	3.3175	-0.32607	0.329933	0.111855	-0.08948	0.022371	-0.23659
Russia	3.68	2.6625	-0.35564	0.41215	0.249613	-0.18371	0.065898	-0.17193
Slovak Republic	4.305	3.78	-0.321	0.268667	0.108494	-0.09341	0.015081	-0.22759
Turkey	4.355	3.09	-0.42957	0.3958	0.140869	-0.1227	0.018172	-0.30687
Uganda	3.1	2.615	-0.24643	0.4357	0.03404	-0.0211	0.012935	-0.22532
Ukraine	3.78	2.6725	-0.37421	0.271	0.440445	-0.33298	0.107468	-0.04124

Table B.8: Selected Jordanian IPR Protection Data

	1980-1984	1985-1989	1990-1994	1995-1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Resident Patent Applications		11			71	52	21	25	42	49	75	59	50	60	45	40	48	35	40	41	22
Non-Resident Patent Applications	183	61			127	147	117	157	141	169	428	507	535	446	429	360	346	357	339	294	256
Total Patent Applications	183	72	0	0	198	199	138	182	183	218	503	566	585	506	474	400	394	392	379	335	278
Resident Patent Grants				76	12		13	8	4	9	10	23	10	11	12	15	3	9	15	15	4
Non-Resident Patent Grants	128				59		16	39	56	46	50	40	11	40	52	25	45	39	100	68	117
Total Patent Grants	128	0	0	76	71	0	29	47	60	55	60	63	21	51	64	40	48	48	115	83	121
Resident Pharmaceutical Patent Grants				1																	
Non-Resident Pharmaceutical Patent Grants	6	25	11	14	6		1	3	13	18	10	8	4	12	9	3	3	3	3	3	2
Software Piracy %			87	81	71	67	64	65	64	63	61	60	58		57						
IPR Cases Decided by Jordanian Courts					10	9	15	31	49	133	172	656	584								

Information from WIPO and Nesheiwat (2012)

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