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An Economic Justification for Open Access to Essential Medicine Patents in Developing Countries

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Introduction

Not all intellectual property rights grant the right to exclude that is indicative of "property rules," as that term was used by Guido Calabresi and A. Douglas Melamed in their seminal article.[1] Some intellectual property rights are "liability rules," in which the right holder has an entitlement to compensation for use of the protected invention, not a right to preclude the use.[2] Although patent laws normally grant a right to exclude others from use of the protected invention as a default, most countries' laws allow the government to convert the patent property rule into a liability rule through a compulsory license. It has been noted, for example, that by the end of the 1950s, the U.S. had issued compulsory licenses covering 40 to 50 thousand patents, including substantial portions of the patent portfolios of AT&T, General Electric, IBM, and Xerox.[3] The U.S. Supreme Court recently expressed a willingness to accept liability rules over injunctions in some patent infringement cases.[4]

The World Trade Organization's (WTO) agreement on Trade-Related Intellectual Property Rights (TRIPS) recognizes the authority of governments to authorize the "use of the subject matter of a patent without the authorization of the right holder, including use by the government or third parties authorized by the government."[5] Under TRIPS, this authority allows the patent right to be converted from a property rule into a liability rule, granting the patent holder a right to "adequate remuneration" for use of the patent rather than the right to preclude all competition.[6] The right of countries to use compulsory licenses to promote access to medicines has been repeatedly reaffirmed in international law, including through the Doha Declaration on the TRIPS Agreement and Public Health, issued at the 2001 WTO Ministerial Meeting.[7]

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Assuming that the degree of compensation that is "adequate" under TRIPS may be significantly lower than the full scope of profits that could have been secured through exploiting an exclusive marketing right to its full, a compulsory license may lead to a reduced incentive for innovation. This potential impact of compulsory licensing is raised repeatedly by industry interests and by many developed country governments. In response to recent compulsory licenses for essential medicines by Thailand, for example, the then European Commissioner for Trade Peter Mandelson stated that "[t]he use of compulsory licensing should not become a standard way of doing business, because systematic recourse to compulsory licensing would eventually be detrimental to the patent system, and so to innovation and the development of new medicines."[8] This paper seeks to address that concern directly. When should recourse to compulsory licensing become, in Mandelson's words, "systematic?" And is the need to expand access to patented essential medicines in a poor country such a case?

In any individual case, choosing to issue a compulsory license involves a trade-off between consumer benefits today (through greater access at a competitive price) and consumer benefits in the future (through greater innovation). Compulsory licensing becomes more attractive when it is predictable that the former is greater than the latter. Systematic use of compulsory licensing likewise may be a justifiable policy response if there are characteristic features of the market that result in the benefits from greater access today being routinely higher than the benefits from increased incentives for innovation through the exclusive right.

A number of studies have examined the link between the welfare of people who need medicines and profits for pharmaceutical firms to fund research and development for new drugs. Many have recognized the need for poor countries to access low-cost medicines.[9] In a key contribution in this regard, F. M. Scherer studied the overall global welfare effects (not just for developing countries) of allowing poor countries a "free ride" on the innovations spurred by intellectual property in the global north. He compared a scenario under which medicines were protected by product patents all over the world to a scenario under which poor countries were allowed access to generic versions of medicines protected by patents in rich countries. Even though the free riding by poor countries in the second scenario was shown to have a negative effect on the overall welfare in rich countries (by cutting into the funds available for R&D to develop future medicines), Scherer found that overall global welfare is most likely increased by allowing poor countries access to low-cost medicines because the marginal utility of income (the benefit derived from one extra unit of currency) is greater in poor nations than in rich ones.[10]

Some intellectual property rights are "liability rules," in which the right holder has an entitlement to compensation for use of the protected invention, not a right to preclude the use.

This paper expands on the economic scholarship on compulsory licensing by showing that in countries with very high income inequality, which characterizes many developing countries, market forces may produce incentives for patent holders to maximize profits by pricing their products to serve only the wealthiest sliver of the population. Such pricing creates massive social costs through lack of treatment for the poor majority. In the balance of benefits and costs of such a system, the costs are likely to be disproportionately large. Fundamentally, we argue that where such a *systematic* failure of the exclusive right-based patent systems for needed medicines in developing countries occurs, compulsory licensing to create open access to patents on needed medicines in such countries may be more broadly justified.

We begin with a brief discussion of patents and monopoly economics, and describe how monopolies, including those created by patents, raise prices and increase profits in the average case described in most basic economics text books. In this average case, the price increases allowed by patent monopolies is not necessarily harmful to overall social welfare, assuming that the increased profits benefits consumers on the whole through increased incentives to innovate in the future. We then show that the balance of benefits and costs changes, however, in a market with highly convex demand curves. In such a market, the profit-maximizing firm will raise prices much higher to serve only the portion of the demand curve which is highly inelastic, creating large deadweight losses because of the substantial fraction of the market unable to afford those high prices. After presenting these basic economic premises, we advance to a specific discussion of how

income inequality produces highly convex demand curves for essential medicines, comparing the profit-maximizing strategies in South Africa and Norway as explanatory examples. In the final section, we argue that situations of highly convex demand curves are the norm in many developing countries, and therefore may warrant a systematic compulsory licensing policy, such as that available under "essential facilities" antitrust standards and license of right patent law clauses, with means outside of the patent system explored for incentivizing innovation.

Balancing Costs and Benefits of Essential Medicine Patent Monopolies

A patent is a government-created right to the exclusive use of an innovation for a fixed period of time, subject to various limitations designed to protect public interests. It is granted as an imperfect incentive to create and share new inventions.[11] The reason that a period of exclusive use is an incentive to innovate is that it may enable the patentee to obtain some monopoly profits during the period of the patent. Granting exclusive use of an innovation creates costs: typically, the monopoly price of a product will be higher than if it were competitively provided. In the case of essential medicines in developing countries, the typical costs and benefits of exclusive rights are skewed. High inequality in the demand side of the market creates incentives for patent holders to price out the large majority of the population from access to the product. To the extent that this problem is systematic — not cabined to a few specific diseases (such as AIDS, tuberculosis, and malaria) or to least developed countries — the discussion we offer below is relevant to a wider set of situations and may have wider policy implications.[12]

Monopoly Economics

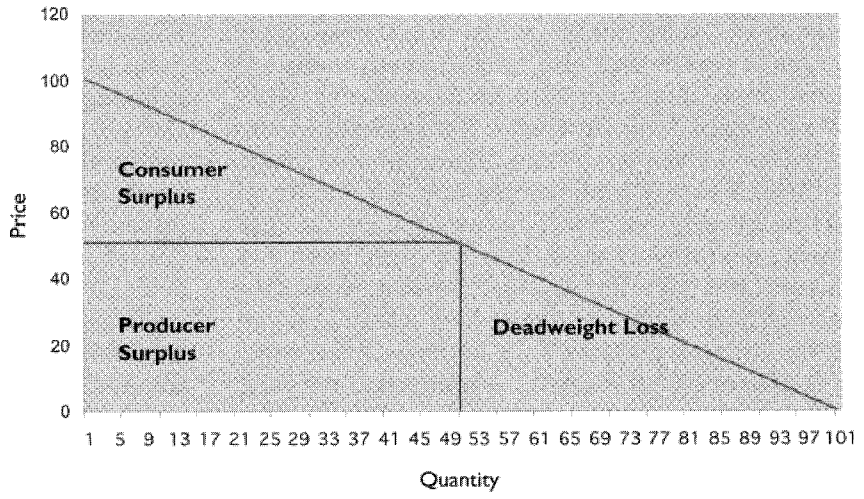
Patents do not always create monopolies. Many patents give the holder an exclusive right to produce a product that has many substitutes and therefore normal competitive markets will restrain the patent holders' pricing.[13] Indeed, there is no guarantee that a patented item will not be functionally inferior to substitutes, denying the patent any real market value.

Patents may create monopolies where there is no effective substitute for the patented product. This may be the case when the patent covers the active ingredient for a needed medicine if other medicines cannot be readily substituted. Such a patent gives its holder the ability to set price for the good, restrained only by the extent to which refusals of consumers to pay the higher price will ultimately decrease profits from a lower volume of sales.[14] The more the demand for the good is inelastic (meaning that consumers are less likely to decrease consumption with each price increase), the higher the price that can be profitably demanded by the monopolist.

Pricing above marginal costs creates two losses for consumers. The first loss is a wealth transfer from consumers to the monopolist, since every unit purchased is at a higher price than consumers would pay a competitive producer. In the case of an innovative monopolist, including a monopoly created by a patent, such a transfer from consumers to the monopolist may be thought to be the reward for innovation.

The second loss from monopoly pricing is a "deadweight loss" from forgone transactions which would have taken place at the lower competitive price. These lost sales are known as "deadweight" because they do not create surplus for the buyer or seller; the surplus benefit that would have gone to consumers simply disappears, and is not compensated by any gain to the monopolist. In pharmaceutical markets, this deadweight loss is often referred to as the problem of "access": the poor may not purchase a drug product because of its high price, and as a result, are untreated. Had the price been lower, more people would have been able to afford the drug and would have been treated. Thus, for drugs essential to life and health, the term deadweight loss created by patented drug pricing takes on added significance.

Figure 1
Straight Demand Curve



Patents and Standard Demand Curves

Patents on ordinary goods lead to higher prices — but not necessarily to unreasonably high prices. A monopolist is constrained by the overall market demand when it is setting price and output. If prices rise too high, then the monopolist loses too many customers who may make a decision not to buy the product.

Figure 1 shows the type of demand curve typically drawn in economics textbooks, with price shown on the vertical axis, and the quantity of products sold on the horizontal. To keep things simple, it is assumed that the cost of production is approximately zero.[15] If the good were competitively produced, it would have a price of about zero. There would be zero profits, but all consumers who are willing and able to pay a price higher than its average cost of production would buy it, and there would be no deadweight loss.

The monopolist will pick the profit-maximizing output for any given demand curve, raising the price until the decrease in sales offsets the increased profits per sale. In the above scenario, the seller could sell a quantity of 99 goods for 1 unit of currency (hereafter, USD), yielding sales of $99. It can raise the price to $2 and will loose one sale (selling 98 goods instead of 99). But the resulting increase in income per sale more than makes up for the loss of demand (enabling earnings of $196). Here, the monopolist will stop raising prices when it sells 50 goods for $50, earning $2500 in sales. Beyond this point, the seller loses money by the lost sales at higher prices. Thus, the profit-maximizing price, given this demand curve, would be about $50. Because all of the consumers would purchase the product at the competitive price, the area below the demand curve and to the right of 50 units is marked as "deadweight loss." The wealth transfer from consumer to producer is marked "producer surplus." An important point is that producer surplus (2500) is about twice as large as the DWL (1250), so that it provides a strong incentive for innovation, compared to current welfare losses owing to the deadweight loss.

Patents and Highly Convex Demand Curves

The profit maximizing pricing strategies for a firm with a monopoly are altered by the shape and slope of the demand curve. The slope of the demand curve may be affected by the elasticity of demand. A monopolist will be more restrained if consumers are more willing to shift to an inferior substitute or do without the good as prices rise. More elasticity in the demand market results in a demand curve that is more flat on the horizontal plane; less elasticity results in a steeper demand curve. A perfectly inelastic demand curve, meaning that consumers will not curb their demand at any price, will be vertical. A horizontal demand curve would mean that the smallest price increase would eliminate all consumer purchases.

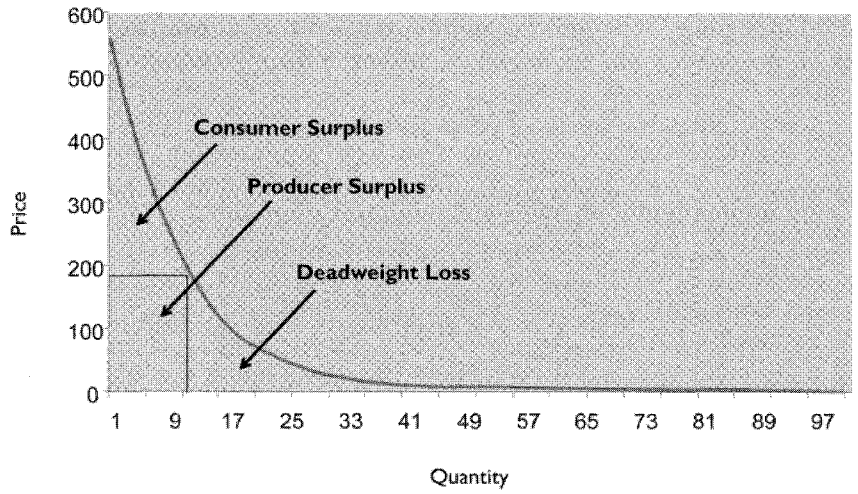
Most demand curves are not straight lines, as in Figure 1, but rather have some element of convexity or concavity. Convexity indicates that some segment of the market (the flatter part of the demand curve) will be highly elastic — giving up the purchase with a slight price increase. Another segment of the market is likely to be more inelastic — willing to pay much higher prices for access. And some part of the market will exist on points along the curve between these two extremes.

Suppose that the demand for a good is highly convex, as illustrated in Figure 2. This figure is drawn with a convex demand curve and so that the area under the demand curve is the same as the area under the demand curve in Figure 1.[16] Given this demand curve, if the product were offered competitively, the surplus in the market would be 5000, just the same as the competitive market given the demand curve drawn in Figure 1.

The shape of the demand curve changes the profit-maximizing price in a predictable way. Attempting to capture a significant portion of the flat/elastic part of the demand curve is unprofitable. There, small price increases knock large numbers of consumers out of the market. The monopolist will target its price toward the steep end of the curve where large price increases will

Figure 2

Convex Demand Curve



cause minimal decreases in additional sales. Thus, the profit-maximizing price given the demand curve in Figure 2 would be almost 200, four times higher than the case of the linear demand curve. In this case, the deadweight loss of 1835 is almost exactly the same as the profits, unlike in the linear case, where the deadweight loss of 1250 is exactly half as large as the profits which are 2500. The result is that only a small proportion of the possible purchasers (about 10%) would buy the product.

To help illustrate the effect of convexity on the deadweight loss to profit ratio, consider a demand curve of the form $p = 1 - q^n$, where $p \in (0,1)$. As shown in the Appendix, the ratio of deadweight loss to profit increases as n decreases (i.e., as the demand curve becomes more convex). The converse also holds, so that the ratio of deadweight loss to profit decreases as n increases. For more complicated real-world demand curves, there will not generally be a single measure of convexity, but the general principle applies that greater convexity will typically drive the monopolist to serve a much smaller segment of the market and produce comparatively large deadweight losses.

The trade-off between incentives for innovation vs. current deadweight losses for convex demand curves is not as favorable for the patent system as in cases with linear demand curves. That is, traditional patent protection has a smaller effect on innovation than in the linear demand case, and at the same time, the deadweight losses are larger.

There is no established ratio of deadweight losses to profit at which economists would agree that unrestrained monopoly pricing of the patented product is undesirable. The straight-line demand curve drawn in Figure 1 might be thought to be somehow "average." The rules relating to patents — including their twenty-year term — have grown in developed countries to reflect a societal willingness to trade-off incentives for innovation (via profits) with deadweight loss in the average case. In effect, the balance has been established that, on average, 20 years of exclusive exploitation of an innovation grants enough incentive to innovate; the implication is that longer patent duration would increase deadweight losses more than it would spur on innovation.[17] For markets which have much less favorable DWL/profits ratios, however, the marginal cost of extending patent protection is much higher for a given amount of benefit, and the optimal period of patent protection — or the type of protection offered — must be less. Indeed, if the DWL/profit ratio is sufficiently unfavorable, the optimal period of exclusion through patent protection will be zero.

It is well known that the optimal patent design should vary depending on market demand and cost characteristics,[18] and therefore the conclusion that the standard patent rules are mal-adapted to markets with convex demand curves will not be surprising. However, if one could identify an important class of markets characterized *systematically* by highly convex demand curves, there would be a strong case for altering the operation of patents in those markets. As we show in the next section, markets for needed medicines in developing countries constitute precisely such a class.

Essential Medicine Patents in Developing Countries

The World Health Organization (WHO) defines essential medicines as "those that satisfy the priority health care needs of the population."[19] In creating its model list of essential medicines that should be available in every country, however, the WHO considers the cost of accessing the drug and generally excludes patented medicines with very high prices.[20] We are concerned here with the access problems related to those medicines that meet the WHO's definition of being "essential" in that they address priority health needs, and in addition are (1) subject to patents or other exclusive marketing rights,[21] and (2) for which there are no adequate substitutes. The lack of substitutes means that the exclusive marketing right creates an effective monopoly. The essential nature of the medicine for life or health means that people requiring the medicine will generally be willing to spend whatever resources

Figure 3
Income by Decile

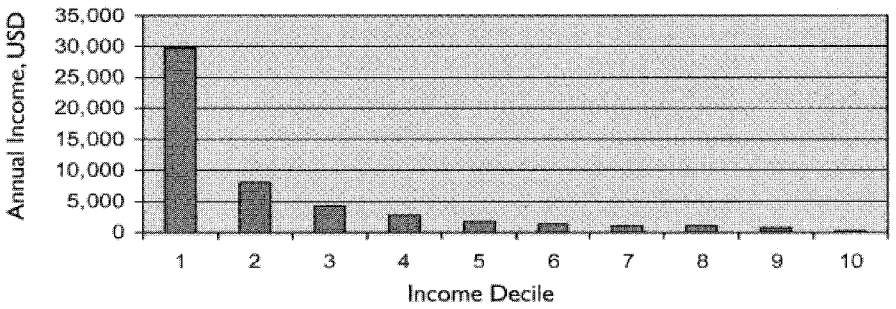


Figure 4.1
ARV Demand if Price = 5% Income

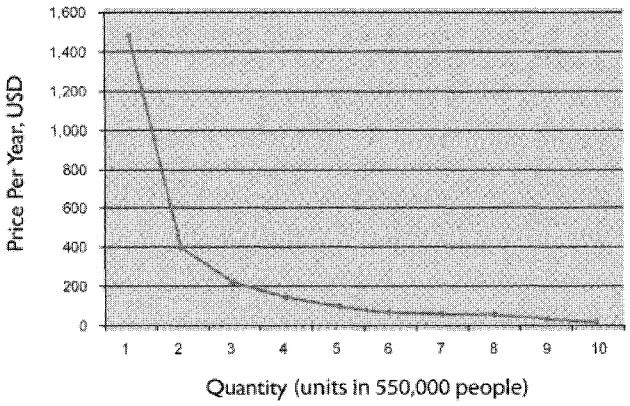
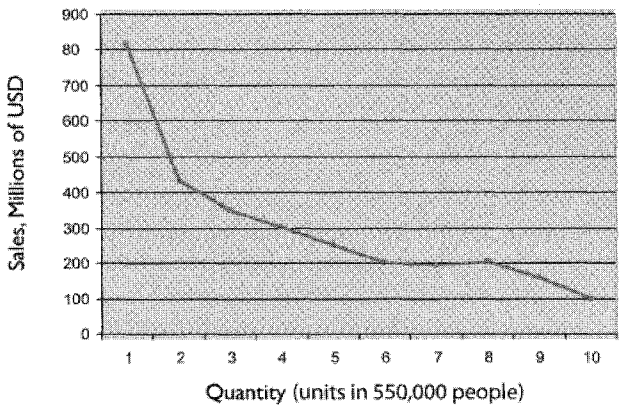


Figure 4.2
Revenue Per Quantity Sold



are available to them to buy that medicine.[22] The relative unlimited willingness of patients to pay for the drug means that, in the sector of the population that must pay for the medicine through private means (which is large in developing countries),[23] the demand curve is likely to be a function of ability to pay.[24]

The distribution of income and wealth in developing countries tends to be extremely uneven. There are a few very wealthy families, with extensive holdings and high income; at the other extreme, a large number of households have essentially no wealth and low incomes. Figure 3.1 shows the distribution of income in South Africa in the form of average per capita income for each decile of the population in 2000. The richest 10% earned 58% of all income. Put another way, the richest 10% earned an average of $29,626 a year, more than 80 times the average income of the poorest 10% (only $362).

High inequality in ability to pay in a country will produce highly convex demand curves for essential goods. Figure 4.1 is a demand curve for AIDS medicine in South Africa constructed according to the assumptions that (1) ability to pay is proportional to annual income, and (2) the incidence of the disease is equal among all income levels. This, in turn, implies a demand curve having proportions very similar to that in Figure 2, for which we demonstrated that the deadweight loss created by monopoly pricing of the good are very large compared to the incentives for innovation enabled by such pricing. The shape of the demand curve can be used to estimate the profit maximizing behavior of a monopolist in this market. Figure 4.1 assumes that people needing AIDS treatment in South Africa will purchase an antiretroviral if the cost is 5% of their income, which is at the outer edge of what South Africans in the top 20% of income earners spend on all of their out-of-pocket medical expenditures.[29] According to 2006 UNAIDS data, 5.5 million people live with HIV/AIDS in South Africa.[30] Since we assume that HIV prevalence is uniform across income deciles,[31] each decile contains 550,000 people who will need antiretroviral treatment. If a firm prices its antiretroviral at $1,481 per patient per year (5% of the per capita GDP distributed to the highest income decile)[32] then 550,000 people will buy it. In order to sell to a greater proportion of the population, the price must fall considerably — people in need of treatment in the second-highest income decile will buy the medicine if it is priced at $396, and half of the people in need of treatment can purchase an antiretroviral if it is priced at $92. In order to sell to all people with AIDS who need treatment, the price would have to be lowered to $18 per patient per year.[33]

Figure 4.2 shows the total sales revenue a firm will gain if it sells at each price on the demand curve. The firm maximizes its sales in South Africa by selling at the price that only the top 10% can afford.[34] At this price, the firm makes $814.6 million in total revenue. If the firm lowers its price to be able to make sales to 20% of the affected individuals (at $396 per patient), then it will sell twice as many medicines at a price less than half of the profit-maximizing price, earning substantially less ($435.6 million). As the monopolist continues to cut prices and raise production, revenues fall further at almost every level of output and corresponding price. In other words, the firm will maximize its profits by setting a price unaffordable for at least 90% of people in need.

To understand the effect that South Africa's inequitable income distribution has on the pricing and output decision of a monopolist in that country, compare it to the corresponding figures for Norway, which has one of the most equitable income distributions. Constructing a similar demand curve based on the assumption that people will buy a medicine at prices

up to 5% of their income yeilds a flatter, less convex demand curve (Figure 5.1).

The less convex Norwegian demand curve produces incentives for the firm to serve a larger percentage of the population through its pricing. Figure 5.2 shows the total revenue a firm will receive if it sells at the price affordable to each decile of the population. If it sets a price at which only the top 10% of Norwegians will buy, it will earn total revenues that are much lower than it will receive if it lowers its price to one which a higher percentage of the population can afford. The seller will maximize profits by selling at the price affordable to all but the poorest 20% of the population.

Because the monopolist's demand curve is flatter, the firm cannot make up lost consumption by the majority of the population with very high price increases at the steeper end of the curve. Thus, the monopolist in this economy will maximize profits by selling at the price where 80% of the HIV+ population can afford to purchase the product (Figure 5.2).

The table above shows the data used for graphs 4.1 through 5.2. Although at every income decile the affordable price in Norway exceeds that in South Africa, this does not mean that the profit-maximizing price is below that of South Africa. As the table shows, the profit-maximizing price in South Africa under our assumptions is $1,481, slightly *higher* than the profit-maximizing price in Norway. Of course, at this price in South Africa, only the wealthiest 10% would be able to afford the medicine while in Norway 80% of the population would have access.

More generally, at high levels of inequality within a country, a monopolist will maximize its revenue by selling at a high price affordable to few people. In countries with more equitable income distribution, a monopolist will maximize revenue by selling at a lower price to a greater number of consumers. Appendix 2 further illustrates this point with demand and revenue curves similar to the ones above for 12 nations with varying degrees of income inequality (with Gini coefficients ranging from 26.4 to 63.3).

Income inequality exists to a greater or lesser extent in every developing country, where a small minority often earns salaries that compare to those of advanced industrialized countries and the majority live in poverty.[38] This inequality creates incentives for an unrestrained monopoly supplier ineluctably to set drugs prices high. The problem is that relatively rich people, though few, are able to pay so much more for their drugs that it is more profitable for a company to serve them only. The greater the inequality of the income or wealth distribution, the more severe this problem becomes, with greater individual ability to pay on the part of the very rich pushing the price up.[39]

One implication of this analysis is that it may be perfectly rational for a company to set very similar prices in rich and poor countries, because the poor countries are likely to have high income inequality leading to highly convex demand curves. One area where there *are* country-to-country price differences is for antiretroviral drugs to treat HIV/AIDS. Price discrimination in this limited area is primarily the result of a vocal activist campaign coupled with the introduction of generic competition.[40] Outside of this limited area, drug prices in very poor countries are often not particularly low.[41] Indeed, middle-income countries with high inequality, such as Brazil and Mexico, often pay higher prices for patented drugs than high-income countries with lower inequality, such as the U.K. and Sweden.[42]

Figure 5.1
ARV Demand if Price = 5% Income

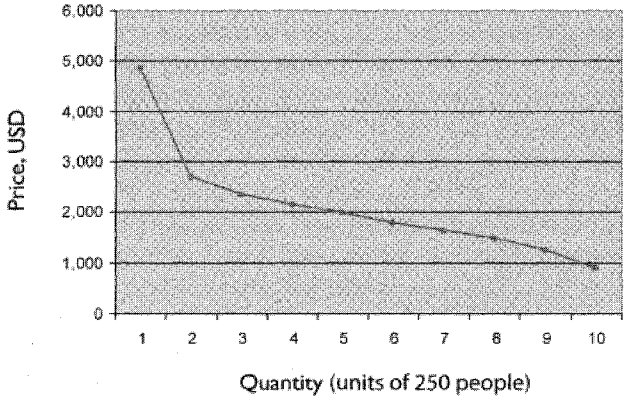
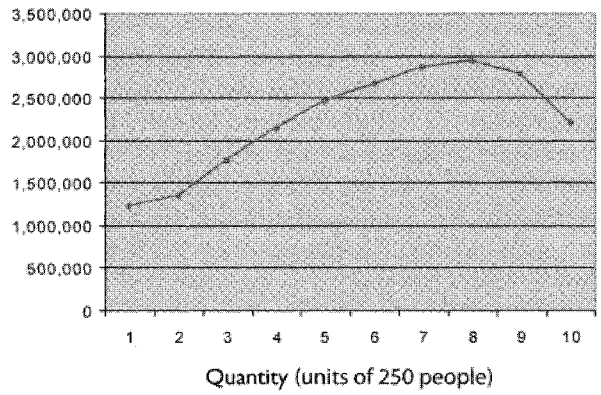


Figure 5.2
Revenue Per Quantity Sold



SOUTH AFRICA			NORWAY		
Affordable P (if this = 5%Y)	**Q Sold at Each Price**	**Total Sales at Each Price**	**Affordable P (if this = 5%Y)**	**Q Sold at Each Price**	**Total Sales at Each Price**
1,481	**550,000**	**814,550,000**	4,864	250	1,215,960
396	1,100,000	435,600,000	2,683	500	1,341,748
213	1,650,000	351,450,000	2,348	750	1,761,045
138	2,200,000	303,600,000	2,138	1000	2,138,412
92	2,750,000	253,000,000	1,971	1250	2,463,366
61	3,300,000	201,300,000	1,782	1500	2,673,014
50	3,850,000	192,500,000	1,635	1750	2,861,698
46	4,400,000	202,400,000	**1,468**	**2000**	**2,935,075**
32	4,950,000	158,400,000	1,237	2250	2,783,080
18	5,500,000	99,000,000	881	2500	2,201,306

Sources: Statistics South Africa; UNAIDS

Sources: Statistics Norway; UNAIDS

Toward Open License Strategies

As shown above, in the case of needed medicines in developing countries where highly convex demand curves are the norm, benefits from lower prices may exceed any potential losses owing to reduced future innovation. This is because demand for needed medicines in developing countries has very special properties, contributing to larger deadweight loss relative to extra producer surplus when monopolies restrict output and raise prices. In these circumstances, the use of compulsory licensing becomes one obvious remedy to problems created by the indiscriminate enforcement of property rules through patent laws in situations where they do not increase social welfare.[43] Converting the property rule to a liability rule through a compulsory license allows a country to change most of the deadweight loss into consumer surplus by using competition to achieve the lowest possible price while providing a measured contribution to research and development expenses through a royalty payment.[44]

Evidence that pharmaceutical companies do not, and lack incentives to, grant significant discounts in poor countries contradicts the prescription offered by Patricia Danzon and Adrian Towse, who suggest that permitting confidential rebates to developing countries will result in Ramsey pricing strategies with higher prices in developed countries than in those that are poorer.[45] Our analysis above suggests that this will not be the case for developing countries with unequal wealth distributions.[46]

While price discrimination is possible within a country, in practice the consumers who benefit from such discrimination are not the poor but rather the well organized (e.g., insurance providers, the government, or other large purchasers). With the exception of discrimination in prices between large purchasers, it is often difficult for companies to charge different prices for different consumers within a country because of the ease with which one segment would access prices intended for another.[47] Likewise, price discrimination focused on discounts to government agencies, with the assumption that such agencies will service the poor, is likely to fail to ameliorate the conditions of large numbers of working people who earn too much money to access government-operated clinics but earn too little, and have too little insurance, to afford the extremely high prices being targeted to the top sliver of income earners.

The more direct, effective, and available tool to accomplish lower prices in developing countries with high-income inequality is for such countries to grant open licenses, permitting competition by any qualified supplier, for essential medicine patents. Such licenses maximize the ability of competitive markets to push prices down as close as possible to the marginal cost of producing the drugs. The key will be for countries to adopt legal standards that will quickly and easily recognize a duty to license intellectual property rights, a refusal of which would trigger an open license remedy.

One such source of legal authority for open licenses may be found in "essential facility," "refusal to deal," and related competition law doctrines. On October 16, 2003, the South African Competition Commis-

sion issued a declaration finding that pharmaceutical firms GlaxoSmithKline and Boehringer Ingelheim violated the South African Competition Act by refusing to grant licenses for patents on essential AIDS medicines.[48] The Commission found that the drug patents of the companies were "essential facilities" for which it was economically feasible to grant competitors access,[49] and that the refusal to grant licenses to generic firms caused an anti-competitive effect that "outweighs its technological, efficiency or other pro-competitive gain."[50] As a remedy, the Commission sought "an order authorising any person to exploit the patents to market generic versions of the respondents patented medicines or fixed dose combinations that require these patents, in return for the payment of a reasonable royalty."[51] In our view, the South African Competition Commission correctly weighed the benefits and costs of monopoly pricing in that case, and indeed, our analysis suggests that there may be merit in a wider application of this approach.

The solution of compulsory licensing, of course, leads to new problems — in particular that the firms' incentives to innovate may be weakened. While this is true, one of the points made here is that for markets in which firms can expect demand to be highly convex — which is likely to be true in markets for medicines in most developing countries — the patent system will be ineffectual in delivering much innovation. It is not just that the countries are poor — it is that extreme income inequality leads to a highly convex demand curve.

Ultimately, the problem of finding an adequate and equitable mechanism to fund research and development for medicines in developing countries must be found elsewhere. While compulsory licensing in developing countries is likely to do little to hurt the existing (negligible) incentives to innovate produced by such markets,[52] it clearly would not help. The most difficult problem here is that of so-called "Type III," or "neglected" diseases, which are mainly prevalent in low- and medium-income countries, and for which there is no substantial market in high-income countries.[53] For these diseases, patent exclusivity offers relatively little incentive to invest in R&D, despite the potentially large health gains that might be realized.[54] Evidently, some other system for encouraging innovation for developing countries is required, such as government-funded basic research, global research and development pools, rewards and prizes, or other strategies.[55]

Appendix 1

Given the inverse demand curve $p = 1 - q^n$, with q and p both between 0 and 1, the profit maximizing quantity and price are given by

$$q^* = \left(\frac{1}{1+n}\right)^{\frac{1}{n}} \text{ and}$$

$$p^* = \frac{n}{n+1}.$$

The profit and DWL arising from this is given by

$$\pi = n\left(\frac{1}{n+1}\right)^{\frac{n+1}{n}} \text{ and}$$

$$DWL = \int_{\left(\frac{1}{n+1}\right)^{1/n}}^{1} \left(1 - q^n\right) dq$$

The deadweight loss to profit ratio that arises from this is

$$\frac{DWL}{\pi} = \frac{1}{n}\left[\frac{1}{n+1} - \left(\frac{1}{n+1}\right)^{-\frac{1}{n}} + \left(\frac{1}{n+1}\right)^{-\frac{n+1}{n}} - \left(\frac{1}{n+1}\right)^{-1}\right].$$

It is easy to verify that as n decreases, this ratio increases.

Appendix 2 — Graphic Representation of Relationship Between Inequality and the Revenue-Maximizing Point of Output

Here we present a series of tables and graphs to illustrate how a monopolist's profit-maximizing combination of price and output varies with the level of inequality in an economy. A pharmaceutical firm with unconstrained pricing power will maximize profits by selling a greater quantity at a relatively affordable price in economies with a fairly equitable income distribution, but will maximize revenues in less equitable economies by selling a smaller quantity at a higher price. Using real GDP and population statistics from the World Bank's development database, UNAIDS estimations of people living with HIV/AIDS, and income-by-decile statics from the World Institute for Development Economics Research of the United Nations University (UNU-WIDER) database, we have constructed a series of demand and total revenue graphs similar to the examples of South Africa and Norway in the body of the paper (Graphs 4.1, 4.2, 5.1, 5.2).

We first calculate per capita income for each decile. Assuming that people will be willing and able to purchase a medicine priced at 5% of their income, we derive a set of demand curves for 12 nations of varying levels of income inequality. They are displayed in the order of most equal (as measured by the Gini coefficient) to the least. As inequality increases, the demand curves become more convex.

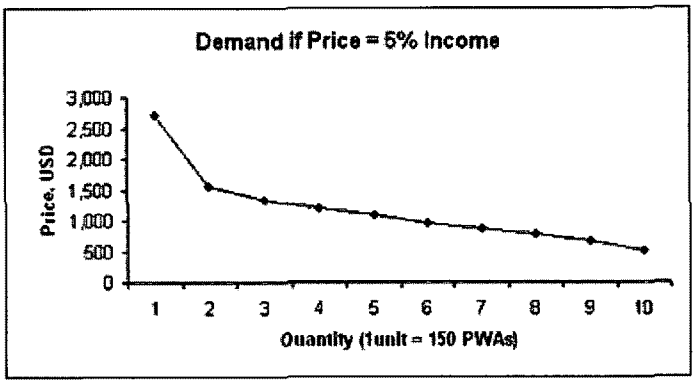
For the sake of simplicity, we assume that disease prevalence is equal among income deciles. We construct graphs of total revenue (quantity demanded times price,

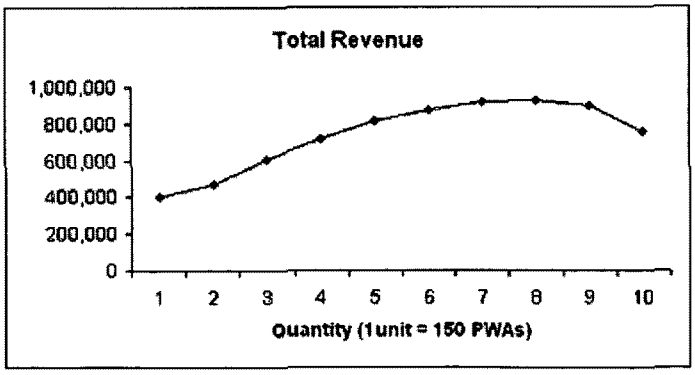
for each price along the demand curve) against the quantity sold. The revenue-maximizing price/quantity combination in the two most equitable economies in our sample, Finland and France, is that in which 80% of the people who need the medicines will obtain them. (In each of the tables in Appendix 2, the maximum revenue and corresponding quantity sold are highlighted.) For countries with higher Gini coefficients and more convex demand curves, the revenue-maximizing point moves leftward, indicating that monopolies in these countries will earn the most money by charging prices that smaller and smaller segments of the population can afford. In the most unequal countries, monopolists clearly maximize revenue by selling at high prices to only the wealthiest 10% of the population.

The UNU-WIDER database on measurements of equality is the most complete compilation of inequality data available, but it contains observations from a variety of sources. We have taken steps to ensure that the data used in this Appendix is comparable from one country to another. Many other studies on equality have suffered from problems arising from improper cross-country comparisons. An excellent discussion of common problems in studies of inequality, and a guide on how to improve on cross-country comparisons is found in Deininger and Squire (1996).

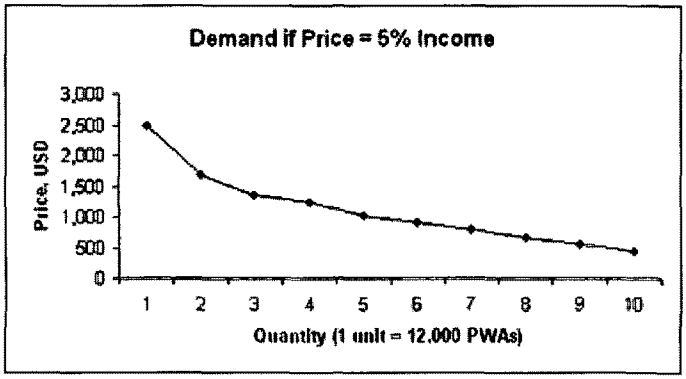
In each country, surveys were conducted at the household level, then adjusted for the differing size of households in order to derive distribution-per-person. In all of our observations, data is taken from surveys which sampled the entire population, including all geographic areas and all age groups. We ignored studies that only surveyed urban populations or a subgroup of the entire population (i.e., employees or people between the ages of 15 and 64). We used only data points on distribution of *income*, ignoring data points measuring the distribution of *consumption*. Finally, the UNU-WIDER database gives each data point a numeric quality rating from 1 (highest) to 4 (lowest). We only included data rated 1 or 2, which indicate that the authors of the database were able to verify the income concept and the survey method (1), or at least one or the other (2).

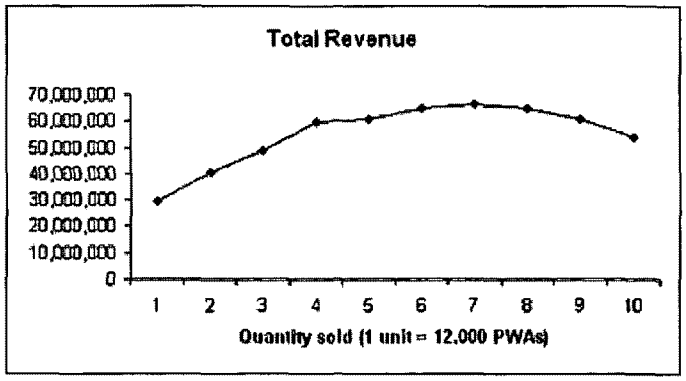
FINLAND		Gini=26.4		Year 2000	
% Income by Decile	% Income x GDP	%Inc(GDP) /(pop/10)	Ave Inc. x 5%	PWAs	Total Revenue
23.20	27,970,592,800	54,037	2,702	150	405,277
13.40	16,155,428,600	31,211	1,561	300	468,165
11.50	13,864,733,500	26,786	1,339	450	602,675
10.30	12,417,978,700	23,991	1,200	600	719,716
9.30	11,212,349,700	21,661	1,083	750	812,301
8.30	10,006,720,700	19,332	967	900	869,948
7.50	9,042,217,500	17,469	873	1050	917,114
6.60	7,957,151,400	15,373	769	1200	922,354
5.70	6,872,085,300	13,276	664	1350	896,151
4.30	5,184,204,700	10,015	501	1500	751,160
GDP	120,562,900,000				
Population	5,176,198				
HIV+	1,500				



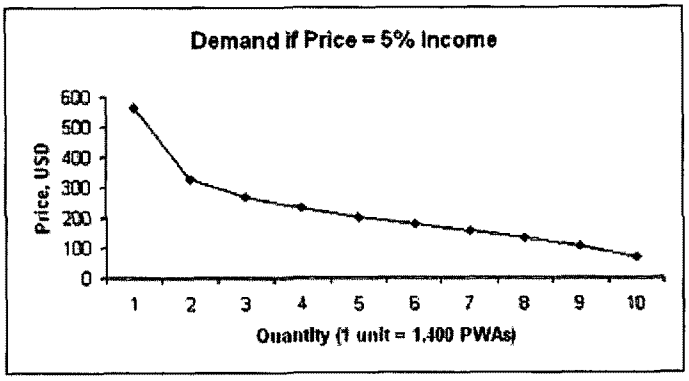


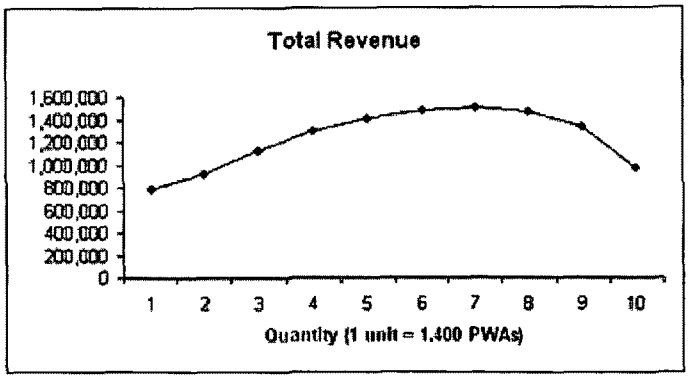
FRANCE		Gini=28.2		Year 2000	
% Income by Decile	% Income x GDP	%Inc(GDP) /(pop/10)	Ave Inc. x 5%	PWAs	Total Revenue
22.00	292,151,860,000	49,605	2,480	12,000	29,763,064
15.00	199,194,450,000	33,822	1,691	24,000	40,585,997
12.00	159,355,560,000	27,057	1,353	36,000	48,703,196
11.00	146,075,930,000	24,803	1,240	48,000	59,526,129
9.00	119,516,670,000	20,293	1,015	60,000	60,878,996
8.00	106,237,040,000	18,038	902	72,000	64,937,595
7.00	92,957,410,000	15,783	789	84,000	66,290,462
6.00	79,677,780,000	15,373	676	96,000	64,937,595
5.00	66,398,150,000	13,529	564	108,000	60,878,996
4.00	53,118,520,000	9,019	451	120,000	54,114,663
GDP	1,327,963,000,000				
Population	58,895,520				
HIV+	120,000				



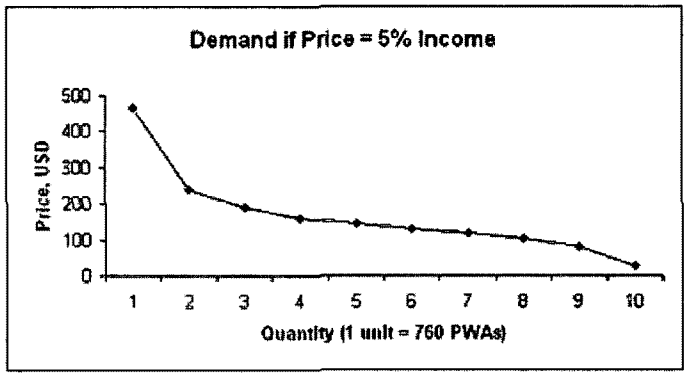


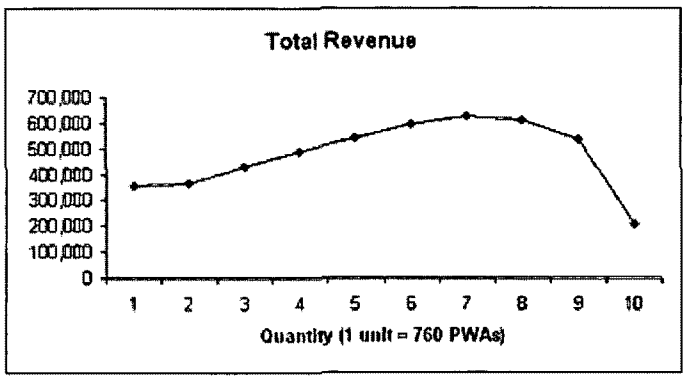
POLAND		Gini=31.9		Year 1999	
% Income by Decile	% Income x GDP	%Inc(GDP) /(pop/10)	Ave Inc. x 5%	PWAs	Total Revenue
25.35	43,425,990,816	11,293	565	1,400	790,512
14.69	25,170,216,864	6,546	327	2,800	916,380
12.04	20,621,692,104	5,363	268	4,200	1,126,171
10.36	17,748,669,120	4,616	231	5,600	1,292,363
9.04	15,490,682,064	4,028	201	7,000	1,409,936
7.92	13,568,480,640	3,529	176	8,400	1,481,976
6.88	11,790,187,344	3,066	153	9,800	1,502,372
5.87	10,056,437,040	2,615	131	11,200	1,464,512
4.75	8,134,235,616	2,115	106	12,600	1,332,656
3.10	5,310,895,200	1,381	69	14,000	966,777
GDP	171,319,200,000				
Population	38,453,800				
HIV+	14,000				



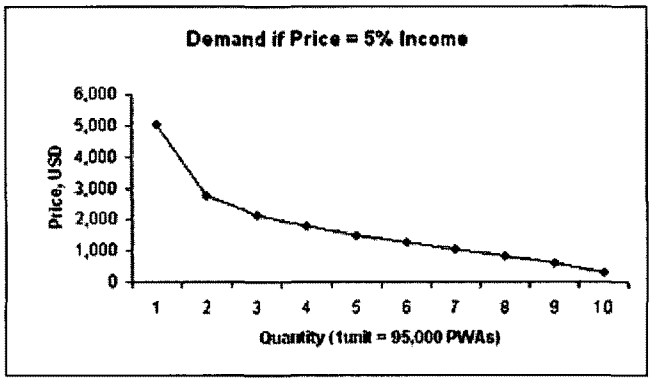


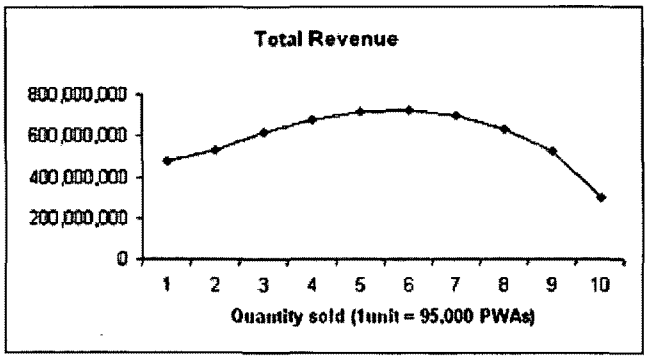
LATVIA		**Gini=35.0**		**Year 1999**	
% Income by Decile	% Income x GDP	%Inc(GDP) /(pop/10)	Ave Inc. x 5%	PWAs	Total Revenue
28.18	2,207,493,616	9,306	465	760	353,646
14.54	1,138,554,372	4,800	240	1,520	364,798
11.41	893,849,835	3,768	188	2,280	429,591
9.70	759,772,360	3,203	160	3,040	486,869
8.65	677,433,016	2,856	143	3,800	542,632
7.88	617,071,862	2,601	130	4,560	593,138
7.14	559,444,838	2,359	118	5,320	627,371
6.10	477,841,606	2,015	101	6,080	612,411
4.74	371,210,578	1,565	78	6,840	535,219
1.66	130,396,917	550	27	7,600	208,899
GDP	7,833,069,000				
Population	2,372,000				
HIV+	7,600				



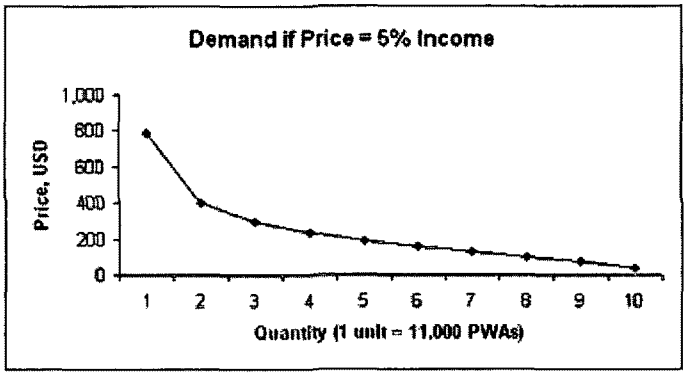


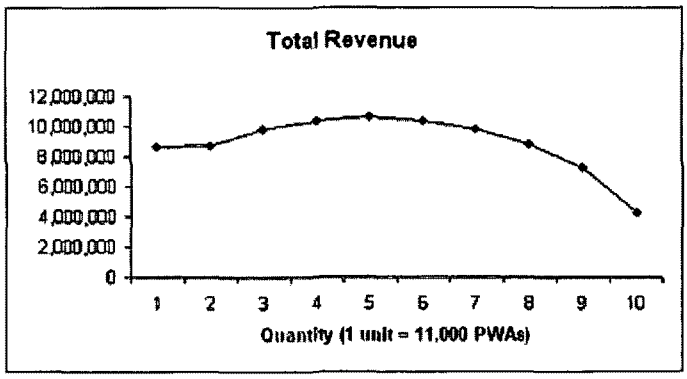
UNITED STATES		Gini=39.4		Year 2000	
% Income by Decile	% Income x GDP	%Inc(GDP) /(pop/10)	Ave Inc. x 5%	PWAs	Total Revenue
29.03	2,834,721,440,000	100,442	5,022	95,000	477,100,702
16.07	1,568,910,416,000	55,591	2,780	190,000	528,114,156
12.45	1,216,108,192,000	43,090	2,155	285,000	614,035,012
10.30	1,005,481,456,000	35,627	1,781	380,000	676,914,354
8.67	846,412,864,000	29,991	1,500	475,000	712,281,929
7.32	714,881,008,000	25,330	1,267	570,000	721,912,691
6.04	589,696,272,000	20,895	1,045	665,000	694,746,054
4.79	467,245,680,000	16,556	828	760,000	629,122,110
3.53	344,502,144,000	12,207	610	855,000	521,836,083
1.81	176,840,528,000	6,266	313	950,000	297,633,266
GDP	9,764,800,000,000				
Population	282,224,000				
PWAs (2003)	950,000				



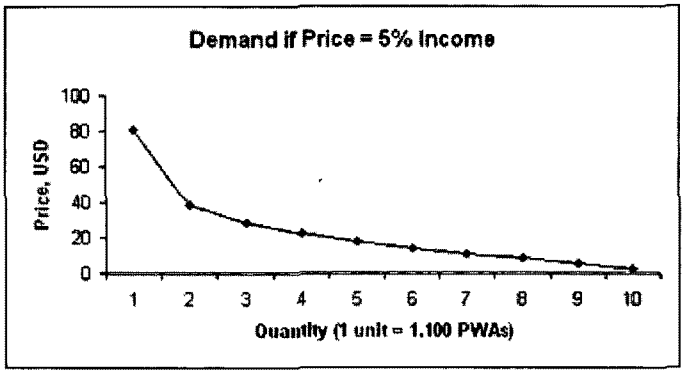


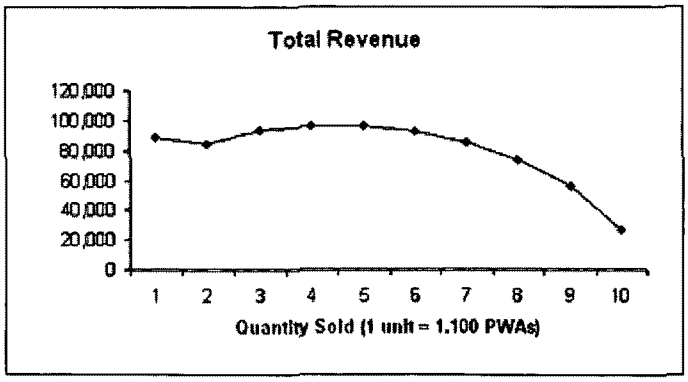
VENEZUELA		**Gini=44.1**		**Year 2000**	
% Income by Decile	% Income x GDP	%Inc(GDP) /(pop/10)	Ave Inc. x 5%	PWAs	Total Revenue
32.70	38,302,077,904	15,755	788	11,000	8,665,272
16.52	19,348,395,171	7,959	398	22,000	8,754,570
12.36	14,482,954,274	5,957	298	33,000	9,829,655
9.78	11,462,839,944	4,715	236	44,000	10,373,184
8.02	9,390,498,900	3,863	193	55,000	10,622,299
6.54	7,664,882,302	3,153	158	66,000	10,404,390
5.28	6,181,261,484	2,543	127	77,000	9,788,925
4.15	4,864,004,551	2,001	100	88,000	8,803,266
3.05	3,571,789,557	1,469	73	99,000	7,272,576
1.60	1,878,895,915	773	39	110,000	4,250,721
GDP	117,147,600,000				
Population	24,311,000				
HIV+	110,000				



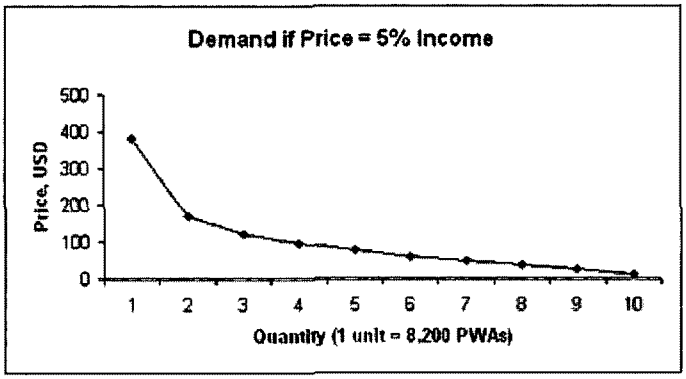


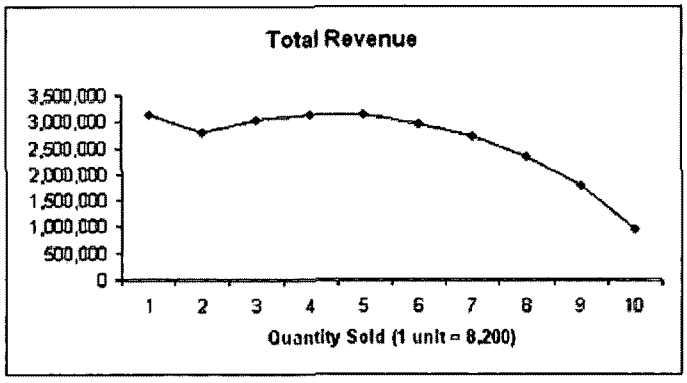
UZBEKISTAN		Gini=48.1		Year 2001	
% Income by Decile	% Income x GDP	%Inc(GDP) /(pop/10)	Ave Inc. x 5%	PWAs	Total Revenue
35.45	4,042,342,942	1,619	81	1,100	89,049
16.79	1,914,602,482	767	38	2,200	84,354
12.36	1,409,009,617	564	28	3,300	93,118
9.62	1,096,359,745	439	22	4,400	96,607
7.63	870,276,105	349	17	5,500	95,857
6.14	700,450,602	281	14	6,600	92,582
4.82	549,915,158	220	11	7,700	84,799
3.64	414,904,818	166	8	8,800	73,120
2.49	283,920,636	114	6	9,900	56,291
1.05	119,567,326	48	2	11,000	26,340
GDP	11,401,350,000				
Population	24,967,000				
PWAs	11,000				



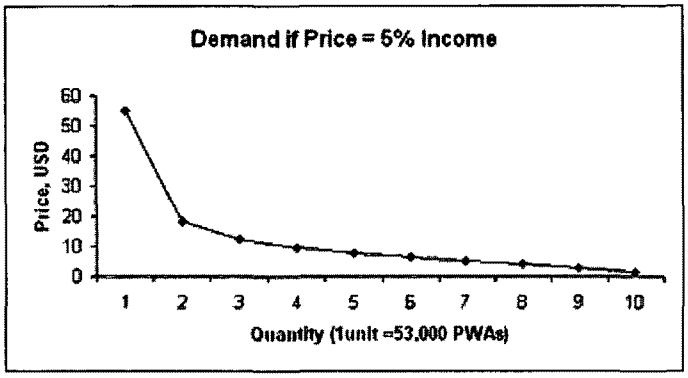


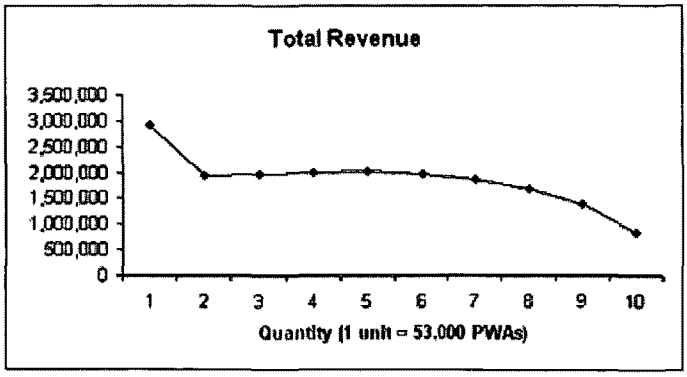
PERU		Gini=49.6		Year 2000	
% Income by Decile	% Income x GDP	%Inc(GDP) /(pop/10)	Ave Inc. x 5%	PWAs	Total Revenue
37.24	19,844,229,947	7,646	382	8,200	3,135,047
16.56	8,826,691,316	3,401	170	16,400	2,788,931
12.03	6,411,208,489	2,470	124	24,600	3,038,582
9.34	4,977,260,456	1,918	96	32,800	3,145,286
7.43	3,957,856,392	1,525	76	41,000	3,126,366
5.84	3,112,908,969	1,199	60	49,200	2,950,717
4.61	2,456,440,275	947	47	57,400	2,716,527
3.45	1,837,784,576	708	35	65,600	2,322,707
2.35	1,253,368,752	483	24	73,800	1,782,096
1.15	612,640,013	236	12	82,000	967,866
GDP	53,290,389,504				
Population	25,952,192				
HIV+	82,000				



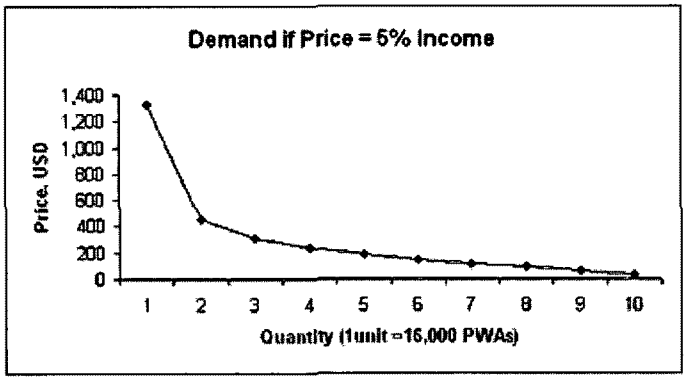


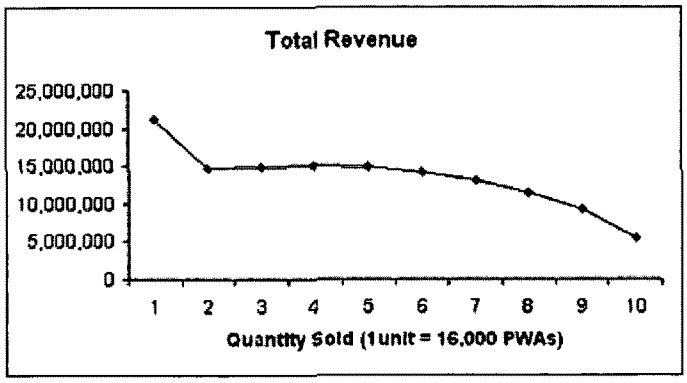
UGANDA		Gini=54.6		Year 2000	
% Income by Decile	% Income x GDP	%Inc(GDP) /(pop/10)	Ave Inc. x 5%	PWAs	Total Revenue
45.05	2,669,913,864	1,098	55	53,000	2,910,588
14.88	881,961,201	363	18	106,000	1,922,927
10.12	599,794,089	247	12	159,000	1,961,584
7.71	456,955,675	188	9	212,000	1,992,588
6.20	367,565,213	151	8	265,000	2,003,493
5.06	300,058,716	123	6	318,000	1,962,641
4.09	242,464,969	100	5	371,000	1,850,250
3.24	191,961,951	79	4	424,000	1,674,128
2.37	140,534,714	58	3	477,000	1,378,826
1.27	75,163,550	31	2	530,000	819,390
GDP	5,926,374,000				
Population	24,308,740				
HIV+	530,000				



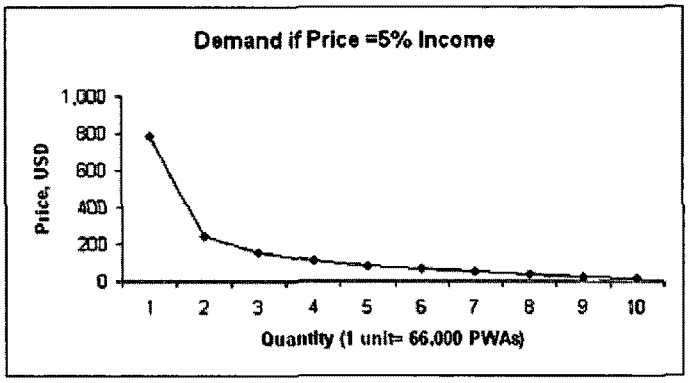


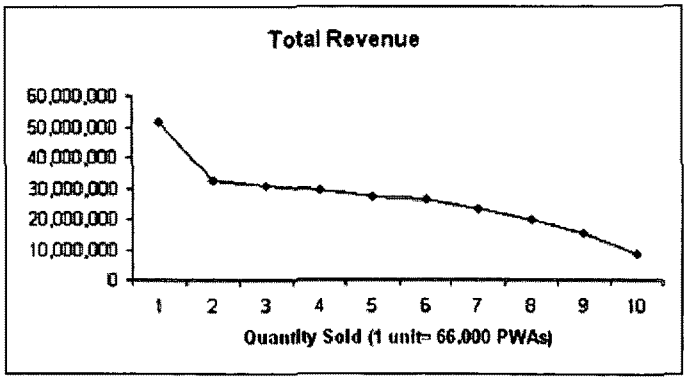
MEXICO		**Gini=55.6**		**Year 2000**	
% Income by Decile	% Income x GDP	%Inc(GDP) /(pop/10)	Ave Inc. x 5%	PWAs	Total Revenue
44.81	260,562,287,460	26,597	1,330	16,000	21,277,773
15.49	90,083,357,427	9,195	460	32,000	14,712,591
10.40	60,470,380,592	6,173	309	48,000	14,814,212
7.90	45,913,620,628	4,687	234	64,000	14,997,406
6.26	36,425,102,265	3,718	186	80,000	14,872,549
4.94	28,715,126,559	2,931	147	96,000	14,069,433
3.90	22,673,082,952	2,314	116	112,000	12,960,544
3.01	17,493,486,568	1,786	89	128,000	11,428,283
2.14	12,463,840,052	1,272	64	144,000	9,160,285
1.14	6,626,086,425	676	34	160,000	5,410,927
GDP	581,426,400,000				
Population	97,966,000				
PWAs	160,000				



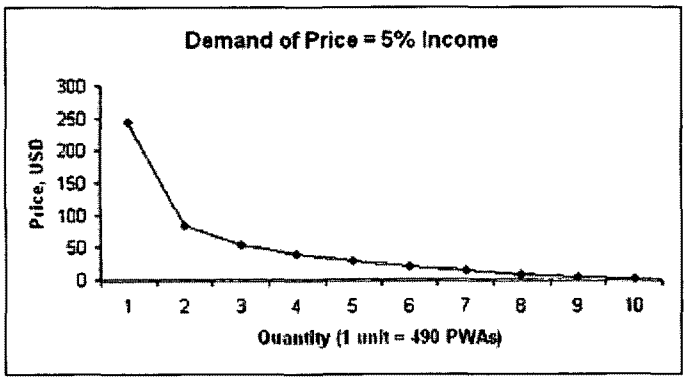


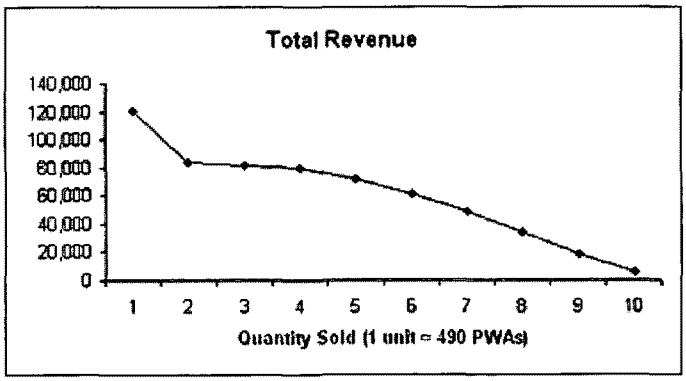
BRAZIL		Gini=61.2		Year 2001	
% Income by Decile	% Income x GDP	%Inc(GDP) /(pop/10)	Ave Inc. x 5%	PWAs	Total Revenue
49.97	276,002,043,648	15,648	782	66,000	51,639,768
15.67	86,517,846,607	4,905	245	132,000	32,374,844
9.84	54,362,038,943	3,082	154	198,000	30,513,286
7.05	38,913,504,781	2,206	110	264,000	29,122,746
5.24	28,958,952,270	1,642	82	330,000	27,090,988
4.21	23,240,293,769	1,318	66	396,000	26,089,446
3.22	17,764,421,688	1,007	50	462,000	23,265,967
2.36	13,049,024,497	740	37	528,000	19,531,699
1.62	8,955,858,636	508	25	594,000	15,080,708
0.82	4,525,466,523	257	13	660,000	8,467,113
GDP	552,289,400,000				
Population	176,377,000				
HIV+	660,000				





BOLIVIA		**Gini=63.3**		**Year 2000**	
% Income by Decile	% Income x GDP	%Inc(GDP) /(pop/10)	Ave Inc. x 5%	PWAs	Total Revenue
48.65	4,085,917,345	4,913	246	490	120,367
16.92	1,420,570,742	1,708	85	980	83,697
10.94	918,981,800	1,105	55	1,470	81,217
8.03	674,625,211	811	41	1,960	79,495
5.78	485,741,092	584	29	2,450	71,547
4.13	346,543,489	417	21	2,940	61,253
2.80	234,858,780	282	14	3,430	48,431
1.70	142,705,305	172	9	3,920	33,632
0.81	68,424,143	82	4	4,410	18,141
0.23	19,490,353	23	1	4,900	5,742
GDP	8,397,858,000				
Population	8,316,648				
PWAs	4,900				





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1. G. Calabresi and A. D. Melamed, "Property Rules, Liability Rules, and Inalienability: One View of the Cathedral," *Harvard Law Review* 85, no. 6 (1972): 1089-1128, at 1092; see also R. P. Merges, "Contracting into Liability Rules: Intellectual Property Rights and Collective Rights Organizations," *California Law Review* 84, no. 5 (1996): 1293-1393; J. H. Reichman, "Of Green Tulips and Legal Kudzu: Repackaging Rights in Subpatentable Innovation," *Vanderbuilt Law Review* 53, NO. 6 (2000): 1743-1798.
2. Liability rules are the default form of protection for digital broadcasting of copyrighted music in the U.S., for example, where "certain non-interactive digital audio services [may] transmit sound recordings under a compulsory license, provided that the services pay a reasonable royalty fee and comply with the terms of the license." Determination of Reasonable Rates and Terms for the Digital Performance of Sound Recordings, 37 C.F.R. §260 (2007); see 17 U.S.C. 106(6) & 114(d) (2001). Liability rules are also used to compensate American agricultural chemical companies when competitors use their test data submitted to the FDA for regulatory approval under the Federal Insecticide, Fungicide, and Rodenticide Act. See S. Basheer, "Protection of Regulatory Data Under Article 39.3 of TRIPS: A Compensatory Liability Model?" (Intellectual Property Institute, forthcoming 2008).
3. See F. M. Scherer and J. Watal, "Post-TRIPS Options for Access to Patented Medicines in Developing Nations," *Journal of International Economic Law* 5, no. 4 (2002): 913-939 [hereinafter Scherer and Watal].
4. *eBay Inc v. MercExchange, L.L.C.*, 126 S. Ct. 1837 (2006) (holding than injunctions should only issue upon showing that (1) that patent holder has suffered an irreparable injury; (2) that remedies available at law are inadequate to compensate for that injury; (3) that considering the balance of hardships between the plaintiff and defendant, a remedy in equity is warranted; and (4) that the public interest would not be disserved by a permanent injunction).
5. Agreement on Trade Related Aspects of Intellectual Property Rights, April 15, 1994, Marrakesh Agreement Establishing the World Trade Organization, Annex 1C, art. 31, Legal Instruments-Results of the Uruguay Round vol. 31, 33 I.L.M. 81 (1994) [hereinafter TRIPS] Article 31(h) of the TRIPS agreement requires that "the right holder shall be paid adequate remuneration in the circumstances of each case [of compulsory licensing], taking into account the economic value of the authorization". Article 31(k) adds that "[t]he need to correct anti-competitive practices may be taken into account in determining the amount of remuneration", allowing for zero royalty licenses in appropriate cases.
6. TRIPS art. 31(h).
7. World Trade Organization, Ministerial Declaration of 14 November 2001, paragraph 3 WT/MIN(01)/DEC/2, 41 I.L.M. 755 (2002) [hereinafter Doha Declaration] (stating: "Each Member has the right to grant compulsory licences and the freedom to determine the grounds upon which such licences are granted"). The Doha Declaration called specific attention to the appropriateness of special measures, including compulsory licenses, to respond to "the gravity of public health problems afflicting many developing and least developed countries, especially those resulting from HIV/AIDS, tuberculosis, malaria and other epidemics." Doha Declaration on TRIPS, paragraph 1. The Declaration recognised, and sought to address, "concerns about effects [of patents] on prices" of medicines. Doha Declaration on TRIPS, at paragraph 3. Further, the Doha Declaration records the agreement of all members that:

   [T]he TRIPS Agreement does not and should not prevent Members from taking measures to protect public health. Accordingly, while reiterating our commitment to the TRIPS Agreement, we affirm that the Agreement can and should be interpreted and implemented in a manner supportive of WTO Members' right to protect public health and, in particular, to promote access to medicines for all. In this connection, we reaffirm the right of WTO Members to use, to the full, the provisions in the TRIPS Agreement, which provide flexibility for this purpose. Doha Declaration on TRIPS, paragraph 4.
8. Letter from Peter Mandelson, EU Trade Commissioner, to Aides and Act Up-Paris (September 3, 2007), *available at* <http://www.essentialdrugs.org/edrug/archive/200709/msg00014.php> (last visited February 16, 2009).
9. See, e.g., WHO Commission on Macroeconomics and Health, *Macroeconomics and Health: Investing in Health for Economic Development* (Geneva: World Health Organization, 2001); Commission on Intellectual Property Rights, *Integrating Intellectual Property Rights and Development Policy* (London: Commission on Intellectual Property Rights, 2002); Commission on Intellectual Property Rights, Innovation and Public Health, *Public Health, Innovation and Intellectual Property Rights*, (Geneva: World Health Organization, 2006); J. Lanjouw, *Patents, Price Controls and Access to New Drugs: How Policy Affects Global Market Entry* (Center for Global Development, Working Paper No. 61, 2005), *available at* <http://www.nber.org/papers/w11321>); Scherer and Watal, *supra* note 3; J. Watal, "Pharmaceutical Patents, Prices and Welfare Losses: Policy Options for India Under the WTO TRIPS Agreement," *World Economics* 23, no. 5 (2000): 733-752.
10. F. M. Scherer, "A Note on Global Welfare in Pharmaceutical Patenting," *World Economics* 27, no. 7 (2004): 1127-1142 (2004). For other economic scholarship using a similar approach, see Lanjouw, *id.*; Scherer and Watal, *supra* note 3; Watal, *supra* note 9.
11. See F. M. Scherer and D. Ross, *Industrial Market Structure and Economic Performance*, 3rd ed. (Boston: Houghton Mifflin Co., 1990): at 621-630; *c.f.* U.S. Constitution, art. 1, § 8 (giving Congress the power "To promote the Progress of Science and useful Arts, by securing for limited Times to Authors and Inventors the exclusive Right to their respective Writings and Discoveries").
12. See generally K. Outterson, *A Request for Clarification Concerning the Proper Scope of the IGWG's Work to Improve Access to Patented Medicines*, September 30, 2007, *available at* <http://www.who.int/phi/public_hearings/second/contributions_section1/Section1_Kevin_Outterson_Boston_Uni_Full_Contribution.pdf> (last visited February 17, 2009).
13. In a perfectly competitive market, each firm is a price "taker," and must accept the market price, which competitors drive down until it is approximately equal to the firm's marginal cost. Patented items in an imperfect, but still competitive, market will be restrained by the same market forces to a greater or lesser extent depending on the degree to which substitutes are functionally equivalent.
14. *Cf.* M. Parkin, *Microeconomics*, 7th ed. (Boston: Addison-Wesley, 2005): at 262-267 (explaining basic monopoly economics).
15. Normally, a diagram of monopoly pricing would include a marginal cost curve. The equation of marginal cost to zero approximates a simplified pharmaceutical market characterized by high fixed costs of R&D, but relatively small production costs (including the active pharmaceutical ingredients used to manufacture medicines). The marginal cost of production in the pharmaceutical industry is typically close to constant, since for most drugs inputs are available in competitive global markets. This is not true of all drugs. For example, Taxol originally used a natural ingredient derived from the yew tree and so there were biological limits to the amount that could be harvested, but for most other drugs, the costs of manufacturing are more or less constant, and therefore the incorporation of a marginal cost curve would not change the basic economic analysis.
16. The equation for inverse demand is $p = 529(0.9^q)$.
17. See J. W. Hughes, M. J. Moore, and E. A. Snyder, *'Napsterizing' Pharmaceuticals: Access Innovation and Consumer Welfare*, Nationall Bureau of Economic Research, Working Paper No. 9229, 2002; J. Duffy, "A Minimum Optimal Patent Term,"

2003, unpublished manuscript, *available at* <http://ssrn.com/abstract=354282> (last visited February 17, 2009).

18. D. Wright, "Optimal Patent Breadth and Length with Costly Imitation," *International Journal of Industrial Organization* 17, no. 3 (1999): 419-436.
19. World Health Organization, "The Selection and Use of Essential Medicines: Report of the WHO Expert Committee," *WHO Technical Report Series* 914 (2002): 16-24 (defining "Essential Medicines" as "those that satisfy the priority health care needs of the population.") The assumption of no adequate substitutes makes our definition not necessarily the same as that of WHO.
20. See E. 't Hoen, "TRIPS, Pharmaceutical Patents, and Access to Essential Medicines: A Long Way From Seattle to Doha," *Chicago Journal of International Law* 3, no. 1 (2002): 27-46, at 34 (explaining that health activists opposed proposals limiting use of compulsory licenses to drugs on the WHO Model List of Essential Drugs because only 11 of the 306 products on the list are patented).
21. Generally, the exclusive marketing right to which we refer would be granted by a patent. But other such rights, for example those created by "data exclusivity" protections that prevent generic products from being registered for sale for a period of time based on the safety and efficacy data submitted by the innovator firm, may cause similar access problems.
22. See Watal, *supra* note 9.
23. WHO Regional Office of the Western Pacific, "TRIPS, Intellectual Property Rights and Access to Medicines," *HIV/AIDS Antiretroviral Newsletter*, December 2002 (reporting that patients themselves pay for 50% - 95% of medicines in developing countries).
24. See E. V. Wong, *Inequality and Pharmaceutical Drug Pricing: An Empirical Exercise*, Center. for Economic Analysis, Economic Department, University of Colorado at Boulder, Working Paper No. 02-19, 2002. In the case that the drug is government-provided, the financial capabilities of the state and its willingness to pay for a given therapy become the relevant constraints.
25. In principle, sick individuals could borrow against expected future earnings to finance purchasing the drug today. But banks will not in general lend on that kind of basis, and so no such borrowing is possible.
26. Data from Statistics South Africa's 2000 Income and Expenditure Survey, as reported by the South African Regional Poverty Network, *available at* <http://www.sarpn.org.za/documents/d0001062/P1175-simkins_Nov2004.pdf> (last visited February 17, 2009). A more complete analysis would include examination of the distribution of wealth as well. But we do not know of an available estimate of the true distribution of wealth in South Africa. Typically wealth distribution is more unequal than income distribution. Poor households with a survival income typically have virtually no accumulated wealth.
27. Our assumptions understate the steepness of the demand curve for the higher income segments since, in fact, wealthier segments of the population are likely to be willing and able to spend a greater share of their income on a needed good. AIDS is also not evenly distributed, but rather is concentrated among urban populations with somewhat higher incomes and mobility. See P. Piot, R. Greener, and S. Russell, "Squaring the Circle: AIDS, Poverty and Human Development," *PLOS Medicine* 4, no. 10 (2007) (noting that AIDS is "more concentrated among the urban employed and more mobile members of society, and consequently the more wealthy groups").
28. Figure 2 is indeed exactly based on this income distribution.
29. See Income and Expenditure Survey (IES) 2000, Statistics South Africa, *available at* <www.statssa.gov.za> (last visited February 17, 2009) showing that the average South African household in the top 20 percent income bracket spends three to five percent of their income on out-of-pocket medical expenses, including medicines; see also *Integrated Household Survey* 1993, World Bank, *available at* <www.worldbank.org/html/prdph/lsms/country/za94/za94data.html#top> (last visited February 17, 2009). Five percent of income also appears to be a reasonable maximum for out of pocket health expenditures in the U.S. See T. J. Songer, R. E. LaPorte, J. R. Lave, J. S. Dorman, and D. J. Becker, "Health Insurance and the Financial Impact of IDDM in Families with an IDDM-affected Child" *Diabetes Care* 20, no. 4 (1997): 577-584.; 42 CFR § 457.560 (requiring participating states to cap poor family contributions to health at 5 percent of income).
30. Joint United Nations Programme on HIV/AIDS, *Epidemiological Fact Sheets on HIV/AIDS and Sexually Transmitted Infections: South Africa*, December 2006, *available at* <http://www.who.int/GlobalAtlas/predefinedReports/EFS2006/EFS_PDFs/EFS2006_ZA.pdf> (last visited February 17, 2009).
31. As noted above, the prevalence of HIV/AIDS is not uniform across deciles, but higher among South Africans with higher incomes. We assume uniformity in order to simplify our demonstration that a firm will maximize sales by selling exclusively to the elite. If we were to weigh demand at each income decile to account for differences in prevalence of HIV/AIDS, it would lead to an even greater difference between demand and sales at the upper and lower income deciles (firms would be *less* likely to sell to the middle and lower classes).
32. World Bank, World Development Indicators Database, *available at* <http://devdata.worldbank.org/query/> (last visited February 17, 2009) (Constant GDP in 2000 USD and population statistics for the year 2000 were taken from the data base for South Africa, Norway, and all of the countries listed in Appendix 2).
33. Since the marginal cost of production is usually very low and nearly constant across production levels, we are showing total revenue instead of marginal revenue and marginal cost. See Parkin, *supra* note 14.
34. In fact, the profit maximizing price may serve a much smaller segment of the population, as world prices of over $10,000 annually for AIDS medicines in the pre-2000 period suggests. Unfortunately, accurate data for segments of the population smaller than a decile are not readily available.
35. Norway also has an excellent health insurance system so that in principle income need not be a barrier for anyone to obtain needed drugs there. Also, we are once again assuming uniformity in HIV/AIDS prevalence across income deciles.
36. Data on income distribution in Norway for 2000 was taken from Statistics Norway, which is under the Norwegian Ministry of Finance (www.ssb.no). Statistics Norway, Norwegian Ministry of Finance, *Income Distribution: More Equal Income Distribution* (March 7, 2008), *available at* <http://www.ssb.no/english/subjects/05/01/iffor_en/> (last visited February 17, 2009). GDP data from the World Bank, *supra* note 32. According to UNAIDS data, there are 2500 people with HIV/AIDS in Norway, far less than South Africa. Figures 5.1 and 5.2 still assume that HIV is distributed evenly across income deciles, so each 10th of the HIV+ population represented in the graphs represents 250 potential consumers. Joint United Nations Programme on HIV/AIDS, *Epidemiological Fact Sheets on HIV/AIDS and Sexually Transmitted Infections: Norway*, December 2006, *available at* <http://www.who.int/GlobalAtlas/predefinedReports/EFS2006/EFS_PDFs/EFS2006_NO.pdf> (last visited February 17, 2009).
37. Indeed, because of universal drug insurance, the monopolist will be able to sell to all consumers.
38. See Appendix 2.
39. See Wong, *supra* note 24.
40. See E. 't Hoen, *supra* note 20. It is noteworthy that the price discounts that major companies do give in poorer countries for antiretrovirals are based on per capita income, not the degree of inequality in the country. For countries with middle incomes but high inequality, such discounts are likely to be insufficient to address the true nature of the access problem.
41. See Scherer and Watal, *supra* note 3 (showing that there was in fact very little correlation between national income and

pricing of AIDS drugs in a large sample of prices from 1995-1999).

42. See K. Maskus, *Parallel Imports in Pharmaceuticals: Implications for Competition and Prices in Developing Countries* (April 2001) (unpublished report for the World Intellectual Property Organization, *available at* <http://www.wipo.int/export/sites/www/about-ip/en/studies/pdf/ssa_maskus_pi.pdf> (last visited February 17, 2009) (finding higher prices in Brazil and Mexico than Sweden or the UK for amlodipine, ciprofloxacin and sertraline). See also CPTech, *Note on Gleevec Price Hike in South Korea*, January 23, 2003, *available at* <www.cptech.org/ip/health/gleevec/gleevecprice-korea01222003.html> (last visited February 17, 2009) (reporting that the price of Gleevec in South Korea was raised 30% to over $1,000 /month, and is sold at a similar price in rich and poor countries); Médicins Sans Frontières, *Untangling the Web of Price Reductions: A Pricing Guide for the Purchase of ARVs for Developing Countries*, 10th ed. (Geneva: Médecins Sans Frontières, 2007): at 6 (showing that, prior to the vocal outcry of international treatment activists, the price of a first-line AIDS regime was the same in developed and developing countries – over $10,000 a year); R. Hellerstein, *Do Pharmaceutical Firms Price Discriminate Across Rich and Poor Countries? Evidence from Antiretroviral Drug Prices*, August 2004, unpublished paper, *available at* <http://www.ny.frb.org/research/economists/hellerstein/JDE2.pdf> (last visited February 17, 2009) (reporting that found that "ARV prices had little or no relationship to developing countries' per-capita incomes in 2000, when there was no generics competition"); C. Perez-Casas et. al., "Access to Fluconazole in Less-Developed Countries," Lancet 365, no. 9247 (2000): 2102-2102, at 2102 (reporting that the 2000 sales price of fluconazole, an important antifungal drug used with AIDS patients, was over twice as high in Guatemala as in the United States; $27.60 vs. $12.20 per unit).
43. Other tools may include prize-type mechanisms, price controls, use of formularies, reference pricing, and mandatory rebates. For a discussion of cost control measures used by OECD countries, see International Trade Administration, *Pharmaceutical Price Controls in OECD Countries* (Washington, D.C.: U.S. Department of Commerce, 2004); K. Outterson *U.S. Senate Testimony on the Dept. of Commerce OECD Drug Pricing Report*, U.S. Senate, Health Education, Labor and Pension Committee Hearings, February 2005. We believe that compulsory licenses to create competitive market in developing countries is a preferable tool for a host of reasons that we will not canvass here. See Watal, *supra* note 9 (preferring compulsory licenses to price controls for administrative efficiency reasons).
44. Section 41(4) of Canada's 1969 Patent Act (in place until 1992) created a presumptive right to a compulsory license for any medicine and instructed that "in settling the terms of the license and fixing the amount of royalty or other consideration payable, the Commissioner shall have regard to the desirability of making the medicine available to the public at the lowest possible price consistent with giving to the patentee due reward for the research leading to the invention and for such other factors as may be described." Under this law, royalties of 4% of the generic sales price were customarily awarded. See J. Reichman and C. Hasenzahl, *Non-voluntary Licensing of Patented Inventions: The Canadian Experience* (United Nations Conf. on Trade and Development/ International Center. for Trade and Sustainable Development Issue Paper No. 5: 2002). Section 41 of the UK Patent Act of 1949 created a rebuttable presumption in favor of compulsory licensing to ensure that food, medicine and surgical devices were "available to the public at the lowest prices consistent with the patentees' deriving reasonable advantage from their patent rights."
45. P. Danzon and A. Towse, *Differential Pricing for Pharmaceuticals: Reconciling Access, R&D and Patents*, (Washington D.C.: American Enterprise Institute-Brookings Joint Center for Regulatory Studies, 2003). The authors define Ramsey pricing as "the set of price differentials that yield the highest possible social welfare, subject to assuring a specified target profit level for the producer, usually a normal, risk-adjusted return on capital. The ROP solution is that prices should differ across market segments in inverse relation to their demand elasticities."
46. See Scherer and Watal, *supra* note 3 (observing a lack of Ramsey pricing in South Africa and other developing countries).
47. See C. F. Phillips, Jr., *The Regulation of Public Utilities*, at 61-63 (Vienna, Virginia: Public Utilities Reports Incorporated, 1988) (reporting that price discrimination tends to occur in situations where seller is able to split the market into distinct sectors that cannot trade with each other, such as utilities).
48. Media Release, South Africa Competition Commission, *Competition Commission Finds Pharmaceutical Firms in Contravention of the Competition Act*, October 16, 2003, *available at* <http://www.wcl.american.edu/pijip/documents/MediaRelease.doc> (last visited February 17, 2009).
49. See Competition Act 89 of 1998 s. 8(b) (S. Afr.) (declaring it unlawful for a dominant firm to "refuse to give a competitor access to an essential facility when it is economically feasible to do so").
50. See Competition Act 89 of 1998 s. 8(c) (S. Afr.) (declaring it unlawful for dominant firm to "engage in an exclusionary act... if the anti-competitive effect of that act outweighs its technological, efficiency or other pro-competitive gain").
51. See Media Release, *supra* note 48.
52. See UK Commission on Intellectual Property Rights, *Integrating Intellectual Property Rights and Development Policy* 32-33 (2002) (finding that developing country markets are small and have relatively little impact on the research agenda of international drug companies).
53. WHO Intergovernmental Working Group on Public Health, *Innovation and Intellectual Property Elements of a Global Strategy and Plan of Action. Provisional Agenda Item 2.3 for First Meeting*, November 2, 2006, *available at* <http://www.who.int/gb/phi/E/E_doc1.html> (last visited March 1, 2009)
54. H. Viñes Fiestas et al., *Investing for Life: Meeting Poor People's Needs for Access to Medicines through Responsible Business Practices* (Oxfam, Briefing Paper No. 109, 2007): 262-267 (noting that between 1999 and 2004, only 3 of the 163 new chemical entities introduced into the world pharmaceutical market were for "Type 3" diseases); C. Nathan, "Aligning Pharmaceutical Innovation with Medical Need," *Nature* 13 (2007): 3.
55. A. Hollis, "The Health Impact Fund: A Useful Supplement to the Patent System?" *Public Health Ethics* 1, no. 2 (2008): 124-133; Pogge, *supra* note 7; T. J. Hubbard and J. Love, "A New Trade Framework for Global Healthcare R&D," *PLoS Biology* 2, no. 2 (2007): 147-150; J. Love and T. Hubbard, "The Big Idea: Prizes to Stimulate R&D for New Medicines," *Chicago-Kent Law Review* 82, no. 3 (2007): 1519-1554.
56. World Institute for Development Economics Research of the United Nations University, *World Income Inequality Database*, Vol 2.0b (2007), *available at* <http://62.237.131.23/wiid/wiid.htm> (last visited February 17, 2009).
57. K. Deininger and L. Squire, "A New Data Set Measuring Income Inequality," *World Bank Economic Review* 10, no. 3. (1996): 565-591.