# What Do Drug Monopolies Cost Consumers?*

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**Abstract**

This paper quantifies the impact of drug monopolies on prices using the example of the antiretroviral (*ARV*) drugs used to treat the *HIV* virus. I use a new cross-country price dataset from 2000 to 2003 to estimate each *ARV*'s marginal cost and markup by country. These markups are compared across two groups of countries: those with and those without competition. Consumers in monopolistic countries did not have access to generic *ARV*'s over the sample period while those in competitive countries did. The results indicate the average markup on an annual dose of an *ARV* equals 109 percent of the annual per-capita income in monopolistic countries and only 25 percent of the annual per-capita income in competitive countries. I consider the implications of these findings for the implementation of the *TRIPS* (Trade-Related Aspects of Intellectual Property Rights) agreement in developing countries. The paper's two main contributions are to (i) estimate, without observing cost data, price-cost markups for each *ARV* in each country with price data; (ii) analyze how markups differ across countries with different degrees of competition.

**Key words**: pharmaceuticals, *TRIPS*, antiretrovirals, patents, monopoly, health.
**JEL classifications**: O3, D1, D4, L6, F1.

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# 1 Introduction

How much do drug monopolies increase prices in developing countries? The 1993 World Trade Organization's *TRIPS* agreement (Agreement on Trade-Related Aspects of Intellectual Property Rights) requires enforcement of intellectual property rights (IPRs) in developing countries by the year 2006. These IPRs include pharmaceutical patents that grant monopolies to produce and market a drug for a limited number of years. While there has been much public debate about the possible effects of the *TRIPS* agreement, there is little empirical evidence on how granting monopoly rights will impact prices in developing countries.

Most developing countries did not recognize or enforce product patents prior to the *TRIPS* agreement. In the U.S., a firm has a legal monopoly to produce and market a drug for twenty years after a patent is filed. This convention was universalized by the *TRIPS* agreement: Every *WTO* member is expected to grant patent protection for a minimum of 20 years to new drugs.

To evaluate the impact of the *TRIPS* agreement, there is a need for empirical work to quantify the costs to consumers of products' markups over marginal cost in developing countries with and without competition in the pharmaceutical market. There has been only a handful of empirical analyses, in published papers or working papers, of the implications of the *TRIPS* agreement for the pharmaceutical sector because of the difficulty in gaining access to good price and cost data.[1]

This study quantifies the effect of drug monopolies on prices using the example of the antiretroviral (*ARV*) drugs used to treat the *HIV* virus.[2] Recent developments make antiretrovirals a good case by which to gauge the impact of competition on drug prices. The unit costs to produce the drugs appear low enough for many individuals in developing countries to afford them. Production of generic variants of these drugs existed in some countries over the sample period (Brazil, India). Other countries had no or very limited access to generic variants of the drugs from 2000 to 2003 (South Africa, Uganda). These country-level differences provide an opportunity to examine pharmaceutical firms' markups in the presence and absence of competition, which will be proxied for by the absence or presence of generic variants of the drugs.

This paper uses a new cross-country data set of *ARV* prices to estimate the drugs' price-cost markups without observing cost data. The price data come from a collaboration with the

[1] See Chaudhuri, Goldberg, and Jia (2003); Challu (1991); Nogues (1993); and Watal (2000).

[2] *HIV* stands for Human Immunodeficiency Virus.

*Campaign for Access to Essential Medicines* run by the well-known NGO *Médicins Sans Frontières (MSF)*. The campaign gathers information on drug prices in developing countries for their own procurement needs and to produce policy reports.[3]

The paper finds that markups on an annual *ARV* dose average 109 percent of per-capita income in countries with a monopolistic market and 25 percent of per-capita income in countries with a competitive market.

The rest of the paper proceeds as follows. The next section reviews the *MSF* data and section 3 discusses the policy developments in the *ARV* market over the sample period from 2000 to 2003. Section 4 introduces the model used to estimate price-cost markups without observing cost data and section 5 reports estimation results. Finally, section 6 concludes.

# 2 Data

In this section I describe the *MSF* data.

## 2.1 MSF

The price data come from a collaboration with the *Campaign for Access to Essential Medicines* run by the well-known NGO *Médicins Sans Frontières (MSF)*. This campaign gathers information on drug prices in developing countries for their own procurement needs and to produce policy reports. Over the past few years *MSF* reports have each collected a single cross-section of antiretroviral drug prices. My data include prices from these studies and additional unpublished price information collected by *MSF*.

The data include the import prices for each product sold over a period of four years, from 2000 to 2003.[4] I define a product as one unit (a single capsule or tablet) of a drug. I supplement the *MSF* data with information on the sample countries' per-capita gross domestic product (*GDP*). The *GDP* data come from the World Bank's *World Development Indicators* for 2003.

[3] In the academic literature Elhanan Helpman (1993) has written the most prominent theoretical model addressing the *TRIPS* agreement. A highly stylized model of North-South trade, Helpman derives welfare effects following stricter enforcement of intellectual property rights from changes in the location of production (and hence in workers' wages) and in the terms of trade.

[4] Most of the prices are CIF, "Cost, Insurance, and Freight." The seller pays the costs and freight to transport the good to the destination port. The buyer is responsible for any additional costs after delivery to the port.

The data include prices for two types of drugs: antiretrovirals and drugs to treat opportunistic infections associated with the *HIV* virus. Antiretrovirals inhibit the actions of enzymes the *HIV* virus needs to reproduce, thus extending the length and quality of life of infected people. *ARVs* are comprised of two major drug classes, reverse transcriptase inhibitors and protease inhibitors (*PI*'s). The first group can be divided into two additional groups: Nucleoside Reverse Transcriptase Inhibitors (*NRTI*s) and Non-Nucleoside Reverse Transcriptase Inhibitors (*NNRTI*s). Therapies that combine drugs from the two classes suppress the *HIV* virus most effectively. Finally, fixed-dose combinations are formulations of more than one of the antiretrovirals and are more common in low-income than in high-income countries.

# 3 Market

This section recounts the dramatic changes in the *ARV* market from 2000 to 2003. It describes the price initiatives of originator and generics firms and reviews how they were implemented in the countries covered in the sample.

## 3.1 International Developments

When the magnitude of the *AIDS* crisis in Africa, Asia, and Latin America became clear in the late 1990s, a controversy erupted over the prices charged for the antiretroviral drugs used to treat the disease.[5] At that time *ARV's* were not widely available or affordable in most developing countries. *ARV* prices declined from 2000 to 2003 following originator firms' introduction of price discounts for low-income countries and increased generic competition.

In May of 2000, pharmaceutical firms that owned the patents on various *ARV's* (the originator firms) announced a number of voluntary price-reduction programs for residents of poor countries through a new public-private partnership called the Accelerated Access Initiative (*AAI*). The *AAI* was a partnership between five pharmaceutical firms and several United Nations organizations to improve the provision of *AIDS*-related treatment in developing countries.[6] The originator firms also made price offers through bilateral negotiations with individual governments. In practice, it

[5] *AIDS* stands for Acquired Immune Deficiency Syndrome.

[6] The pharmaceutical companies are *Boehringer Ingelheim*, *Bristol-Myers Squibb*, *Glaxo Wellcome*, *Merck & Co., Inc.*, and *F. Hoffmann-La Roche*.

often proved difficult for practitioners in the field to acquire the *AIDS* drugs at the pre-announced prices. Originator firms generally made their price offers to the 49 countries classified as "Least Developed" (*LDC*s) by the World Bank or in sub-Saharan Africa. Two of the originator firms, *Merck* and *Hoffmann-La Roche*, publicized price offers for medium-income countries.

Starting in the year 2000, Indian and Brazilian generics firms' low prices put pressure on originator firms to reduce their markups in low- and medium-income countries. For example, competition from generics manufacturers in India and Brazil forced the average branded price of an *AIDS* triple-combination therapy from $10,439 per year to less than $1,000 per year in 2000. Price competition between *ARV* manufacturers entered a new phase in February 2001 when the Indian generics manufacturer *Cipla* declared it would sell a triple-combination *ARV* treatment for $350 per patient per year. Finally, from 2002 to mid 2003, a number of Latin American countries bargained collectively with originator and generics firms to purchase *ARVs* under the *AAI*. The agreements that resulted reduced *ARV* prices in most of Latin America by the middle of 2003.

### 3.2 Developments within Countries

Countries included in the M*SF* sample belong to one of four groups which determined how their *ARV* markups changed from 2000 to 2003. The first group is made up of countries with domestic generic manufacturing of *ARVs* such as Brazil, India, and Thailand. The aggressive competition between generics producers in these countries produced prices roughly equal to marginal cost over the sample period. The second group includes medium-income countries with low *AIDS* prevalence. These countries did not qualify for most originator firms' *ARV* price offers until early 2003 and did not normally produce or import generic *ARV*'s. Prices remained high through 2003 when negotiations through the *AAI* led to the first substantial reductions. The third group includes countries that qualified for originators' price offers but that only allowed the purchase of generic *ARV's* with special government authorizations. This third group includes many sub-Saharan countries with high *AIDS* prevalence such as Ethiopia, Kenya, Rwanda, South Africa, Tanzania, and Uganda. Generics were not locally available in these countries and could be imported only via special arrangements between the nonprofit sector and the government. The fourth group consists of countries that qualified for the originator firms' price offers and that chose to purchase *ARV's* from both originator and generic manufacturers. Cameroon is the only country from this group

included in the sample. Cameroon is a medium-income country with an *HIV* prevalence of 15 percent among adults. In 2000, at the beginning of the sample, only originator drugs were available in the country. In 2001, the national procurement center, a government agency authorized to purchase *ARV*'s for the country, began to hold public tenders.[7] Since then both originator and generic *ARV's* have been available locally.

# 4 Model

This section describes the model used to estimate the price-cost markups.

## 4.1 Demand

Suppose we observe demand for a product in two countries, country 1 and country 2. Let a market be the total demand for the product in one time period and in one country. Each country's demand is characterized by a representative individual. Let there be a monopolist that produces the market's only product. The monopolist chooses its price in each country to maximize its profits:

$$\Pi_t = (p_{1t} - mc_t)\, x_{1t}\,(p_1) + (p_{2t} - mc_t)\, x_{2t}\,(p_{2t}) \tag{1}$$

where $p_{jt}$ is the price of the product in country $j$ at time $t$, $x_{jt}$ is the quantity demanded of the product in country $j$ at time $t$, and $mc_t$ is the marginal cost to produce the product which does not vary across countries. Assuming the firm sets prices to maximize profits, the price $p_{jt}$ must satisfy the first-order conditions:

$$0 = x_{1t} + (p_{1t} - mc_t)\frac{\partial x_{1t}}{\partial p_{1t}} \tag{2}$$

$$0 = x_{2t} + (p_{2t} - mc_t)\frac{\partial x_{2t}}{\partial p_{2t}} \tag{3}$$

This gives us a set of two equations, one for each product where $\frac{\partial x_{jt}}{\partial p_{jt}}$, $j$,$k$=1,2., is the change in demand for the $k$th country's product given a change in the $j$th country's price for the product.

[7] This public procurement agency is named CENAME which stands for Centre Nationale d'Approvisionnement en Médicaments et Consommables Médicaux Essentiels.

If markets are perfectly segmented, each market's price is a function of the marginal cost and the demand elasticity in that market alone. One can rearrange equations 2 and 3 to express the price as a function of the marginal cost and a markup term that depends on each country's demand elasticity:

$$p_{jt} = mc_t \left( \frac{\eta_j}{(\eta_j - 1))} \right) \text{ for } j = 1, 2. \tag{4}$$

where $\eta_{_1} = \frac{\partial x_1}{\partial p_1} \frac{p_1}{x_1}$ is the demand elasticity for the product in country 1. If one takes logs of this expression, one can identify the marginal-cost term separately from the markup term:

$$\ln p_{jt} = \ln mc_t + \ln \left( \frac{\eta_{jt}}{(\eta_{jt} - 1))} \right) \text{ for } j = 1, 2. \tag{5}$$

I use a methodology developed by Knetter (1989) to estimate equation 5.[8] Consider a fixed-effects panel-data regression model:

$$lnp_{it} = \theta_t + \lambda_j + \varepsilon_{jt}$$

where $\theta_t$ is a time effect, $\lambda_j$ is a country effect, and $\varepsilon_{jt}$ is a regression disturbance. If one assumes imperfectly competitive firms, a reasonable model for the pharmaceutical industry, and a constant demand elasticity in each country, then the price in each country should be a fixed markup over marginal cost. Markups vary over destinations by the demand elasticity at each. The marginal cost of the drug may vary over time but not by destination.

The constant-elasticity hypothesis allows $\lambda$ to vary across countries. The time effects measure marginal-cost movements and the country effects measure the markups to each country. Under the null hypothesis, the only factor that affects price is marginal cost, which because it is affected equally across markets, will not be subject to idiosyncratic effects. This technique thus produces estimates of the marginal costs and price-cost markups for each $ARV$ in each destination country without observing cost data. Knetter (1989) describes how even if the null hypothesis of constant demand elasticities is rejected in the data, the model will produce consistent (if somewhat noisy)

[8] The empirical approach is similar to that used by Sullivan (1985) in his study of firm behavior in the cigarette industry.

estimates of marginal cost.

The model's identification assumption of constant demand elasticities over time in each country may generate some biases in the estimates. For example, a fall in markups over time may be attributed, incorrectly, to a fall in the marginal cost to produce the drug. If the decline in marginal costs were correctly attributed to a fall in markups, however, the gap in the cost of *ARV* treatment as a share of per-capita income would widen between competitive and monopolistic countries. While the identification assumptions clearly have the potential to introduce biases into the results, the empirical exercise should produce estimates of reasonable magnitudes for the differences in markups across countries with and without competition in their drug market. If anything, these biases will lead the paper to understate these differences, and so can be regarded as lower bounds on the magnitudes of these differences.

# 5 Results

This section presents results. It first describes the marginal cost and markup estimates for the drugs in the three *ARV* classes: *NRTI*'s, *NNRTI*'s, and *PI's*. Second, it compares each *ARV*'s markups to a per-capita GDP index calculated on a purchasing-power-parity basis (PPP per-capita GDP), that is, per-capita GDP adjusted for cross-country differences in price levels. This adjustment reduces the gap between wealthy and poor countries' per-capita income as rich countries' price levels are typically higher than poor countries' price levels. PPP per-capita GDP produces more accurate estimates of consumers' opportunity costs in terms of forgone consumption than would an unadjusted per-capita GDP measure. PPP per-capita GDP tends to flatten the income differences across rich and poor countries. This stacks the deck against finding empirically that drug prices do not vary across countries with per-capita income.

## 5.1 Consumers' Drug Costs with and without Competition

Tables 1 through 3 report the average markup across the two groups of countries for the three classes of *ARV*'s: *NRTI*'s, *NNRTI*'s, and *PI's*. The first group includes African countries that did not have widespread availability of generic *ARV*'s over the sample period. These low-income countries faced markups set by monopolistic firms: Originator firms were their only suppliers.

Ethiopia, Kenya, Rwanda, Tanzania, and Uganda make up this group. The second group includes countries with widespread availability of generic *ARV*'s in their domestic market over the sample period. This may have resulted from domestic generics manufacturing, as in Brazil, India, and Thailand, or from a permissive generics import policy, as in Cameroon. These four countries faced markups set by competitive firms, that is, firms operating in markets characterized by relatively free entry.

The two country groups proxy best for monopolistic and competitive markets for the *NRTI*'s class of the *ARV*'s as generics firms manufactured all the drugs in this class over the sample period. Although the competitive countries extracted price reductions from originator firms for the *NNRTI*'s and *PI's* with the threat of generics production, only the *PI's Indinavir* and *Nevirapine* were produced by generic manufacturers over the sample period.

| | Didanosine | Lamivudine | Stavudine | Zidovudine | All NRTI's | All ARV's |
|---|---|---|---|---|---|---|
| Markup: | | | | | | |
| per capsule: | | | | | | |
| monopolistic ($) | .05 | .17 | .23 | .17 | .15 | .26 |
| competitive ($) | .15 | .19 | .04 | .08 | .11 | .24 |
| per annual dose: | | | | | | |
| monopolistic ($) | 68 | 126 | 164 | 205 | 143 | 292 |
| competitive ($) | 214 | 139 | 26 | 58 | 105 | 318 |
| as a share of per-capita GDP: | | | | | | |
| monopolistic (%) | 22 | 61 | 77 | 149 | 81 | 109 |
| competitive (%) | 10 | 7 | 1 | 8 | 6 | 25 |

Table 1: *A comparison of markups for NRTI's in African countries without generics and in countries with widespread availability of generics*

Table 1 reports the markup per capsule and per annual dose for the sample's four *NRTI*'s for the monopolistic and competitive countries. Tables 2 and 3 report the same calculations for the sample's two *NNRTI*'s and three *PI's*. The last two lines of each table report the average cost of an annual dose as a share of each country's per-capita GDP. Holding the degree of competition constant, one would expect markups to be somewhat lower in the monopolistic countries, with

an average per-capita annual income of 236 dollars, than in the competitive countries, with an average per-capita annual income of 1010 dollars.[9] In fact, monopolistic countries generally paid a higher average markup on *ARV*'s than did the competitive countries, both in dollar terms and as a share of their per-capita annual income. The average markup on an *ARV* capsule was 26 cents in the monopolistic countries and 24 cents in the competitive countries, and the average markup on an annual *ARV* dose was 109 percent of annual per-capita income in monopolistic countries and 25 percent in competitive countries.

For two of the three classes of *ARV*'s, the *NRTI*'s and the *NNRTI*'s, average markups were higher in dollar terms in the low-income monopolistic countries than in the medium-income competitive countries. Monopolistic countries paid a 15-cent average markup per *NRTI* capsule: competitive countries paid a 10-cent average markup per *NRTI* capsule. *NRTI*'s average markup on an annual dose equalled 81 percent of per-capita GDP in monopolistic countries and 6 percent in competitive countries. By comparison, an annual dose of triple-combination *ARV* therapy equalled almost 30 percent of annual per-capita income in the US over the sample period. Firms marked up *NNRTI*'s by 48 cents per capsule and 387 dollars per annual dose in monopolistic countries, and by 41 cents per capsule and 362 dollars per annual dose in competitive countries. The annual-dose markup equalled 139 percent of annual per-capita income in the monopolistic countries and 35 percent in the competitive countries. Finally, firms marked up *PI's* by 14 cents per capsule and 347 dollars per annual dose in the monopolistic countries, and by 21 cents per capsule and 539 dollars per annual dose in the competitive countries. The annual-dose markup equalled 146 percent of annual per-capita income in the monopolistic countries and 64 percent in the competitive countries.

Tables 4 reports the average difference across countries between each *ARV*'s markup and a per-capita GDP index. It finds that the difference between the markup on an annual *ARV* treatment and a per-capita GDP index equals 64 percent of per-capita GDP in monopolistic countries. One can use this result to decompose into three parts monopolistic countries' 109-percent average markup on an *ARV*'s annual dose. First, if the monopolistic countries had paid markups under a competitive market, their markups would be 25 percent higher than in a fully

[9] The average per-capita annual income calculated on a purchasing-power-parity basis in the monopolistic and competitive countries was 1010 and 4570 dollars, respectively.

| | Efavirenz | Nevirapine | All NNRTI's | All ARV's |
|---|---|---|---|---|
| Markup: | | | | |
| per capsule: | | | | |
| monopolistic ($) | .22 | .73 | .48 | .26 |
| competitive ($) | .36 | .46 | .41 | .24 |
| per annual dose: | | | | |
| monopolistic ($) | 241 | 533 | 387 | 292 |
| competitive ($) | 391 | 332 | 330 | 318 |
| as a share of per-capita GDP: | | | | |
| monopolistic (%) | 104 | 191 | 139 | 109 |
| competitive (%) | 35 | 35 | 35 | 25 |

Table 2: *A comparison of markups for NNRTI's in African countries without generics and in countries with widespread availability of generics*

| | Indinavir | Nelfinavir | Saquinavir | All PI's | All ARV's |
|---|---|---|---|---|---|
| Markup: | | | | | |
| per dose: | | | | | |
| monopolistic ($) | .28 | .08 | .05 | .14 | .26 |
| competitive ($) | .41 | .01 | .21 | .21 | .24 |
| per annual dose: | | | | | |
| monopolistic ($) | 614 | 263 | 164 | 347 | 292 |
| competitive ($) | 905 | 22 | 690 | 520 | 318 |
| as a share of per-capita GDP: | | | | | |
| monopolistic (%) | 288 | 97 | 53 | 146 | 109 |
| competitive (%) | 104 | 1 | 24 | 64 | 25 |

Table 3: *A comparison of markups for PI's in African countries without generics and in countries with widespread availability of generics*

| ΔMarkup per: | dose ($) | year ($) | share of per-capita PPP GDP (%) |
|---|---|---|---|
| NRTI's | | | |
| Didanosine | 0 | -.55 | -2 |
| Lamivudine | .04 | 27 | 11 |
| Stavudine | .01 | 6 | 5 |
| Zidovudine | .23 | 170 | 131 |
| All NRTI's | .08 | 61 | 44 |
| NNRTI's | | | |
| Efavirenz | .08 | 94 | 45 |
| Nevirapine | .53 | 383 | 139 |
| All NNRTI's | .26 | 209 | 82 |
| PI's | | | |
| Indinavir | .18 | 384 | 184 |
| Nelfinavir | .06 | 197 | 74 |
| Saquinavir | .03 | 75 | 53 |
| All PI's | .09 | 218 | 93 |
| All ARV's | .12 | 131 | 64 |

Table 4: *The difference between markups for ARV's and a PPP per-capita GDP index for African countries without generics*

competitive market with zero markups. Second, if their markups under the monopolistic regime were indexed to their per-capita GDP (with the US's markup set equal to its per-capita GDP and other countries indexed to the US) they would be 20 percent higher than in the competitive regime. The remaining 64 percent of the markup must be attributed to unobserved market forces that cause firms not to price discriminate fully across high- and low-income countries.

# 6 Conclusion

This paper compares the markups paid by consumers in countries with monopolistic drug markets to those markups paid by consumers in countries with more competitive drug markets. It finds

that consumers in monopolistic and competitive countries paid an average markup on an annual $ARV$ dose of 109 and 25 percent of per-capita GDP, respectively. Consumers in monopolistic countries paid markups that were 84 percent higher as a share of per-capita GDP than did consumers in competitive countries. This result implies that the total cost to consumers of drug monopolies to supply $ARV$'s to be 84 percent of their annual income (over and above the $ARV$'s marginal costs). Finally, this paper's estimates of $ARV$'s markups and marginal costs may be useful for other researchers as they seek to evaluate the impact of granting monopoly rights on prices, and consumers, in developing countries.

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# A Appendix

This appendix gives a description of and reports estimated individual markups for each ARV drug in the sample.

## A.1 *NRTI's*

*Didanosine* is an *NRTI* whose patent is held by the firm *Glaxo Wellcome* (*GW*). It is manufactured by *Bristol-Myers-Squibb* (*BMS*). *GW*'s patent rights expire in the US market in late 2006. Table 5 reports the marginal cost to produce a single 100 mg packet ranges from 58 cents in the year 2000 to 14 cents in the year 2003. Table 5 also reports the international distribution of markups. The second column of table 5 reports the markup per 100 mg packet, while third column reports the markup per daily dose and the fourth column per annual dose. The US has the highest markup at $1.62 per packet. Spain has the next highest markup at 83 cents per packet. A group of medium-income countries, Thailand, Argentina, and Brazil have the next highest set of markups at 28, 22, and 18 cents per packet, respectively. Finally, the sub-Saharan African countries and India have the lowest set of markups that range from 0 cents per packet for India to 9 cents per packet for South Africa. Columns 5 through 7 of table 5 give the difference between what each country's markup would be if it equalled a PPP per-capita GDP index (with the US PPP per-capita GDP index set equal to its markup and other countries' PPP per-capita GDP indexed to the US's). Column 4 indicates that *Didanosine*'s markup is less than the PPP per-capita GDP index for every country in the sample except for two African countries: Kenya and Tanzania. Kenyan consumers pay 2 cents more per packet, 34.77 dollars more per annual dose, than they would if the drug's markup were indexed to their PPP per-capita GDP. Tanzanian consumers pay five cents more per packet, 66.36 dollars more per annual dose, than they would if the drug's markup were indexed to their per-capita GDP. Figure 1 compares *Didanosine*'s markups to two per-capita GDP indexes, one calculated on a purchasing power parity basis, and the other not. The figure shows that markup is exceeded by the GDP indexes for every country except for the two low-income African countries: Kenya and Tanzania.

*Lamivudine* is an *NRTI* manufactured by *GlaxoSmithKline* (*GSK*) under the trade name *Epivir* and remains under patent in the US market until 2009. Table 6 reports that the marginal

| Country | Markup packet ($) | day ($) | year ($) | - Markup$_{PPPGDP}$ packet ($) | day ($) | year ($) | Year | Marginal cost packet ($) |
|---|---|---|---|---|---|---|---|---|
| Argentina | .22 | .88 | 321.20 | -.31 | -1.26 | -458.93 | 2000 | .58 |
| Brazil | .16 | .64 | 233.60 | -.19 | -.75 | -273.62 | 2001 | .35 |
| India | 0 | 0 | 0 | -.13 | -.54 | -195.72 | 2002 | .30 |
| Kenya | .07 | .28 | 102.20 | .02 | .09 | 34.66 | 2003 | .14 |
| South Africa | .09 | .36 | 131.40 | -.44 | -1.77 | -646.66 | | |
| Spain | .83 | 3.32 | 1211.80 | -.12 | -.48 | -176.86 | | |
| Tanzania | .07 | .28 | 102.20 | .05 | .18 | 66.36 | | |
| Thailand | .28 | 1.12 | 408.80 | -.02 | -.09 | -32.26 | | |
| Uganda | 0 | 0 | 0 | -.07 | -.28 | -102.68 | | |
| USA | 1.62 | 6.48 | 2365.20 | 0 | 0 | 0 | | |

Table 5: *Derived marginal costs and markups for Didanosine 100 mg packets.* Normalized by prices in Cameroon. Source: My calculations.

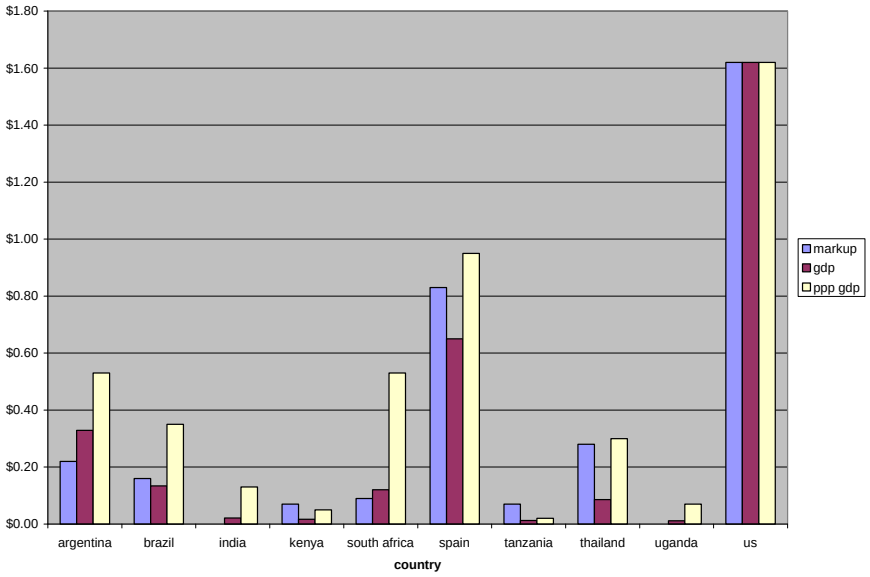


Figure 1: A comparison of two GDP per-capita indexes, one on a purchasing power parity basis, the other not, with markups for Didanosine 100 mg packets.

cost to produce a single 100 mg capsule ranges from 58 cents in the year 2000 to 9 cents in the year 2003. Table 6 also reports the international distribution of markups. The second column of table 6 reports the markup per 100 mg capsule, while third column reports the markup per daily dose and the fourth column per annual dose. The US has the highest markup at $4.88 per capsule. Spain has the next highest markup at $2.64 per capsule. A group of medium-income countries, Thailand and South Africa, have the next highest set of markups at 40 and 56 cents per capsule, respectively. Finally, Argentina, Brazil, and the sub-Saharan African countries have the lowest set of markups that range from 0 cents per capsule for Cameroon to 22 cents per capsule for Uganda. Columns 5 through 7 of table 6 give the difference between what each country's markup would be if it were equal to a per-capita GDP index (with the US PPP per-capita GDP index set equal to its markup and other countries' PPP per-capita GDP indexed to the US's). Column 5 reports that *Lamivudine*'s markup is less than the PPP per-capita GDP index for every country in the sample except for four African countries: Ethiopia, Kenya, Tanzania, and Uganda. Ethiopian consumers pay 1 cent more per capsule, 10.82 dollars more per annual dose, than they would if the drug's markup were indexed to their PPP per-capita GDP. Kenyan consumers pay 3 cents more per capsule, 22.38 dollars more per annual dose, Tanzanian consumers pay 10 cents more per capsule, 70.12 dollars more per annual dose, and Ugandan consumers pay roughly 1 cent more per capsule, 5.94 dollars more per annual dose, each than they would if the drug's markup were indexed to their PPP per-capita GDP. Figure 2 compares *Lamivudine*'s markups to two per-capita GDP indexes, one calculated on a purchasing power parity basis, and the other not. The figure shows that the markup is exceeded by the PPP GDP index for every country except for the four African countries: Ethiopia, Kenya, Tanzania, and Uganda.

*Stavudine* is an *NRTI* manufactured by *Bristol-Myers Squibb* (*BMS*). Yale University holds the US patent on the drug which expires in 2008. Table 7 reports the marginal cost to produce a single 40 mg capsule ranges from 43 cents in the year 2000 to 7 cents in the year 2003. Table 7 also reports the international distribution of markups. The second column of table 7 reports the markup per 40 mg capsule, while the third column reports the markup per daily dose and the fourth column per annual dose. The US has the highest markup at $5.43 per capsule. Spain has the next highest markup at $2.61 per capsule. The three countries with the next highest set of markups are Uganda, Rwanda and South Africa, at 18, 27, and 34 cents, respectively. Finally,

| Country | Markup | | | - Markup$_{PPPGDP}$ | | | Year | Marginal cost |
|---|---|---|---|---|---|---|---|---|
| | capsule ($) | day ($) | year ($) | capsule ($) | day ($) | year ($) | | capsule ($) |
| Argentina | .02 | .04 | 14.60 | -1.59 | -3.18 | -1160.41 | 2000 | .58 |
| Brazil | .17 | .34 | 124.10 | -.88 | -1.75 | -639.86 | 2001 | .32 |
| Cameroon | 0 | 0 | 0 | -.24 | -.48 | -174.38 | 2002 | .23 |
| Ethiopia | .13 | .26 | 94.90 | .01 | .03 | 10.82 | 2003 | .09 |
| Kenya | .17 | .34 | 124.10 | .03 | .06 | 22.38 | | |
| South Africa | .56 | 1.12 | 408.80 | -1.05 | -2.09 | -763.10 | | |
| Spain | 2.64 | 5.28 | 1927.20 | -.23 | -.45 | -164.36 | | |
| Tanzania | .17 | .34 | 124.10 | .10 | .19 | 70.12 | | |
| Thailand | .40 | .80 | 292.00 | -.51 | -1.02 | -372.32 | | |
| Uganda | .22 | .44 | 160.60 | .01 | .02 | 5.94 | | |
| USA | 4.88 | 9.76 | 3562.40 | 0 | 0 | 0 | | |

Table 6: *Derived marginal costs and markups for Lamivudine 100 mg capsules.* Normalized by prices in India. Source: My calculations.

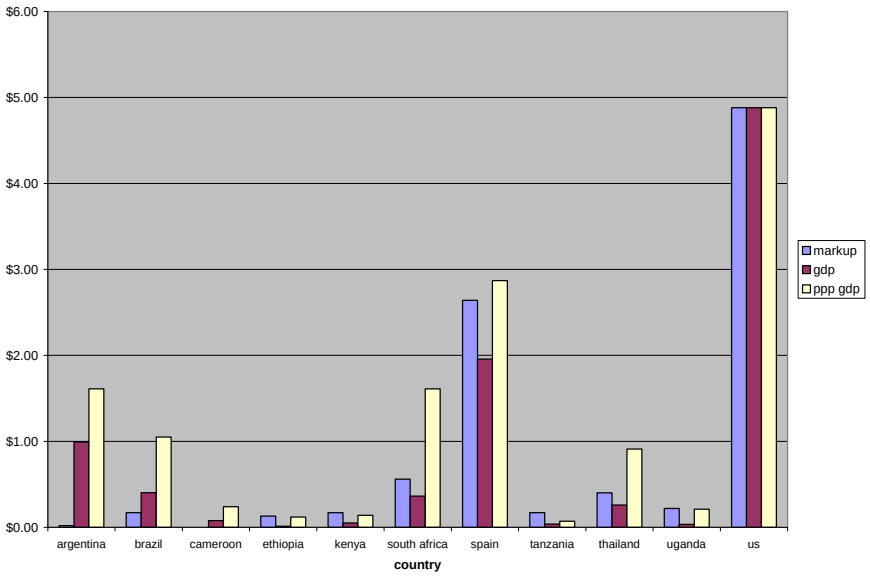


Figure 2: A comparison of two GDP per-capita indexes, one on a purchasing power parity basis, the other not, with markups for Lamivudine 100 mg capsules

medium-income countries with domestic generics production, Brazil, India, and Thailand, and the African country with a wide availability of generics, Cameroon, have the lowest set of markups that range from 0 cents per capsule for India to 8 cents per capsule for Thailand. Columns 5 through 7 of table 7 give the difference between what each country's markup would be if it equalled a PPP per-capita GDP index (with the US PPP per-capita GDP index set equal to its markup and other countries' PPP per-capita GDPs indexed to the US's). Column 5 reports that *Stavudine*'s markup is less than the per-capita GDP index for every country in the sample except for Rwanda. Rwandan consumers pay 7 cent more per capsule, 52.73 dollars more per annual dose, than they would if the drug's markup were indexed to their PPP per-capita GDP. Figure 3 compares *Stavudine*'s markups to two per-capita GDP indexes, one calculated on a purchasing power parity basis, and the other not. The figure shows that the drug's markup exceeds the GDP index for Rwanda and Uganda, but exceeds the PPP GDP index only for Rwanda.

*Zidovudine* is another *NRTI* manufactured by *GlaxoSmithKline* (*GSK*). *Glaxo Wellcome* holds the drug's patent which expires in the US market in 2005. Table 8 reports the marginal cost to produce a single 100 mg capsule ranges from 23 cents in the year 2000 to 6 cents in the year 2003. Table 8 also reports the international distribution of markups. The second column of table 8 reports the markup per 100 mg capsule, while the third column reports the markup per daily dose and the fourth column per annual dose. The US has the highest markup at 1.72 dollars per capsule. Spain has the next highest markup at 56 cents per capsule. The other countries in the sample have markups below 20 cents with South Africa and Uganda at the high end with a 19 cent markup and Brazil and Thailand at the low end with 3 and 4 cent markups, respectively. Columns 5 through 7 of table 8 give the difference between what each country's markup would be if it were equal to a PPP per-capita GDP index (with the US PPP per-capita GDP index set equal to its markup and other countries' PPP per-capita GDP indexed to the US's). Column 5 reports that *Zidovudine*'s markup exceeds the PPP per-capita GDP index for five countries in the sample: Cameroon, Ethiopia, Kenya, Tanzania, and Uganda. Figure 4 compares *Zidovudine*'s markups to two per-capita GDP indexes, one calculated on a purchasing power parity basis, and the other not. The figure shows that the drug's markup exceeds the GDP index for Cameroon, Ethiopia, Kenya, South Africa, Tanzania, and Uganda, but only exceeds the PPP GDP index for Cameroon, Ethiopia, Kenya, Tanzania, and Uganda.

| Country | Markup | | | - Markup$_{PPPGDP}$ | | | Year | Marginal cost |
|---|---|---|---|---|---|---|---|---|
| | capsule ($) | day ($) | year ($) | capsule ($) | day ($) | year ($) | | capsule ($) |
| Brazil | .05 | .10 | 36.50 | -1.11 | -2.23 | -813.57 | 2000 | .43 |
| Cameroon | .01 | .02 | 7.30 | -.26 | -.51 | -186.74 | 2001 | .22 |
| India | 0 | 0 | 0 | -.45 | -.90 | -328.02 | 2002 | .11 |
| Rwanda | .27 | .54 | 197.10 | .07 | .14 | 52.73 | 2003 | .07 |
| South Africa | .34 | .68 | 248.20 | -1.45 | -2.89 | -1055.78 | | |
| Spain | 2.61 | 5.22 | 1905.30 | -.58 | -1.16 | -421.99 | | |
| Thailand | .08 | .16 | 58.40 | -.93 | -1.87 | -680.79 | | |
| Uganda | .18 | .36 | 131.40 | -.06 | -.11 | -40.69 | | |
| USA | 5.43 | 10.86 | 3963.90 | 0 | 0 | 0 | | |

Table 7: *Derived marginal costs and markups for Stavudine 40 mg capsules.* Normalized by prices in Argentina. Source: My calculations.

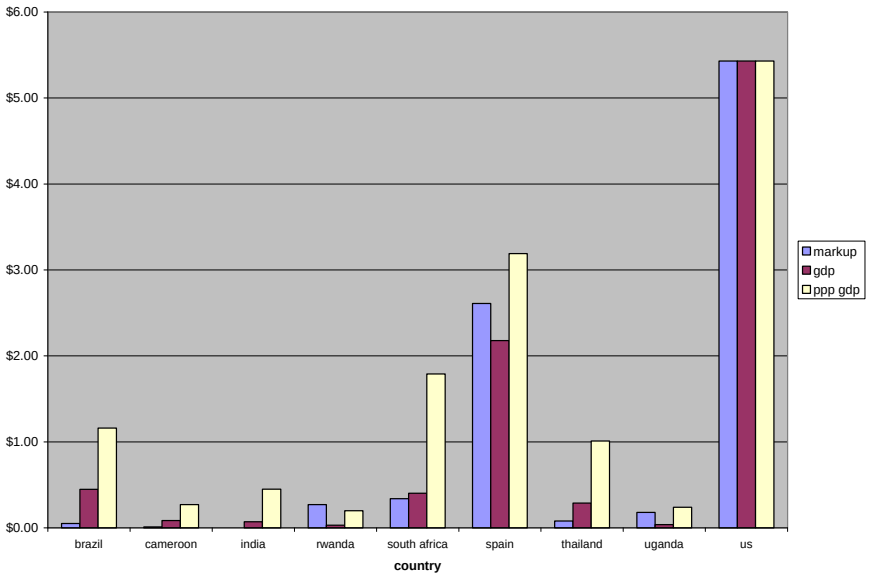


Figure 3: A comparison of two GDP per-capita indexes, one on a purchasing power parity basis, the other not, with markups for Stavudine 40 mg capsules.

| Country | Markup capsule ($) | day ($) | year ($) | - $\text{Markup}_{PPPGDP}$ capsule ($) | day ($) | year ($) | Year | Marginal cost capsule ($) |
|---|---|---|---|---|---|---|---|---|
| Brazil | .03 | .06 | 21.90 | -.34 | -.68 | -247.37 | 2000 | .23 |
| Cameroon | .17 | .34 | 124.10 | .09 | .17 | 62.64 | 2001 | .13 |
| Ethiopia | .16 | 1.20 | 438.00 | .56 | 1.12 | 408.37 | 2002 | .10 |
| Kenya | .15 | .30 | 109.50 | .10 | .20 | 73.65 | 2003 | .06 |
| South Africa | .19 | .38 | 138.70 | -.38 | -.75 | -274.35 | | |
| Spain | .56 | 1.12 | 408.80 | -.45 | -.90 | -328.39 | | |
| Tanzania | .18 | .36 | 131.40 | .15 | .31 | 112.38 | | |
| Thailand | .04 | .08 | 29.20 | -.28 | -.56 | -204.94 | | |
| Uganda | .19 | .38 | 138.70 | .12 | .23 | 84.19 | | |
| USA | 1.72 | 3.44 | 1255.60 | 0 | 0 | 0 | | |

Table 8: *Derived marginal costs and markups for Zidovudine 100 mg capsules.* Normalized by prices in India. Source: My calculations.

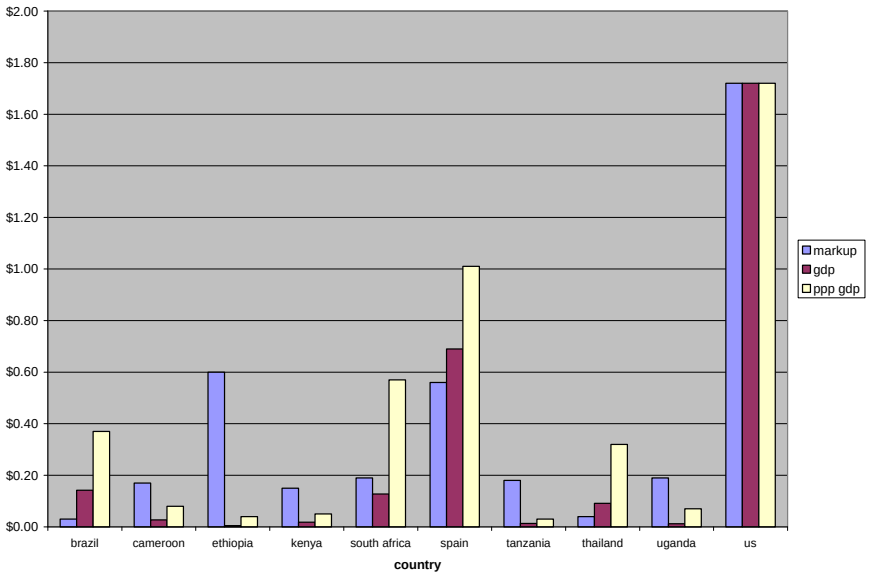


Figure 4: A comparison of two GDP per-capita indexes, one on a purchasing power parity basis, the other not, with markups for Zidovudine 100 mg capsules.

| Country | Markup | | | - Markup$_{PPPGDP}$ | | | Year | Marginal cost |
|---|---|---|---|---|---|---|---|---|
| | capsule ($) | day ($) | year ($) | capsule ($) | day ($) | year ($) | | capsule ($) |
| Argentina | 1.38 | 4.14 | 1511.10 | .15 | .46 | 167.54 | 2000 | 1.01 |
| Brazil | .73 | 2.19 | 799.35 | -.07 | -.20 | -74.20 | 2001 | .64 |
| Cameroon | .14 | .42 | 153.30 | -.04 | -.13 | -46.10 | 2002 | .44 |
| India | .30 | .90 | 328.50 | -.01 | -.02 | -8.58 | 2003 | .31 |
| Kenya | .04 | .12 | 43.80 | -.07 | -.20 | -72.52 | | |
| Mexico | .21 | .63 | 229.95 | -.70 | -2.11 | -770.60 | | |
| Rwanda | .23 | .69 | 251.85 | .09 | .28 | 103.49 | | |
| South Africa | .19 | .57 | 208.05 | -1.03 | -3.10 | -1131.95 | | |
| Spain | 2.37 | 7.11 | 2595.15 | .19 | .56 | 203.57 | | |
| Thailand | .26 | .78 | 284.70 | -.43 | -1.30 | -474.91 | | |
| Uganda | .39 | 1.17 | 427.05 | .23 | .69 | 250.20 | | |
| USA | 3.72 | 11.16 | 4073.40 | 0 | 0 | 0 | | |

Table 9: *Derived marginal costs and markups for Efavirenz 200 mg capsules.* Normalized by prices in Senegal. Source: My calculations.

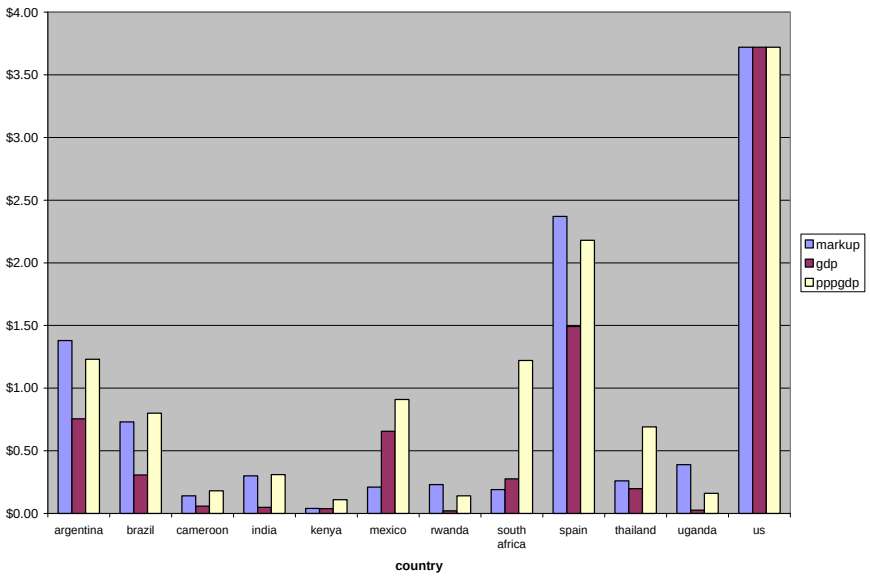


Figure 5: A comparison of two GDP per-capita indexes, one on a purchasing power parity basis, the other not, with markups for Efavirenz 200 mg capsules.

## A.2 *NNRTI's*

*Efavirenz* is a Non-Nucleoside Reverse Transcriptase Inhibitor (*NNRTI*) produced by *Merck* that is under patent in the US market until 2015. Table 9 reports the marginal cost to produce a single 200 mg capsule ranges from 1.01 dollar in the year 2000 to 31 cents in the year 2003. Table 9 also reports the international distribution of markups. The second column of table 9 reports the markup per 200 mg capsule, while the third column reports the markup per daily dose and the fourth column per annual dose. The US has the highest markup at 3.72 dollars per capsule. Spain, Argentina, and Brazil have the next highest markups at 2.37, 1.38, and .73 dollars per capsule, respectively. The remaining countries have markups below 50 cents including Uganda at 39 cents, India, at 30 cents, Thailand, at 26 cents, and Mexico at 21 cents. Sub-Saharan African countries generally have the lowest markups: South Africa, Cameroon, and Kenya have markups of 19, 14, and 3 cents, respectively. Columns 5 through 7 of table 9 give the difference between what each country's markup would be if it equalled a PPP per-capita GDP index (with the US per-capita GDP index set equal to its markup and other countries' PPP per-capita GDP indexed to the US's). Column 5 reports that *Efavirenz*'s markup is greater than the PPP per-capita GDP index for four countries: Argentina, Rwanda, Spain, and Uganda. Rwandans, Spaniards, and Ugandans pay, respectively, 9, 19, and 23 cents more per capsule, and 103, 204, and 250 dollars more per annual dose than if their country's markups were indexed to their PPP per-capita GDP. Figure 5 compares *Efavirenz*'s markups to two per-capita GDP indexes, one calculated on a purchasing power parity basis, and the other not. The figure shows that the drug's markup exceeds the GDP index for Argentina, Brazil, Cameroon, India, Rwanda, Spain, Thailand, and Uganda, but only exceeds the PPP GDP index for Argentina, Rwanda, Spain, and Uganda.

Another commonly used *NNRTI* is *Nevirapine*. *Boehringer-Ingelheim* (*BI*) holds the patent on *Nevirapine* through late 2011 in the US and also manufactures the drug. Table 10 reports the marginal cost to produce a single 200 mg capsule ranges from 81 cents in the year 2000 to 11 cents in the year 2003. Table 10 also reports the international distribution of markups for a single 200 mg capsule. The second column of table 10 reports the markup per 200 mg capsule, while the third column reports the markup per daily dose and the fourth column per annual dose. The US has the largest markup at 5.72 dollars per capsule. Spain has the next highest markup at 3.63 dollars per capsule. Countries with markups from 50 cents to 1 dollar include

| Country | Markup | | | - Markup$_{PPPGDP}$ | | | Year | Marginal cost |
|---|---|---|---|---|---|---|---|---|
| | capsule ($) | day ($) | year ($) | capsule ($) | day ($) | year ($) | | capsule ($) |
| Argentina | .74 | 1.48 | 540.20 | -1.15 | -2.29 | -837.07 | 2000 | .81 |
| Brazil | .37 | .74 | 270.10 | -.86 | -1.71 | -625.37 | 2001 | .49 |
| Cameroon | .68 | 1.36 | 496.40 | .40 | .80 | 292.00 | 2002 | .26 |
| India | .11 | .22 | 80.30 | -.36 | -.73 | -265.23 | 2003 | .11 |
| Kenya | .47 | .94 | 343.10 | .31 | .61 | 223.87 | | |
| Spain | 3.63 | 7.26 | 2649.90 | .27 | .54 | 198.32 | | |
| Thailand | .66 | 1.32 | 481.80 | -.41 | -.81 | -296.87 | | |
| Uganda | .99 | 1.98 | 722.70 | .74 | 1.48 | 541.42 | | |
| USA | 5.72 | 11.44 | 4175.60 | 0 | 0 | 0 | | |

Table 10: *Derived marginal costs and markups for Nevirapine 200 mg capsules.* Normalized by prices in Senegal. Source: My calculations.

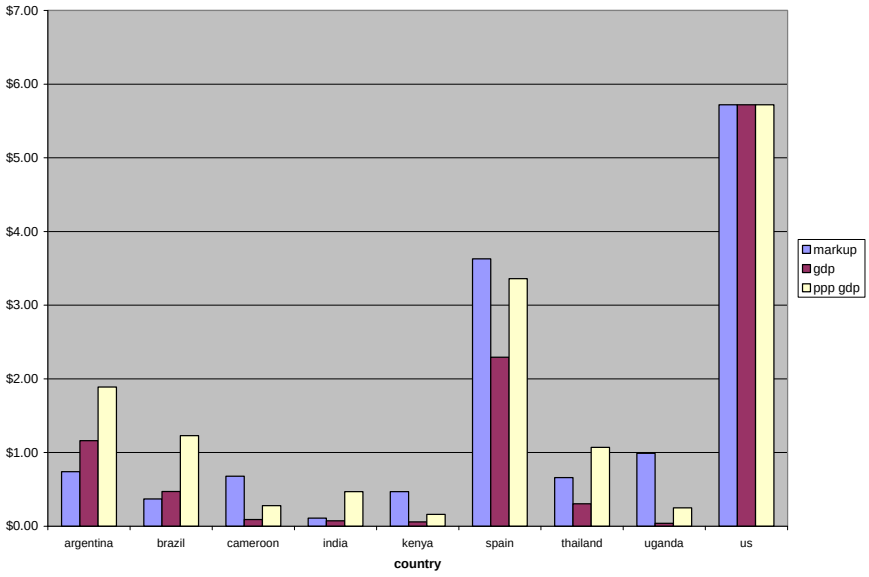


Figure 6: A comparison of two GDP per-capita indexes, one on a purchasing power parity basis, the other not, with markups for Nevirapine 200 mg capsules.

Argentina, Cameroon, Thailand, and Uganda, at 74, 68, 66, and 99 cents per capsule, respectively. Countries with markups below 50 cents include Brazil, India, and Kenya at 37, 11, and 47 cents per capsule, respectively. Columns 5 through 7 of table 10 give the difference between what each country's markup would be if it equalled a per-capita GDP index (with the US per-capita GDP index set equal to its markup and other countries' PPP per-capita GDP indexed to the US's). Column 5 reports that *Nevirapine*'s markup is greater than the PPP per-capita GDP index for four countries: Cameroon, Kenya, Spain, and Uganda. Consumers in Cameroon pay 40 cent more per capsule, 292 dollars more per annual dose, than they would if the drug's markup were indexed to their PPP per-capita GDP. Similarly, Kenyans, Spaniards, and Ugandans pay, respectively, 31, 27, and 74 cents more per capsule, and 224, 198, and 541 dollars more per annual dose than if their country's markups were indexed to their PPP per-capita GDP. Figure 6 compares *Nevirapine*'s markups to two per-capita GDP indexes, one calculated on a purchasing power parity basis, and the other not. The figure shows that the drug's markup exceeds the GDP index for Cameroon, India, Kenya, Spain, Thailand, and Uganda, but only exceeds the PPP GDP index for Cameroon, Kenya, Spain, and Uganda.

### A.3 *PI's*

*Merck* holds the patent on *Indinavir*, a protease inhibitor, and also manufactures it. Its patent expires in 2013 in the US market. Table 11 reports the marginal cost to produce a single 400 mg capsule ranges from 68 cents in the year 2000 to 15 cents in the year 2003. Table 11 also reports the international distribution of markups. The second column of table 11 reports the markup per 400 mg capsule, while the third column reports the markup per daily dose and the fourth column per annual dose. The US has the largest markup at 2.63 dollars per capsule. Spain has the next highest markup at 1.37 dollars per capsule. With the exception of Brazil, the other countries in the sample have markups below 50 cents with Argentina, India, and Rwanda at the high end at 45, 45, and 35 cents per capsule, respectively, and Cameroon, South Africa, and Uganda at the low end at 12, 13, and 21 cents per capsule, respectively. Columns 5 through 7 of table 11 report the difference between what each country's markup would be if it equalled a per-capita GDP index (with the US PPP per-capita GDP index set equal to its markup and other countries' PPP per-capita GDP indexed to the US's). Column 5 reports that *Indinavir*'s

| Country | Markup | | | - Markup$_{PPPGDP}$ | | | Year | Marginal cost |
|---|---|---|---|---|---|---|---|---|
| | tablet ($) | day ($) | year ($) | tablet ($) | day ($) | year ($) | | tablet ($) |
| Argentina | .45 | 2.70 | 985.50 | -.42 | -2.50 | -914.26 | 2000 | .68 |
| Brazil | .67 | 4.02 | 1467.30 | .11 | .64 | 232.12 | 2001 | .46 |
| Cameroon | .12 | .72 | 262.80 | -.01 | -.05 | -19.14 | 2002 | .19 |
| India | .45 | 2.70 | 985.50 | .23 | 1.39 | 508.88 | 2003 | .15 |
| Rwanda | .35 | 2.10 | 766.50 | .25 | 1.53 | 556.72 | | |
| South Africa | .13 | .78 | 284.70 | -.74 | -4.41 | -1610.03 | | |
| Spain | 1.37 | 8.22 | 3000.30 | -.17 | -1.04 | -381.34 | | |
| Uganda | .21 | 1.26 | 459.90 | .10 | 0.57 | 209.84 | | |
| USA | 2.63 | 15.78 | 5759.70 | 0 | 0 | 0 | | |

Table 11: *Derived marginal costs and markups for Indinavir 400 mg capsules.* Normalized by prices in Senegal. Source: My calculations.

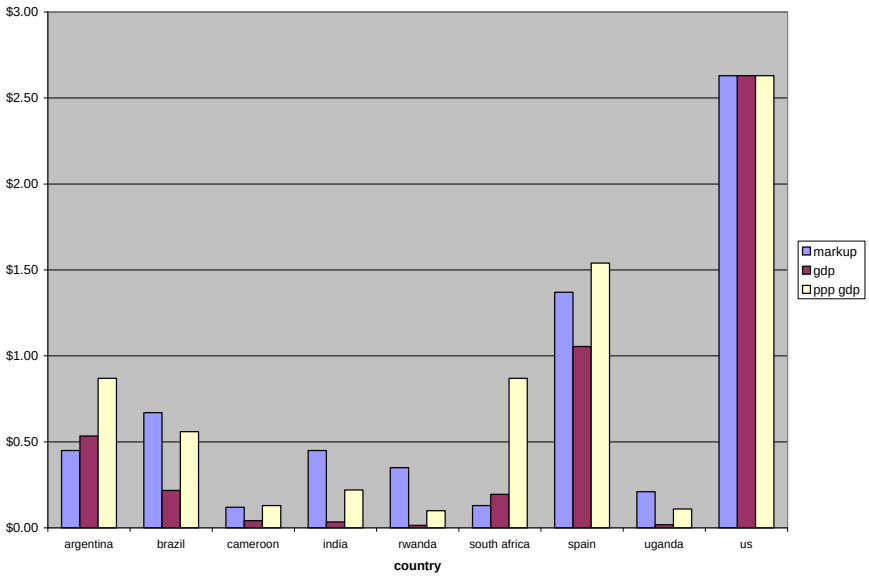


Figure 7: A comparison of two GDP per-capita indexes, one on a purchasing power parity basis, the other not, with markups for Indinavir 400 mg capsules

markup is greater than the PPP per-capita GDP index for four countries: Brazil, India, Rwanda, and Uganda. Rwandans and Ugandans pay, respectively, 25 and 10 cents more per capsule, and 557 and 210 dollars more per annual dose than if their country's markups were indexed to their PPP per-capita GDP. Figure 7 compares *Indinavir*'s markups to two per-capita GDP indexes, one calculated on a purchasing power parity basis, and the other not. The figure shows that the drug's markup exceeds the GDP index for Brazil, Cameroon, India, Rwanda, Spain, and Uganda, but only exceeds the PPP GDP index for Brazil, India, Rwanda, and Uganda.

*Nelfinavir* is another protease inhibitor that is manufactured by *Hoffmann-La Roche*. It is under patent in the US market until 2013. Table 12 reports the marginal cost to produce a single 250 mg tablet ranged from 1.04 dollars in the year 2000 to 35 cents in the year 2003. Table 12 also reports the international distribution of markups. The second column of table 12 reports the markup per 250 mg tablet, while the third column reports the markup per daily dose and the fourth column per annual dose. Argentina and Spain have the highest markups at 34 and 33 cents per tablet. Uganda has the next highest markup at 12 cents per tablet. The other countries in the sample have markups below 5 cents with Brazil and Kenya at the high end with markups of 2 and 4 cents per tablet, respectively, and Cameroon and India at the low end with zero markups. Columns 5 through 7 of table 12 report the difference between what each country's markup would be if it equalled its PPP per-capita GDP index (with Spain's PPP per-capita GDP index set equal to its markup and other countries' PPP per-capita GDP indexed to Spain's). Column 5 reports that *Nelfinavir*'s markup is greater than the PPP per-capita GDP index for three countries: Argentina, Kenya, and Uganda. Kenyans and Ugandans pay, respectively, 15 and 10 cents more per tablet, and 508 and 314 dollars more per annual dose than if their country's markups were indexed to their PPP per-capita GDP's. Figure 8 compares *Nelfinavir*'s markups to two per-capita GDP indexes, one calculated on a purchasing power parity basis, and the other not. The figure shows that the drug's markup exceeds both the GDP index and the PPP GDP index for Argentina, Kenya and Uganda.

*Saquinavir* is a protease inhibitor under patent in the US market until 2010. Its patent is held by *Hoffmann-La Roche*. Table 13 reports the marginal cost to produce a single 200 mg gel tablet ranged from 71 cents in the year 2000 to 27 cents in the year 2003. Table 13 also reports the international distribution of markups. The second column of table 13 reports the markup

| Country | Markup | | | - Markup$_{PPPGDP}$ | | | Year | Marginal cost |
|---|---|---|---|---|---|---|---|---|
| | tablet ($) | day ($) | year ($) | tablet ($) | day ($) | year ($) | | tablet ($) |
| Argentina | .34 | 3.06 | 1116.90 | .15 | 1.39 | 507.90 | 2000 | 1.04 |
| Brazil | .02 | .18 | 65.70 | -.10 | -.90 | -330.26 | 2001 | .93 |
| Cameroon | 0 | 0 | 0 | -.03 | -.25 | -90.38 | 2002 | .77 |
| India | 0 | 0 | 0 | -.05 | -.42 | -152.79 | 2003 | .35 |
| Kenya | .04 | .36 | 131.40 | .02 | .22 | 78.68 | | |
| Spain | .33 | 2.97 | 1084.05 | 0 | 0 | 0 | | |
| Uganda | .12 | 1.08 | 394.20 | .10 | .86 | 314.04 | | |

Table 12: *Derived marginal costs and markups for Nelfinavir 250 mg tablets.* Normalized by prices in Senegal. Source: My calculations.

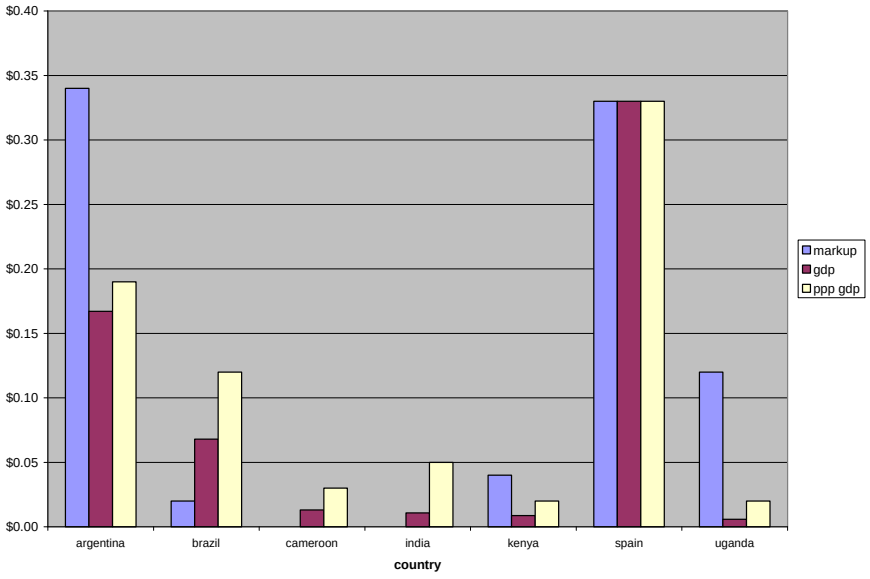


Figure 8: A comparison of two GDP per-capita indexes, one on a purchasing power parity basis, the other not, with markups for Nelfinavir 250 mg tablets

| Country | Markup | | | - Markup$_{PPPGDP}$ | | | Year | Marginal cost |
|---|---|---|---|---|---|---|---|---|
| | tablet ($) | day ($) | year ($) | tablet ($) | day ($) | year ($) | | tablet ($) |
| Brazil | .42 | 3.78 | 1379.70 | .26 | 2.31 | 844.30 | 2000 | .71 |
| India | 0 | 0 | 0 | -.06 | -.57 | -206.60 | 2001 | .43 |
| Kenya | .06 | .54 | 197.10 | .04 | .34 | 125.81 | 2002 | .41 |
| Spain | .46 | 4.14 | 1511.10 | .01 | .12 | 45.29 | 2003 | .27 |
| Uganda | .04 | .36 | 131.40 | .01 | .06 | 23.01 | | |
| USA | .76 | 6.84 | 2496.60 | 0 | 0 | 0 | | |

Table 13: *Derived marginal costs and markups for Saquinavir 200 mg gel tablets.* Normalized by prices in South Africa. Source: My calculations.

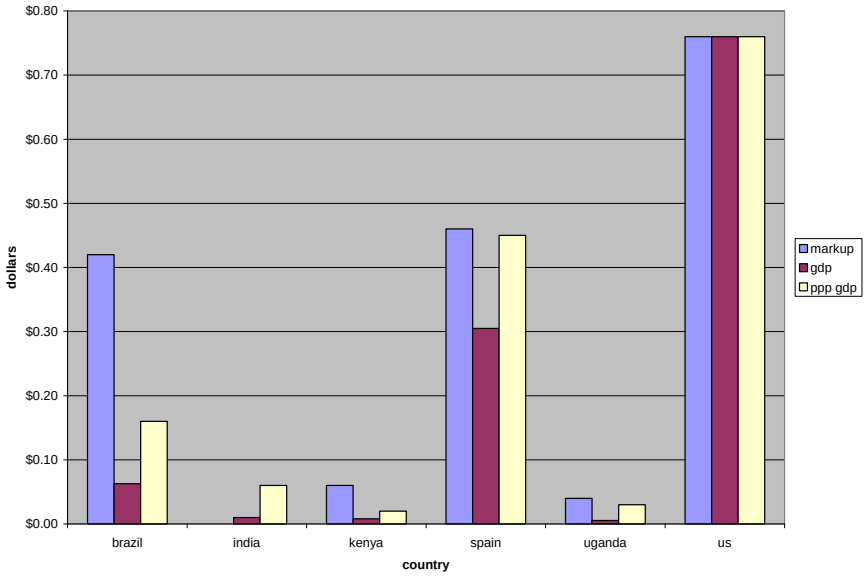


Figure 9: A comparison of two GDP per-capita indexes, one on a purchasing power parity basis, the other not, with markups for Saquinavir 200 mg gel tablets.

per 200 mg gel tablet, while the third column reports the markup per daily dose and the fourth column per annual dose. The US, Spain, and Brazil have the highest markups at 76, 46, and 42 cents per gel tablet, respectively. The other countries in the sample have quite low markups: Kenya at 6 cents per tablet, Uganda at 4 cents per tablet, and India with zero markup. Columns 5 through 7 of table 13 report the difference between what each country's markup would be if it equalled a PPP per-capita GDP index (with the US's PPP per-capita GDP index set equal to its markup and other countries' PPP per-capita GDP indexed to the US's). Column 5 reports that *Saquinavir*'s markup is greater than the PPP per-capita GDP index for four countries: Brazil, Kenya, Spain, and Uganda. Kenyans and Ugandans pay, respectively, 4 and 1 cents more per tablet, and 126 and 23 dollars more per annual dose than if their country's markups were indexed to their PPP per-capita GDP. Figure 9 compares *Saquinavir*'s markups to two per-capita GDP indexes, one calculated on a purchasing power parity basis, and the other not. The figure shows that the drug's markup exceeds both the GDP index and the PPP GDP index for Brazil, Kenya, Spain, and Uganda.

### A.4 Other Drugs

*Combivir* is a fixed-dose combination manufactured by *GlaxoSmithKline* (*GSK*). Table 14 reports the marginal cost to produce a single tablet ranged from 98 cents in the year 2000 to 24 cents in the year 2003. Table 14 also reports the international distribution of markups. The second column of table 14 reports the markup per tablet, while the third column reports the markup per daily dose and the fourth column per annual dose. The US and Spain have the highest markups at 9.93 and 4.47 dollars per tablet, respectively. The other countries in the sample have markups below 1 dollar: Uganda, South Africa, and Thailand at the high end with markups of 81, 72, and 53 cents per tablet, respectively, and Brazil, Rwanda, and Kenya at the low end, with markups of 32, 32, and 27 cents per tablet, respectively. Columns 5 through 7 of table 14 report the difference between what each country's markup would be if it equalled a PPP per-capita GDP index (with the US's PPP per-capita GDP index set equal to its markup and other countries' PPP per-capita GDP indexed to the US's). Column 5 reports that *Combivir*'s markup is greater than the PPP per-capita GDP index only for Uganda. Ugandans pay 38 cents more per tablet and 277 dollars more per annual dose than if their country's markups were indexed to their PPP

| Country | Markup | | | - $\text{Markup}_{PPPGDP}$ | | | Year | Marginal cost |
|---|---|---|---|---|---|---|---|---|
| | tablet ($) | day ($) | year ($) | tablet ($) | day ($) | year ($) | | tablet ($) |
| Brazil | .32 | .64 | 233.60 | -1.81 | -3.62 | -1320.94 | 2000 | .98 |
| Kenya | .27 | .54 | 197.10 | -.01 | -.03 | -9.89 | 2001 | .80 |
| Rwanda | .32 | .64 | 233.60 | -.04 | -.08 | -30.42 | 2002 | .62 |
| Spain | 4.47 | 8.94 | 3263.10 | -1.36 | -2.72 | -992.88 | 2003 | .24 |
| South Africa | .72 | 1.44 | 525.60 | -2.55 | -5.09 | -1859.02 | | |
| Thailand | .53 | 1.06 | 386.90 | -1.32 | -2.64 | -964.88 | | |
| Uganda | .81 | 1.62 | 591.30 | .38 | .76 | 276.59 | | |
| USA | 9.93 | 19.86 | 7248.90 | 0 | 0 | 0 | | |

Table 14: *Derived marginal costs and markups for Combivir.* Normalized by Indian prices. Source: My calculations.

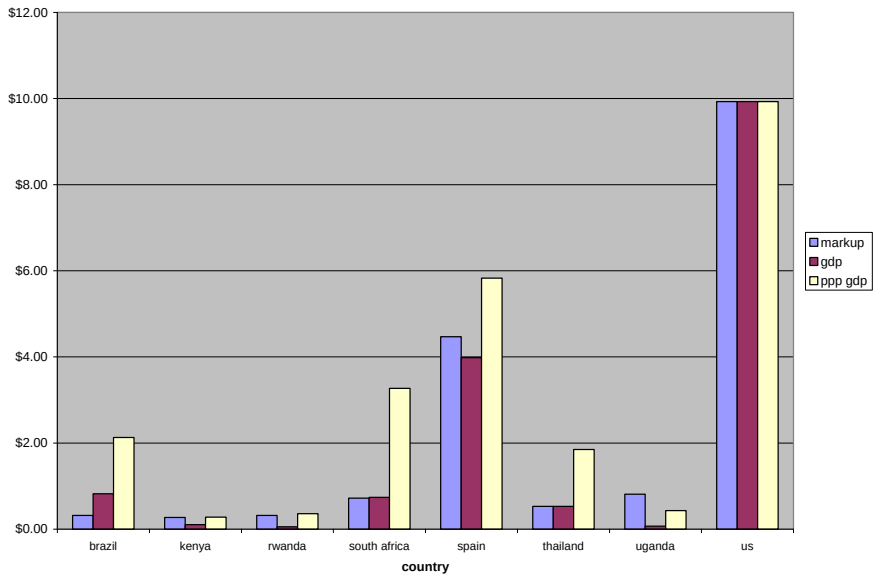


Figure 10: A comparison of two GDP per-capita indexes, one on a purchasing power parity basis, the other not, with markups for Combivir.

per-capita GDP. Figure 14 compares *Combivir*'s markups to two per-capita GDP indexes, one calculated on a purchasing power parity basis, and the other not. The figure shows that the drug's markup exceeds the GDP index for Kenya, Rwanda, and Uganda but that it exceeds the PPP GDP index only for Uganda.

Table 15 reports the international distribution of markups for *Menomune*, a vaccine for meningitis which is under patent in the US market until 2014. It reports the marginal cost to produce a single dose ranged from 1.66 dollars in the year 2000 to 1.63 dollars in the year 2001. Table 15 also compares the markups for *Menomune* to a measure of per-capita GDP on a PPP basis which is indexed to the US markup. Table 15 shows that most European countries had *Menomune* markups that were significantly below their per-capita *GDP* index, including France, Germany, the UK, Ireland, Greece, Hungary, and the Czech Republic. Medium-income countries such as Saudi Arabia and Turkey had markups closer to their respective per-capita *GDP* indexes. The holder of *Menomune*'s patent faced little public pressure to change its prices in low-income countries over the sample period, so the price distribution remained more stable than those of the sample's *ARV*'s.

| Country | Markup dose ($) | - Markup$_{PPPGDP}$ dose ($) | Quarter | Marginal cost dose ($) |
|---|---|---|---|---|
| Argentina | 12.14 | -1.42 | 2000:1 | 1.66 |
| Australia | 17.20 | -13.19 | 2000:3 | 1.63 |
| France | 11.19 | -17.55 | 2001:1 | 1.63 |
| Germany | 7.54 | -22.83 | | |
| Greece | 5.00 | -15.89 | | |
| Malaysia | 3.78 | -6.70 | | |
| Morocco | 3.29 | -1.02 | | |
| Netherlands | 9.42 | -23.15 | | |
| South Africa | 1.73 | -11.79 | | |
| Spain | 4.90 | -19.24 | | |
| UK | 6.65 | -22.29 | | |
| USA | 41.11 | 0 | | |

Table 15: *Derived marginal costs and markups for Menomune.* Normalized by prices in the United Arab Emirates. Source: My calculations.

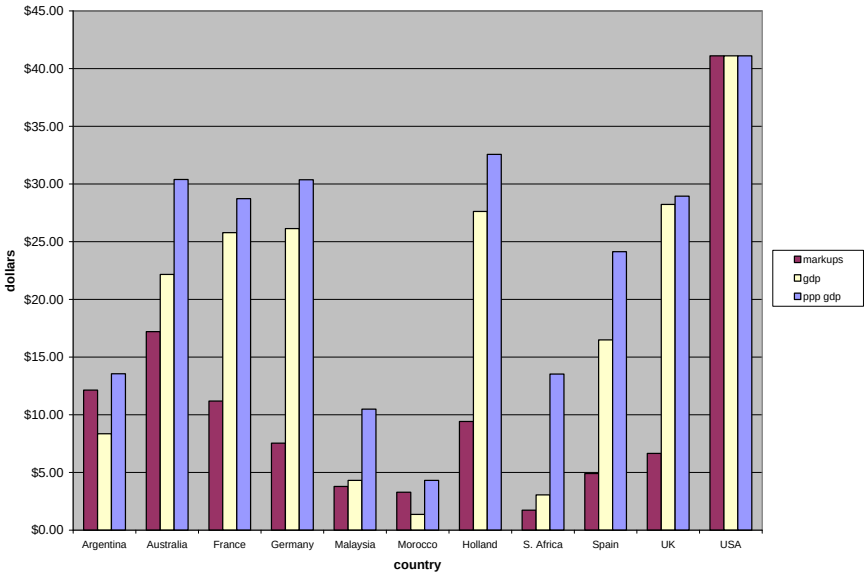


Figure 11: A comparison of two GDP per-capita indexes, one on a purchasing power parity basis, the other not, with markups for Menomune.