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Affordability of Pharmaceutical Drugs in Developing Countries

By

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Abstract

This paper investigates the affordability of life-saving drugs in developing countries. We provide new evidence on systematic differences in prices of pharmaceutical drugs across a sample of countries by using a unique dataset on supplier and agency prices of innovator brand and generic drugs. Our main objective is to empirically test the Ramsey pricing hypothesis for a group of live-saving drugs. We find that branded drugs are sold at significantly lower prices in low-income countries. The results are robust with respect to alternative specifications and income measures such as out-of-pocket expenditures.

Keywords: Affordability; Price discrimination; Ramsey pricing; Developing countries; Pharmaceutical industry; HIV/AIDS; Out-of-pocket spending.

JEL Classification: I18, F19, L13

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1. Motivation

The affordability of life-saving drugs is of critical importance in all countries that are afflicted by deadly diseases like AIDS. Unaffordable treatments in developing countries are a source of welfare losses and slowdown growth by making human capital obsolete. In developing countries 50 to 90 percent of drugs are paid out-of-pocket as a share of total health expenditures. In more than 30 low- and middle-income countries, public spending on medicines accounts for less than $2 per person. It is not unusual for people in developing countries to pay on average more for medicines through out-of-pocket expenditures than consumers in the developed world, including all people paying insurance premia regardless of their health condition. Besides, one third of the world population lacks reliable access to essential drugs (World Health Organization 2004). The improved access to pharmaceutical markets and the affordability of essential drugs are highlighted targets of international institutions in their attempt to achieve poverty reduction and welfare enhancement.

Consumer prices in developing countries are often charged higher than in developed countries, even though producer prices may not follow the same path. Taking into account strategic pricing of pharmaceutical companies and the fact that the major R&D based pharmaceutical industry is international in its structure and ownership, it is necessary to address the question of improving affordability of drugs at a global level to improve the affordability at a national level. Also more focus must be put on the intermediary sector, which plays an important role in consumer price determination process.

The objective of this study is to investigate whether there are systematic differences in prices of certain pharmaceutical drugs between the group of developing and developed countries. A pricing pattern where inhabitants of poorer countries pay less for same drugs than in richer countries would ensure affordability. We use the Ramsey pricing theory (Ramsey 1927) to guide our economic intuition. Affordability does not need to be brought about by moral suasion or political pressure. On the contrary, affordability can be in interest of multinational pharmaceutical companies, if they can effectively limit their sales to the country of destination and set prices according to price elasticities of demand. Ramsey pricing can occur only in the absence of parallel trade so that firms are free to set prices in each country independently of prices in other countries.

In the previous literature (Ramsey 1927; Scherer 1997; Lanjouw 2002; Lichtenberg 1996 and 2003; Kremer 2000) and Towse and Danzon (2003), there is little empirical evidence on the determinants of pharmaceutical drug prices in developing countries relative to the international level. We compile a unique dataset and construct alternative measures of income to better estimate price elasticities of demand in low-income countries. We investigate pricing strategies of pharmaceutical companies by using the retail prices of branded drugs, those still under patent protection, and generic drugs. We use median prices because the distribution of drug prices across sectors and countries is highly skewed, since mean prices would be misleading as a measure of centrality.

Our main objective is to empirically test the Ramsey pricing hypothesis for a group of live-saving drugs. If drug prices exhibit a Ramsey pricing pattern, then price ratios of local branded and generic drugs to international prices in any sample of developing countries are negatively associated with the measures of ability to pay. Our results confirm the theoretical prediction. We find that pharmaceutical drugs in national markets are sold at significantly lower prices relative to international prices in countries.

We experiment with different measures of affordability. First, we use the out-of-pocket spending on pharmaceuticals, which tends to account for a much larger share of total pharmaceutical spending in poor countries. Second, we use the poverty rate of the population as a measure of purchasing power. Finally, more general measures of wealth like out-of-pocket expenditures, daily wages of civil servants and the poverty rate in a country, are positively correlated with drug prices and explain local deviations of drug prices from international price level better than the GDP per capita.

The remainder of our paper is organized as follows. In Section 2, we review the previous evidence on the effect of pharmaceutical strategic pricing in the global TRIPs environment on the affordability of drugs in poor countries. We build upon a simple theoretical framework in line with the Ramsey pricing hypothesis to provide guidance in support of our empirical analysis. In Section 3, we describe our dataset and examine the evolution of international and local prices of pharmaceuticals and present determinants of affordability for our sample of countries. In Section 4, we perform a cross-country econometric analysis and test for the presence of the Ramsey pricing in the pharmaceutical markets for innovator brands and generics. In Section 5, we discuss some policy options related to the affordability problem. Section 6 concludes.

2. Ramsey Pricing in the Pharmaceutical Sector

Before turning to the empirical investigations, we build upon the previous literature to understand the economic intuition behind strategic pricing of pharmaceuticals and to outline the reasons for differences in retail prices of drugs across countries. Many studies have been conducted for developed countries, but there has only been a few studies related to developing and least developed countries (see among others Lichtenberg 1996 and 2003; Kremer 2000; Lanjouw 2002; Towse and Danzon 2003; Scherer 1997).[1] In what follows, we also briefly examine the factors behind the pricing behaviour of pharmaceutical companies.

2.1 Theoretical Concept

The concept of Ramsey (1927) pricing originates from the optimal taxation theory and has been extensively applied to public utilities that need to recover high incurred fixed costs. If drug prices exhibit a Ramsey pricing pattern, then prices in developing country are lower than in richer countries the lower is the difference in consumers' ability to pay in different countries. In the pharmaceutical sector large aggregate sunk costs are related to R&D investments and such pattern of pricing can be predicted on the basis of Ramsey (1927) pricing rules. Third degree price discrimination between different groups enhances the opportunities for strategic pricing, charging different prices in different markets according to consumers' purchasing power as well as to their price sensitivities to essential new launched drugs. It is in the firms' interest to pass-through some of their costs on consumers in different markets by charging prices according to consumers' ability and willingness to pay. However, there are specific conditions for such pricing to occur. First, companies must have significant market power, which allows them to practice price discrimination. Second, demand elasticities across markets must differ and last, markets must be segmented. These conditions are easily met in the pharmaceutical sector, which we show in the following sub-section.

In the absence of strict price regulation, patent protection may provide an important source of company's market power. The extent of market power depends on the existence of therapeutic

[1] High prices of pharmaceuticals in developing countries disproportionally mirror a fraction of companies' global R&D costs dedicated to developing drugs for rare tropical diseases and improving drugs for treatment of main communicable diseases in poor countries. In recent times, the role of R&D activities in pharmaceutical companies on pricing strategies and establishing brand name attracted many researches to perform analysis on these issues, among most recent Lichtenberg (1996 and 2003), Kremer (2000) and Towse and Danzon (2003). There are two outlying reasons that research is mainly conducted for the developed world. First, the majority of drug giants have their seats in the US and the EU and second, the data is more reliable and easier to obtain for the advanced economies.

substitute products that may offer patients an alternative medical treatment. Parallel trade tends to destroy the opportunities for price discrimination across countries, because arbitrageurs can freely purchase drugs in a low price market and re-sell them in a high price market, so that market equilibrium is characterized by uniform pricing.

Demand for pharmaceutical products varies widely across developing countries. First, poor groups of society are more price-sensitive because the out-of-pocket spending accounts for much larger share of their income. Affluent groups within poor countries will experience even steeper demand curves than poor groups in developed countries, where about three quarters of pharmaceutical purchases are covered through reimbursement schemes. By contrast, 50 to 90 percent of pharmaceutical purchases are via out-of-pocket spending in the developing world, according to the OECD (2001, 2002) and the WHO (2001, 2002). Second, there are differences in the proportion of insured consumers, covered by a national or social insurance schemes, relative to non-insured consumers, carrying the full costs of treatments via out-of-pocket spending. Finally, the strain of a particular disease may vary internationally and the same pharmaceutical products applied may not be effective in all countries. For instance, there are large variations in the prevalence of HIV/AIDS, tuberculosis and malaria. It is therefore necessary to distinguish between global and country specific diseases.

Since parallel trade is of limited importance and demand elasticities may vary, Ramsey pricing is likely to be practiced in the pharmaceutical markets. In the simple case of a monopoly producer, the price p_i in market i is determined by the marginal cost of production, c, and the elasticity of demand, ε_i, in market i, i.e. $p_i = (1 - 1/\varepsilon_i)^{-1} c$. If there is competition from therapeutic substitute products, then the price p_i will additionally depend on the cross-elasticities of demand and the form of oligopolistic competition among pharmaceutical producers.

2.2 Previous Research on Ramsey Pricing of Pharmaceuticals

2.2.1 Empirical Evidence

Recently, a few papers have focused on what would be the appropriate optimal pricing regarding growth and welfare issues (e.g. Barton 2001; Lanjouw 1998; Lu and Comanor 1998; Scherer and Watal 2002). Differential pricing should not include favourable conditions, such as compelling poor countries to turn over their rights guaranteed under the TRIPS agreement. Such favourable pricing can only be justified when providing pharmaceuticals to mission hospitals in poor countries. However, price discrimination can play a positive role when establishing private health and insurance schemes in addition to public sector health services. As mentioned above, there are clear theoretical incentives for pharmaceutical companies to consider Ramsey pricing as the optimal strategy, even though there is not much empirical evidence for the developing world.

There are several reasons for firms' incentives to practice Ramsey pricing. Companies may be encouraged to set drug prices close to the marginal cost in the least developed countries with a successive procurement of prices from low to high income countries[2]. As Barton (2001) states, such price differentiation appears unambiguously desirable, since it makes products available to patients in the developing world who would not otherwise be able to afford them. These differentials, in addition, allocate the cost of research in an equitable way without harming patients in the developed world. The economic theory underlying this statement implies that demand for medicines is typically more inelastic in high-income, as opposed to, low-income countries. In the case of setting higher prices in high-income countries and low prices in low-income countries, the total world welfare is maximized.

Lanjouw (1998) shows companies find more incentives to gather global social returns than to consider national markets individually. Such discriminatory pricing also maximizes the profits of oligopolists, i.e. patent holders. Thus, pharmaceutical companies would be expected to practice it voluntarily. However, if this is the case, why do we not observe strong evidence on this issue? There is some evidence that pharmaceutical firms set prices according to income, although this link is fairly weak. Scherer and Watal (2002) suggest that the necessary condition is the segmentation of markets in the presence of restricted arbitrage trades from low to high priced markets. Towse (1997) further points out differences in regulatory regimes across countries may serve as a *de facto* trade barrier in the pharmaceutical market. The driving forces underlying price differentials are distinctive regulatory schemes that may even occur within free trade areas and firms may due to several reasons not find Ramsey pricing strategy as the optimal one.[3]

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[2] See the research papers presented at the WTO Workshop on Differential Pricing and Financing of Essential Drugs, held in April 2001, at Hosbjor, Norway, available at the following address:
http://www.wto.org/english/tratop_e/trips_e/hosbjor_presentaions_e.htm

[3] According to the International Federation of Pharmaceutical Manufacturers Associations (2003) there may be several reasons for price differentials not according to Ramsey pricing since pharmaceutical companies may confront several constraints like government policies implying differences in health care conditions and medical practices, differences in national health care funding systems, differences in reimbursement systems, government trade-distorting interventions, inflation differences and exchange rate changes, variation in per-capita national incomes and preferences, marketing and sales strategies of patent-holders and distribution margins, discounting and donations, differences in regulatory systems, product liability laws and tax levels and differences in the remaining term of patent protection among countries.

Scherer (1997) regards greater total output under price discrimination than under price uniformity as a necessary condition for welfare gains. It presumes the optimality of marginal cost pricing, ignoring the sunk costs of research and development. Danzon (1997) responds to his study with a claim that pharmaceutical products are global products, thus R&D is a global joint cost passed through prices onto patients worldwide. Ramsey pricing principles imply that differential pricing related to inverse price elasticities of demand is second best optimal strategy to cover the joint costs of R&D[4]. Hence, a supplier would charge in each country "what the market can bear" in order to maximize her profits in a particular country, consequently, in aggregate terms. Prices can be proportional to the average economic capacity, but it is not necessary, because companies target only a small share of wealthy people in poor countries. Although drug prices are regulated in most countries, each local regulator has power only in their home markets, whereas the joint costs are global.

There are several reasons why Ramsey pricing could not hold in practice. First, large buyers such as governments and hospitals are most common purchasers of pharmaceutical drugs. Unlike the implicitly assumed individual patient in Ramsey setup, large buyers purchase drugs on the open market and exhibit a certain degree of negotiation power to lower prices offered by a monopolistic seller. Agencies in countries with national health security can organize some monopsony power positively correlated with income, which would favour lower prices in richer countries offsetting the discriminatory pricing structure. The lobbying groups of consumers are better organized in rich countries and when they confront low prices in developing countries, they may force Ramsey pricing pattern to fail. Therefore, we distinguish between *supplier* and *agency* drug prices in the following section, where we empirically assess the issues discussed so far.

Second, companies may not set prices at the profit-maximizing level as determined by the Ramsey principle. On the one hand, pharmaceutical firms may set prices closer to, or at, marginal cost in poor countries, especially in the case of epidemics like HIV/AIDS under the pressure of NGOs, health activists and the media, or certain charity reasons. On the other hand, pharmaceutical firms may choose a uniform pricing structure even in the presence of perfectly segmented markets. High political pressure towards lower drug prices in high-priced markets may occur due to misunderstanding of the Pareto improving price discrimination and take form of subsidies to poor countries. Government price regulation in turn either suggests with the "reasonable profit margin" determination to cover some of the R&D costs or accepts

[4] For a thorough overview of the Ramsey pricing principles see Ramsey (1927) and Baumol and Bradford (1970).

the price of other therapeutically similar drugs on the local market or the price of the same drug in foreign markets as a reference price. Companies under such conditions may prefer uniform pricing across countries to avoid low price references, since the revelation of lower prices in one market may lead a government in another market to introduce reference-based price regulations.

2.2.2 Pricing Strategies

In practice, two main pricing strategies are observed in the pharmaceutical market. Within the US market, Lu and Comanor (1998) identify the link to substitutability of pharmaceutical products. First, *skimming pricing strategy* is optimal, when there is limited substitutability of therapeutic drugs. Setting a high initial price and then lowering it over time implies not only third degree discrimination, but also inter-temporal price discrimination. Second, *penetration pricing strategy*, i.e. at the moment of introduction, prices of a new product do not differ from existing drugs prices, but generally rise over the next four years. The probability of the latter strategy is higher in case of greater product substitution. Pharmaceutical companies practice skimming pricing strategies to cover high expenses related in particular to R&D investments and high testing costs for new products that offer significant advantages over the existing ones. In contrast, penetration pricing is often employed for products that represent only marginal improvements over their established counterparts.

In developing countries, there is limited substitutability of pharmaceuticals, thus penetration pricing strategy may not be the optimal one. Since demand for pharmaceuticals usually exceeds the current supply of drugs in developing countries, the need to build a demand by setting low initial prices cannot be a rationale for such a strategy[5]. Three other reasons support this fact. First, a certain selection bias may be present in the developing world. There are many important individual attributes like age, education, race, income, insurance status, the condition on which the drug was prescribed and the compatibility of the local knowledge of hospital staff about procedures and medicines. Without controlling for these conditions, people cannot be treated equally and medicines will certainly not have the same treatment effect across different environments[6]. On the supply side, there is a low variety of

[5] More than 95% of HIV infected patients, which have experienced around 95% of all deaths from AIDS, live in the developing world, according to UNAIDS (2001). This implies that demand for HIV/AIDS-related drugs remarkably exceeds the supply of these drugs.

[6] In line with these reasons, one cannot really observe Dixit-Stiglitz preferences, i.e. the so called "love of variety" concept, among patients in the developing world. Patients are more willing to test new drugs but such testing of new drugs can be misleading, since people in extreme conditions cannot be considered as a representative group of society.

pharmaceutical products for treatment of similar diseases. On the demand side, population is constrained by their low purchase power.

Second, availability of information and the knowledge necessary to distinguish between the qualities of new available drugs are not the same among patients living in developing and developed countries. Finally, penetrating strategies are more likely to be applied in chronic circumstances where there is likely to be a repeated number of purchases and there is a prospect for benefits from increasing prices in the future. A continuous number of purchases can only be guaranteed by a sufficient coverage health scheme, not common among patients living in the developing world. In line with reasons, we may expect that companies will find it profitable to practice skimming pricing rather than penetrating pricing strategies in the developing world.

3. Empirical Analysis

3.1 Data

Our data are compiled from several sources. We use developing indicators from the World Bank Group (WB) and core health indicators from the World Health Organisation Statistical Information System (WHOSIS), which were used for the wealth measures, prevalence rates of diseases and mortality data. We use the same source for information on essential drugs from the official Essential Drugs and Medicines List. We use the Orange Book on Patents, Thomson Delphion and Health Action International data (HAI) for data on patents. In either of them we fail to find complete data on patent expirations and exclusivity rights for our sample of developing countries. Therefore, we limit the empirical part of our analysis on patents to AIDS/HIV-related drugs. For data on international retail prices we use the Management Science for Health (MSH) International Price Indicator Guide and Health Action International price surveys.

A notion on the quality of our data is worthwhile here. We use the official survey data on drug prices. The reliability of price surveys depends on the infrastructure and education of the staff in charge of compiling the data. An accuracy bias can occur in case of strong presence of black-market transactions. Data on prices mainly refer to developed urban areas in developing countries. One cannot obtain similar information from pharmaceutical companies, which are unwilling to reveal data on price mark-ups and their pricing strategies. Nonetheless, organisations attempt to improve the quality of their data through control processes, when collecting data on health indicators and pharmaceutical prices.[7]

3.2 Evolution of International Prices of Pharmaceuticals

We compile the reference international prices of thirty essential drugs using the MSH International Drug Price Indicator Guide. The data cover a seven-year period of 1996-2003, and represent medians of recent procurement prices from drug suppliers and procurement agencies offered to developing countries.[8] These drugs are widely used, available in standard formulations and treat acute and chronic diseases prevalent in our sample of developing countries[9]. Prices per unit of item are calculated as international median prices provided by suppliers or agencies. Median prices are used due to a non-parametric distribution of drug prices that exhibit a positive standardized third moment distribution skewed to the right. Therefore, it is possible that the mean value is overestimated due to some outliers; therefore the use of median is more appropriate.

3.2.1 Suppliers and Intermediate Agencies

Suppliers maintain warehouses and supply items directly to customers. A large number of suppliers and agencies imply a large variation in prices. Intermediate agencies negotiate prices and place purchase orders for nongovernmental organizations (NGOs), private voluntary organizations (PVOs) and Ministries of Health. These agencies may additionally charge a fee for their service over and above the drug’s CIF price. We calculate a median price across suppliers’ offers and agencies’ to make prices internationally representative. Since we expect

[7] MSH, for instance, requires from all suppliers and agencies to complete a quality assurance questionnaire. Questions are developed in collaboration with WHO Essential Drugs and Medicines Policy staff addresses issues including inspection, testing, quality assurance, licensing, recalls, quality control procedures, standards, and documentation. This requirement provides some assurance of quality control processes. Typical suppliers and agencies selected for this guide are not manufacturers, but they offer products which are stated to be in compliance with international quality standards specified by the organizations such as the United States Pharmacopeia (USP), the British Pharmacopeia (BP), and the European Pharmacopeia (EP).

[8] Five primary types of suppliers and agencies are included: Suppliers who maintain a warehouse and supply items directly to consumers. Procurement agencies that negotiate prices and place purchase orders for client nongovernmental organizations (NGOs), private voluntary organizations and Ministries of Health, International development organizations, Government agencies and Community Development Medical Unit (CDMU). All sample drugs are classified as core essential drugs, according to the WHO List of Essential Drugs. We report the scope of our data on international prices in Appendices in Tables 1 and 2, where non-available data or non-existing data is marked with the symbol N/A. For international median prices we could not obtain data on prices for the year 1997. Since many problems due to package size, strength and dosage form of drugs may occur, we use per unit of drugs prices, i.e. per tablet, capsule, vial or inhaler. The most sold package sizes and commonly used strength of drugs are being used.

[9] We could not take a larger sample since we wanted to keep it comparable with local prices of the same drugs, number of which is determined by the completeness of available data. International median prices provided by suppliers and agencies are reported in the Tables 1 and 2 in the Appendices.

that intermediary agents have an important role in the price determination of branded and generic drugs, we consider this aspect in our further steps.

A close analysis of the evolution of international prices throughout the period 1996 to 2003 can provide a comparison of differences in pharmaceutical prices among countries.

[Insert Figure 1 here]

The first insights into our data already reveal useful information about the intermediary agents. In Figure 1 we distinguish between agency and supplier prices and present the evolution of median international prices of our thirty drugs over the seven-year period. Agency prices are on average higher than supplier prices, however, both following an upward trend. In Tables 1 and 2 we report times series of international median prices and observe extreme values departing from this trend extensively. This suggests monopsony power of agencies that have better access to expensive drugs like HIV/AIDS-related drugs and can thus charge additional fees for their services. This fact is clearly observed in Figure 2, where we compare HIV/AIDS-related drugs provided by agencies to those provided by suppliers. Higher negotiating power of agencies could account for agency prices set far above supplier prices. Agency prices exhibit a decreasing trend of HIV/AIDS-related drugs prices, since a pandemic extension of AIDS triggered the reduction of prices. The negotiating power of parties likely drives hedges between consumers and producers. On the one hand, consumers face high prices. On the other hand, there are potential welfare gains from the monopsony power of agencies in the case of epidemic outbreaks and organized purchasing power within different groups of consumers.

[Insert Figure 2 here]

3.2.2 Extinction of Property Rights

Launches of new drugs and the extinction of property rights are also attributed to observations in Figures 1 and 2. Frequent changes in trade regulations, particularly with regard to intellectual property rights, may affect international prices and consequently the affordability of drugs. Scherer (2000) suggests that average pharmaceutical product prices fall sharply when generic entry occurs following the expiration of patents. Scherer and Watal (2002) provide some evidence that when generic competition emerges, the price of the patent-expired but still branded product may be raised in an attempt to exploit brand differentiation and market segmentation.

We consider the Scherer and Watal (2002) evidence by looking at a specific drug for which we observe the highest correlation between expiration date and decrease in prices. The median price of *Ciprofloxacin*, a drug used to treat the sexually transmitted disease gonorrhoea, sharply declined after expected patent expiration.[10] In Figure 3, we observe a sharp decrease in its price provided by suppliers, since the industry of innovator brands has already prepared for generic competition. This suggests that negotiating power of agencies took part in the price determination process, although we cannot explain specific variations of brand prices over time due to the introduction of generics.[11]

[Insert Figures 3-6 here]

In Figures 3-6 we examine the behaviour of on-patent drugs, mostly HIV/AIDS-related drugs, more precisely by distinguishing between supplier and agency prices over the period 1998-2003. Figure 6 shows a remarkable decrease from almost 50,000 US$ per capsule of HIV/AIDS anti-retroviral drug *Nevirapine* in 2001 to less than one US$ two years after. Similar conclusions can be drawn for cases of *Losartan* and *Indinavir*, which also exhibit such remarkable behaviour.

3.2.3 Launches of New Drugs

In addition the extinction of property rights, we look at the behaviour of new drug prices after their launch. We consider both skimming and penetrating pricing strategies. Pharmaceutical companies may set prices higher to cover high expenses related in particular to R&D investments and high testing costs. These pioneer companies can allow themselves to perform skimming pricing strategies, as they assure through their brands a high quality of new drugs. According to Lichtenberg (1996), there is a compensation effect in terms of trading higher prices for better quality of new drugs. Though, these high prices, affordable only for a part of the population, will eventually decline as more developed drugs enter the market.

Another explanation of this decline, as Lu and Comanor (1994) suggest, is that high premiums will eventually attract additional rivals and the originating company will face increased competition in future years if strict industry protection is not provided. Suppliers of those drugs that offer little therapeutic advantage over existing ones may, on the contrary, follow the classic penetration strategy. We assume that the penetrating strategy may prevail in

[10] Its patent was expected to expire in 2000, but has later been extended as reported in Table 3.
[11] To perform a better analysis we would require complete time series across countries on comparable innovator brand and generic local prices.

the generics sector, because of more vigorous competition than in the innovator brands sector. However, Figures 3-6 provide little evidence of such pattern of prices.

3.3 Local Drug Prices

We use annual data from 2001 on thirty essential drugs for ten low-income representative countries from different continents, i.e. Armenia, Brazil, Cameroon, Ghana, India, Kenya, Peru, the Philippines, South Africa and Sri Lanka. Our leading variable is the ratio of local median prices to international median prices, both expressed in US$ at current exchange rates. We construct median retail prices per unit of medicine, calculating the median of innovator brand, and their generic equivalent that is present in pharmacies and clinics in the capital and major cities of each country. This gives us a representative price across four locally relevant major sectors, i.e. procurement, public, private-for-profit and private not-for-profit. We compare prices nation-wide by using a common set of benchmark reference prices, as motivated by the WHO and Health Action International measurement approach (2003).

Apart from the affordability problem, we consider the limited access to drugs. In Figure 7 we observe large differences regarding the access to drugs among countries, for both, generic and innovator brand pharmaceuticals. We consider people have the access to those drugs, for which local prices have been assembled. Generics in our sample are on average more accessible than their innovator brand equivalents. In particular, India and Brazil have growing generic industries that provide a large variety of drugs to their patients. In contrast, inhabitants of the Philippines have better access to innovator brands.

[Insert Figure 7 here]

3.3.1 Branded and Generic Drugs

In line with the economic theory presented in Section 2, we expect generic drugs to be less expensive than their branded drugs equivalents due to several reasons: vigorous competition after patent expiration, more variety of products, and higher substitutability among generics. Median prices in our sample of countries are for both innovator brand products and generics on average higher than international prices.

This is shown in Figure 8, where we compare median prices across ten countries between nine generic and innovator brand drugs that are common to all countries in 2001. These are the most available drugs, which help treating diseases responsible for the largest share of deaths in our sample of developing countries.[12] The average innovator brand price is $26.57 and about three times larger than the price of an equivalent generic. This relationship between generics and brands holds largely within the countries, however, we observe large variation in prices among countries. The highest median brand price is set in the Peruvian market and is about thirteen times higher than in the cheapest country, India. In case of generics, differences are not that striking. For instance, the highest prices exhibited in the Philippines are only about eleven times above prices of generics in Sri Lanka.

[Insert Figures 8 and 9 here]

3.3.2 Measuring Affordability in Terms of Treatment Costs

Comparisons of unit prices do not provide adequate information on the affordability of specific drugs, as several units of a medicament are required to cure a disease. Therefore, we compile information on units and days of treatment yielding values for median treatment prices. In 2001, the average brand treatment cost among these developing countries was about twenty times more expensive than the same treatment quantified in international terms. Patients, using generic products, experienced three times cheaper treatment cost for the same disease. In India, both generics and brands treatments, are more affordable than in the rest of countries. By contrast, Ghana experienced the least affordable prices.

Comparing treatment costs does not complete the picture as fatality among diseases differs. For example, a person suffering from HIV/AIDS-related diseases needs a prompter treatment than a person suffering from peptic ulcer. We measure the relative importance of each disease using mortality tables disaggregated by the cause of death. As a benchmark we use the number of deaths per cause in different sub-regions of the world, as classified by the WHO mortality database. Although hypertension accounted for the largest number of deaths, its treatment cost did not exceed the cost of treating far less fatal disease – peptic ulcer.

To evaluate the affordability problem in real terms, we measure the number of working days required to purchase a typical course of treatment, as motivated by HAI. We collected data on daily wages earned by the lowest paid government worker, as a representative of the active population. Daily wages in the year 2001 are converted to US dollars at current exchange rates. Although, this wage is typically above the average earning, it provides a useful

[12] The reduced sample contains the following drugs: Amitriptyline, Amoxicillin, Atenolol, Ciprofloxacin, Co-trimoxazole suspension, Glibenclamide, Hydrochlorothiazide, Ranitidine and Salbutamol inhaler.

benchmark upon which we can compare people's ability to pay for treatment of their illnesses.[13] It is hard to imagine that people in Ghana, who typically dedicate at least half of their earnings for daily elementary needs, could afford themselves to be ill, when they had to work 65 days only to pay for a course of Ranitidine, a medicine that treats peptic ulcer. Furthermore, this problem is even more worrying in treatments of fatal diseases, such as AIDS. Regarding this issue, we dedicate the last part of the following section to the analysis of the affordability of HIV/AIDS-related drugs.

4. Empirical Analysis

In this section we analyse the development of essential drugs prices in the international environment and provide some empirical insights into why pharmaceutical companies set prices at widely varying levels in different national markets. We test the presence of Ramsey pricing, where pharmaceutical companies set prices in different markets according to consumers' price elasticities of demand. If the underlying conditions of Ramsey pricing hold, then low-income countries in cross-country price discrimination are likely to receive pharmaceuticals at lower prices than when parallel trade arbitrages prices towards uniformity. The empirical question is, whether pharmaceutical companies have indeed engaged, and to what extent, in Ramsey pricing strategies.

4.1 The Model

4.1.1 The Choice of Variables

The econometric model is specified as a simple linear cross-section regression following Scherer and Watal (2002). The dependent variable in the univariate analysis is the ratio between local and international median prices. The choice of our explanatory variables is suggested by previous literature (see Section 2) and determined by a means of scatter diagrams. In Figures 10 and 11 we compare two different approaches for measuring the price elasticity of demand for drugs. Figure 10 arrays prices of generics and Figure 11 prices of local innovator brands against the GDP per capita across countries.

[Insert Figures 10 and 11 here]

[13] Daily wages of civil servants are the only officially obtainable wages in these ten countries. One needs to be aware that the formal sector may not be a fully representative sector, but is the only one that can be used due to scarce reliable data. In developing countries companies are usually state-owned. The lack of competition leads to efficiency problems also from the employment perspective. An excessive employment in the public sector may be one of the reasons why wages are set lower than in other sectors of the economy.

We observe a weak correlation between income and prices. This is partly due to large outliers in sample drugs prices, which we address in the next steps. The average median price ratio is 26.57$ for innovator brand drugs and 7.67$ for generic drugs, which indicates large differences between local and international reference prices. On the one hand, the maximum price for innovator brand was almost 190 times higher for *Fluoxetine* in South Africa relative to its international price. On the other hand, the generic drug *Hydrochlorothiazide* in Peru was priced almost sixty times higher relative to its international reference price. The correlation between the innovator brands price ratios and GDP is 0.25 and 0.19 between generics price ratios and GDP.

We find similar low correlations as Scherer and Watal (2002) in their analysis, including a different set of low-income countries and using standardized prices expressed as a ratio of the Red Book wholesale list prices. So far, we find only slight evidence of Ramsey pricing pattern in favour of the out-of-pocket measure. Figures 12 and 13 show a high correlation between price ratios and different income proxies especially for out-of-pocket expenditures. Out-of-pocket measure is expressed as a percentage of all out-of-pocket expenditures from total health expenditures. Figures 12 and 13 largely motivate the choice of variables in the econometric model.

[Insert Figures 12 and 13 around here]

4.1.2 Econometric Specification

To capture the single impact of different income measures on median drug prices we conduct several simple cross-country regressions, including different explanatory variables for different groups of drugs. First, we estimate income with GDP per capita at current purchasing power parity. This measure may not be optimal for capturing real demand elasticity and actual ability to pay for drugs in developing countries. Therefore, we construct alternative measures for both models, including either innovator brands or generics. GDP may exhibit delayed effects on prices and perform poorly in capturing the skewness of the income distribution in low-income countries. These countries share a low Gini coefficient, thus a small share of the population exhibits an unreasonably high income, in particular in South

Africa.[14] Therefore, we also use the measure of out-of-pocket expenditures in the sensitivity analysis.

We define ratios between local and international prices as MPR_BRAND for innovator brands, and MPR_GENERIC for generics. GDPPC stands for GDP per capita at average purchasing power parity divided by 1 000. The first regression equation including 118 observations, with significance values of tests in parentheses, is as follows:

$$\text{MPR\_BRAND} = \underset{(5.4217)}{15.1882} + \underset{(2.3989)}{1.2231}*\text{GDPPC} \qquad (1)$$

$$\text{MPR\_GENERIC} = \underset{(3.7489)}{4.7748} + \underset{(2.3963)}{0.6762}*\text{GDPPC} \qquad (2)$$

The estimated relationship is consistent with Ramsey Pricing, although we cannot conclude it is strong. It is highly significant for both, innovator brands and generics, at the 99 percent significance level. An additional $1,000 increase in income per capita on average contributes 1.22$ in equation (1) and 0.56$ in equation (2) to the median price ratios. In Table B1 in the Appendix we report regression outputs, without adjusting for outliers. These results imply a relatively large impact of the explanatory variable on price relatives with statistically less significant results.[15]

4.2 Robustness Checks

Our findings are robust to a variety of adjustments with respect to outliers and different set of countries. The official price lists may be distorted if the ratio of local prices to international prices is very high, because there would be large incentives to import on the black market from countries with lower official prices. We experimented with different regressions, including wages, the poverty rate and out-of-pocket expenditures as more reliable indicators of the ability of the low-income population to pay for locally available drugs. All our measures are highly correlated, on average more than 70 percent, and all of them may thus explain price-settings better than GDP per capita. We use daily wages of the lowest paid civil servant to capture the middle-income class' ability to pay. Countries in our sample face large

[14] The average annual GDP per capita for our countries is US$ 4 064 in purchasing power terms in year 2001, which is slightly less than half of the World's average (US$ 8 727). Kenya with US$ 980 is the poorest among all and the most affluent in the sample, South Africa, exhibits GDP per capita of US$ 11 290.

[15] We estimated the relationship between price ratios and GDP per capita to make it comparable to the study of Scherer and Watal (2002), who use different sample countries with more aggregated data on drug prices. We report similar results with comparable significance of GDP per capita effect on price-setting. In addition, we showed that including alternative measures for demand elasticity in low-income countries lead to better results. Price setting is also determined by interaction of different other factors. But since our main objective is to test for the relationship between price relatives and ability to pay, we only include some of the plausible variables; their choice was determined by data availability.

poverty problems and typically people belonging to the lowest income group demand a significant part of available drugs. In addition, we use the poverty rate as a proxy variable for income. In following, we report main results of our regressions.

Due to income skewness, particularly in South Africa, pharmaceutical companies may misjudge some countries as higher-income markets. The small minority of a wealthy elite, which usually has greater access to drugs and is willing to pay for better quality innovator brand drugs, may misleadingly represent the purchasing power of the whole population. This part of the population typically enjoys a comprehensive health insurance that covers among others prescription drug purchases. Since the poorest people bear the heaviest part of the burden of diseases, we estimated equations (1) and (2) including other income proxies, i.e. OOPX defining out-of pocket expenditures, WAGE defining daily wages of civil servants and POVR defining the poverty rate. As presented in Table B1 in the Appendix, they all exhibit higher explanatory power[16].

$$\underset{}{MPR\_BRAND} = \underset{(9.5934)}{36.7032} - \underset{(-4.5357)}{0.3489 * OOPX} \qquad (3)$$

$$\underset{}{MPR\_GENERIC} = \underset{(7.8418)}{13.3062} - \underset{(-4.7502)}{0.1297 * OOPX} \qquad (4)$$

OOPX is constructed as a percentage of total health expenditure, thus we assume that a decrease in this measure could imply greater coverage of health insurance. This relationship is significant in both cases, for innovator brands and generics, at the 99 percent significance level. This is an important result, which indicates that drug providers may set higher prices when expecting the largest share of drugs purchases to be covered by insurance policies. This measure explains about 15 percent and 11 percent of the variance of price ratios in the innovator brands and generics case, respectively. This may be evidence on drug companies taking advantage of specific circumstances, when a significant part of one nation is able and willing to purchase health insurance policies.

According to demographic studies, reported by the WHO (2001, 2002), we assume that the lowest income group represents a significant part of the aggregate demand for drugs. Our estimates including the poverty rate show that its relationship with price ratios is more consistent with Ramsey pricing in the case of generic drugs than innovator brands.[17] We find a weak negative relationship between the poverty rate and price ratios, in particular in the case of generics. Scherer and Watal (2002) find similar results using GDP per capita measure and

[16] We report relevant regressions in the Appendix in Table 4.
[17] The World Bank defines the poverty rate as the percentage of population living with resources below $1 per day.

interpret their findings with the economies of scale and claim that generic competition is fiercer as it responds to greater demand for generics by the poorest people.

4.3 The Effect of HIV/AIDS on Pricing Decisions

In the case of HIV/AIDS-related diseases, a strong political influence, an intense public awakeness and economies of scale, magnify the importance of the affordable HIV/AIDS-related medicines. AIDS is an expensive disease, expensive to prevent and expensive to treat. In developing countries, and notably in South Africa and India, it represents a heavy burden. Almost 4 Million people affected with HIV live in India and about 5 Million in South Africa. The prevalence rate is the highest among people in their most productive years, between 15 and 29 years of age.

On the one hand, India spent in the year 2001 only $75 per person on health, of which more than 80 percent was in the private sector via out-of-pocket expenditures. Government health spending was only about $4 per person. On the other hand, we find much larger deviations in prices among countries for different HIV/AIDS-related drugs than for other drugs. Pharmaceutical companies began in the year 2000, under pressure of public stand up, international organizations and local governments, to offer price discounts for HIV/AIDS-related drugs. Since it is not unusual for discounts to reach 25 percent, we inquired whether this recent pricing behaviour could force prices to move consistently with the Ramsey pricing hypothesis and make them more affordable for individuals. As reported in the previous section, most of the prices for HIV/AIDS-related drugs are among the extreme values. Therefore, we estimate models with non-adjusted observations.

We include the HIV prevalence rate, defining it as PREV_HIV, as a measure of the burden of disease. We found significant results in the case of wages and the poverty rate for innovator brands, in particular, although only at a 95 percent significance level in the latter and at a 90 percent significance level in the first case. HIV/AIDS-related drugs, as previously explained, are recently launched drugs and therefore share a small number of substitutable drugs. This may explain why we find significant results only in the case of innovator brands. According to discount price strategies, we would expect a negative sign of the prevalence rate, which is not evident from our estimations.

On the contrary, we find that the higher the prevalence of HIV, the higher the prices. We could assume that with increasing prevalence the price elasticity of demand decreases, which theoretically speaking could provide incentives for setting higher prices. This positive relationship may be explained by the fact, that we could not exclude countries like Armenia and the Philippines, where HIV/AIDS does not present a major threat. We indeed estimated models only for African countries as they present the highest HIV prevalence rates, as reported in Table B1 in the Appendix. Presumably, due to the low number of observations, we fail to find significant results. Despite that, we find an interesting result, when including only nine drugs, among them HIV/AIDS-related drugs sold in all countries. But since there is no great government coverage and drugs are mostly financed through out-of-pocket expenditures, it is plausible to assume that pharmaceutical companies respond to higher demand with lower prices, exploiting their economies of scale. We find a statistically significant negative relationship between the prevalence rate of HIV in the case of generics for models with wages, out-of-pocket expenditures and the poverty rate.

5. Discussion of Policy Options

5.1 Incentives for Firms within the TRIPs

In April 1994, at the end of the Uruguay round of the General Agreement on Tariffs and Trade (GATT), a wide-ranging international agreement on Trade-Related aspects of International Property Rights (TRIPS) was signed. This agreement obliges all WTO members to make available a 20-year patent protection for novel, non-obvious and useful inventions, either for products or processes, in all fields of technology, including pharmaceuticals, with very few exclusions and limitations. In the prelude of the signature of the TRIPS a dispute was entitled among developing and developed countries.

On the one hand, developing countries feared that this agreement would lead to higher prices and be detrimental to the development of their infant domestic high-tech industries. On the other hand, developed countries complained about large losses from imitation in the least developed countries. They argued that stronger property rights would bring along new investment by encouraging foreign direct investments, greater technology and greater domestic research in development. In the long run, this development could be beneficial to both consumers and companies in the developing world. The argument brought forward by the developed world made its way through and the TRIPS agreement came into force with the formation of the World Trade Organization in January 1995.

The process patent regime allowed pharmaceutical companies in developing countries to specialize in the production of low cost generic versions of on-patent drugs for domestic markets. Under the TRIPS agreement, with the move to product patents, such production is no longer legal. Lanjouw (2002) points out that there might still be a rationale for developing countries to extend protection even if they are poorer, since they do not face the same tradeoffs as developed countries. Different markets exist in terms of diseases and pharmaceutical needs among developed and developing countries. First, a market for drugs developed to fight against global diseases that affect both poor and rich countries and second, a market for those pharmaceuticals brought about to cure illnesses such as malaria, tuberculosis and HIV/AIDS.

In the case of poor country ailments, stronger intellectual property protection may not be sufficient to induce new affordable medical treatments for these diseases. The relevant question is: What measures can developing countries implement in the global environment to improve low-cost access to pharmaceuticals? R&D costs for global diseases treatments can be covered by wealthy consumers, implying a price reduction in less developed countries to more affordable levels, without diminishing incentives for future research and innovation. It is puzzling point, whether poor countries free ride or not. On the one hand, free riding on innovation investment for poor countries diseases is less likely, since affluent countries are not motivated to conduct research in this field. On the other hand, poor countries themselves could free ride on the research in their own markets, for instance. This could be an additional reason why there has been so little original pharmaceutical research conducted in the developing world. From an economic incentives perspective, the problem of developing medicines for diseases like malaria, tuberculosis, and to a less extent, HIV/AIDS, is in its nature similar to the ‘orphan drug’ problem concerning new medicines for rare illnesses. In both cases, rare and tropical diseases, there are inadequate incentives for companies to bear the high cost and risks engage in the development of new drugs.

5.2 Orphan Drugs

The term ‘orphan drugs’ refers essentially to those drugs, which treat patients afflicted with rare diseases such as Huntington’s disease or Wilson’s disease. The small size of the ailing population makes R&D investments unprofitable. There is a similar problem in the case of diseases in developing countries. A lack of economic resources resulting from low income per capita discourages research, despite the increasing number of afflicted patients[18].

Lichtenberg (2001) finds out that the Orphan Drugs Act has had a favourable effect on mortality from rare diseases both in absolute and relative terms to other deaths in the post-1983 period, as the number of deaths from rare diseases declined. An international counterpart to the US Orphan Drug Act to address the problem of promoting the development of improved medical treatments for the third world ailments is required.

5.3 Improving the Economic Access to Pharmaceuticals

Lanjouw (2002) stresses out the importance of ‘pull’ and ‘push’ mechanisms to subsidize research with public funds in conjunction with stronger property rights. Bulk purchase pre-commitments are another solution when ensuring the availability of new medical treatments for poor country specific diseases. Patents in low-income countries are not sufficient to encourage additional research on global diseases. Currently discussed set of mechanisms, such as tiered pricing, national price regulations and compulsory licensing, stimulate access and affordability of global diseases treatments, where R&D investment is already supported by consumption in affluent countries.

Another option to improve economic access to drugs to developing countries is to issue compulsory licenses. Referring to Scherer and Watal (2002), compulsory licensing addresses the situation where a government allows a third party to make, use or sell a patented invention without the owner’s consent. The old TRIPS agreement did not define or limit the circumstances under which patented inventions can be subject to compulsory licensing and was therefore implemented with Article 31.

Watal (1998) argues that national governments have some leeway in designing rules regulating the grant of compulsory licenses.[19] Although members may issue compulsory licenses for importation, they are restricted to import goods from countries where pharmaceuticals are not under patent law. Products made under compulsory licensing have to be in the first place manufactured for the supply of the domestic market. This fact has a negative impact on countries, unable to develop their own medicines, which face difficulties

[18] The U.S. Congress faced the problem of rare diseases by passing the Orphan Drug Act in 1983, which provided a slew of incentives, including exclusive marketing rights and subsidized clinical testing for clinical treatments. This legislation, despite some drawbacks, served well its objective.

[19] Under Article 31 (f) governments can issue compulsory licenses to allow other companies to make a patented product or use a patented process under licence without the consent of the patent owner, but only under certain conditions aimed at protecting the legitimate interests of the patent holder.

finding suppliers of drugs developed under compulsory licensing. As a result, a group of fifty developing countries members of the WTO presented the following request. They pled the Doha Ministerial Conference to take further steps to ensure that the TRIPS Agreement would not undermine the legitimate rights to formulate their own public health policies. The response to their will was Paragraph 6 of the Doha Declaration, which instructed the Council for TRIPS to find an expeditious solution to that problem. A joint agreement was finally reached on the 30th August 2003. The decision takes the form of an interim waiver, which allows countries producing generic copies of products under compulsory licenses to export the products to eligible importing countries. The waiver will last until the WTO's intellectual property agreement is amended.

5.4 Welfare Implications

The welfare implications can be addressed from different perspectives. First, the Ramsey pricing should be compared to uniform pricing under different health insurance schemes. Second, welfare implications can be empirically tested through changes in health indicators and through mortality patterns across diseases over time. Finally, affordability of medicines and welfare can be enhanced by stimulating innovation and development of drugs via channels alternative to patents.

Rovira (2003) defines prices as equitable when the price paid in each country is proportional to the average wealth, income, or to some other indicator of economic capacity. Thereby he emphasizes the central role of equity and solidarity, which seem to be left out from the traditional definition of differential pricing. Discriminatory pricing can be, considering welfare implications, Pareto superior to uniform pricing. In other words, if a pharmaceutical company is able to discriminate markets, it will be profitable to set higher prices in richer countries relative to poorer countries. If the same company would set prices uniformly worldwide, patients in poorer countries would face the affordability problem. Patients in rich countries would not be worse off, as they would face the same prices as under uniform pricing. Profits of pharmaceutical companies would not diminish, since the price in the low-income market would still exceed the marginal cost of production. This may not be the case, if the pharmaceutical company also serves some patients in a low-income country under uniform pricing. Then it is possible that patients in rich countries will face higher prices under segmented markets.

To quantify the net welfare effect in high-income countries the loss in the consumer surplus should be compared to the increase in the pharmaceutical producer's surplus. Consumers in rich countries should thereby be considered as less price-sensitive, since the majority of them are sheltered by reimbursement schemes. Malueg and Schwartz (1994) show that uniform pricing by a monopolist can yield lower global welfare than discriminatory pricing if the dispersion of demand across countries is sufficiently large. They suggest that global welfare can be maximized allows discriminatory pricing between groups of countries, but uniform pricing within groups.

Welfare implications of the lack of affordability of drugs in developing countries can be measured through their impact on mortality across different diseases. Lichtenberg (1996) analyses the impact of specific drugs on the reduction of the demand for hospital care, leading to a decrease in mortality in the US. He finds that increases in drug consumption and novelty reduce the utilization of inpatient care and mortality. Moreover, Lichtenberg (1998) investigates the contribution of pharmaceutical innovation to mortality reduction and growth in lifetime per capita income in the US. Results show that innovation in drugs has increased life expectancy and lifetime income by about 0.75-1 percent per annum during the studied period, thus there is an innovation-induced mortality reduction. In a more recent paper, Lichtenberg (2001) investigates the effect of new drugs on mortality from rare diseases. His results show that one additional HIV/AIDS-related drug approval in year t will prevent 5,986 AIDS related deaths in year $t+1$ and ultimately prevent 33,819 AIDS related deaths.

The development of new drugs is costly and is far from being perfect as the current patent system places out of reach secondary uses of patented drugs. High costs of trials limit the number of drug tests to one disease, although new usage of drugs can be also discovered after some natural experimentation. Some areas of technology such as software development and bio-technology are already benefiting from an experimental approach called "open-source".[20] This approach follows a decentralized way of production, with freely available instructions provided an agreement on further modifications of the product. In the pharmaceutical industry open-source could be applied in two areas where lack of protection places further innovation out of researchers' interest – of non-patentable drugs and of drugs where patents have expired. Through this new approach, existing drugs could be improved and provided at lower prices to low-income patients, as well as new drugs could be develop for those ailments where yet little research has been done. It seems to be a promising way to increase the affordability and

[20] See The Economist (Jun 10th 2004).

availability of new drugs. But there are some drawbacks regarding specificities of the pharmaceutical industry such as high financial needs, long duration of projects, high entry barriers and as well the lack of guarantee that self-interest will not put the new discoveries under patent make this new approach not that clear. It is yet unclear how to efficiently organize demand- and supply-side incentives in order to achieve welfare enhancement in aggregate terms.

6. Conclusion

This paper has found new evidence on systematic differences in drug prices across countries by using a unique set of data and constructing alternative measures of income such as out-of-pocket expenditures that capture better the ability to pay in low-income countries. Our main result is that branded drugs are sold at significantly lower prices in low-income countries. The effect is significant when considering either the poverty rate or out-of-pocket expenditures on pharmaceuticals, which tend to account for large share of total pharmaceutical spending in poor countries. In line with theoretical assumptions, we find little evidence of Ramsey pricing in the more competitive and less R&D driven generic production. Our results are robust to alternative specifications. Our results suggest that the international community has to some extent succeeded in providing incentives for less strict pricing strategies in case of life-saving drugs and stimulating the development of a generic drugs industry.

In this paper, we document the affordability problem in developing countries using great data on drug prices, which unfortunately is still rather incomplete and potentially inaccurate. Using the available data, we find some evidence of less strict pricing strategies for life-saving drugs and the appearance of more affordable generic drugs. But unreliable and incomplete information on medicine prices still represent one of the obstacles for the research. Therefore, it is hard to make serious judgements about the magnitude of the affordability problem in developing countries together with the assessment of the firms' incentives for the investments in development of cheaper drugs that would suit well the needs of poor patients. There is urgent need to improve information on pricing of pharmaceutical drugs. Better product- or firm-level data would stimulate future research that would lead to more accurate future research on pricing of pharmaceutical drugs and allow better insights into affordability of treatments in the developing world, providing guidelines for policy actions.

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Appendices

Figure 1: Comparison among international median prices between suppliers and agencies in the period 1996-2003

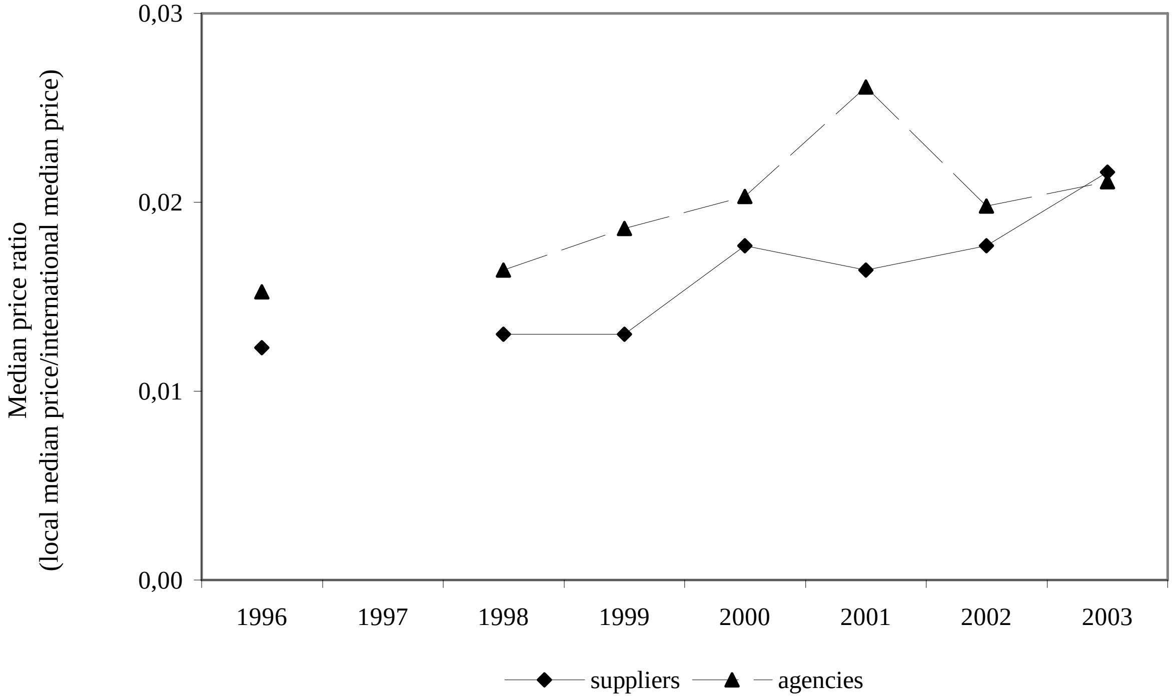

Figure 2: Comparison of yearly averages of international median prices for HIV/AIDS-related drugs between suppliers and agencies in the period 1998-2003

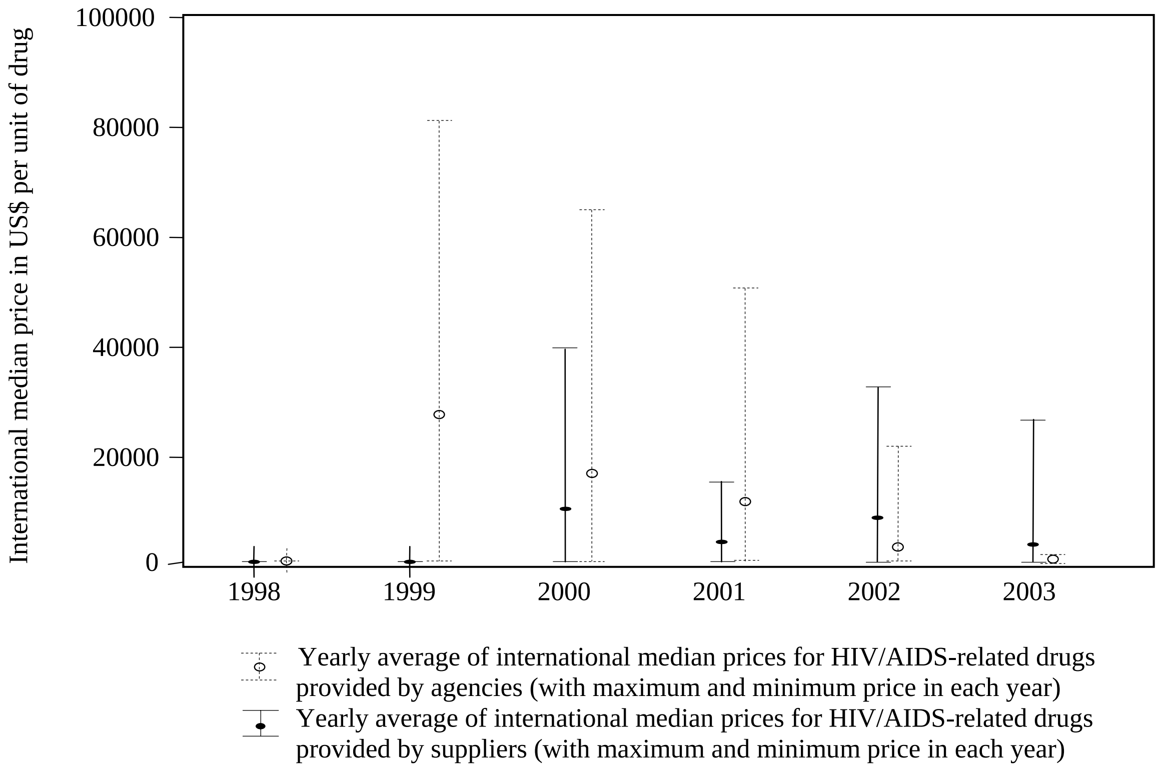

Figure 3: Comparison among international median prices for the tablet-capsule of HIV/AIDS-related drug Ciprofloxacin between suppliers and agencies in the period 1998-2003

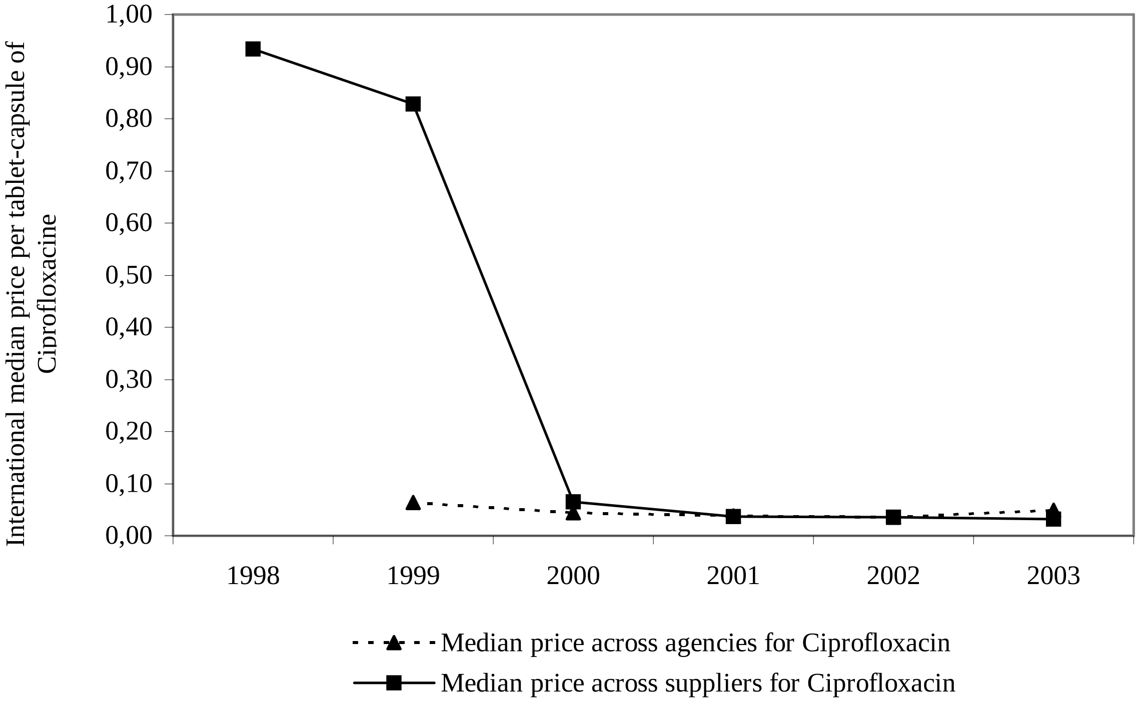

Figure 4: Comparison across international median prices for on-patent drugs provided by suppliers in the period 1998-2003

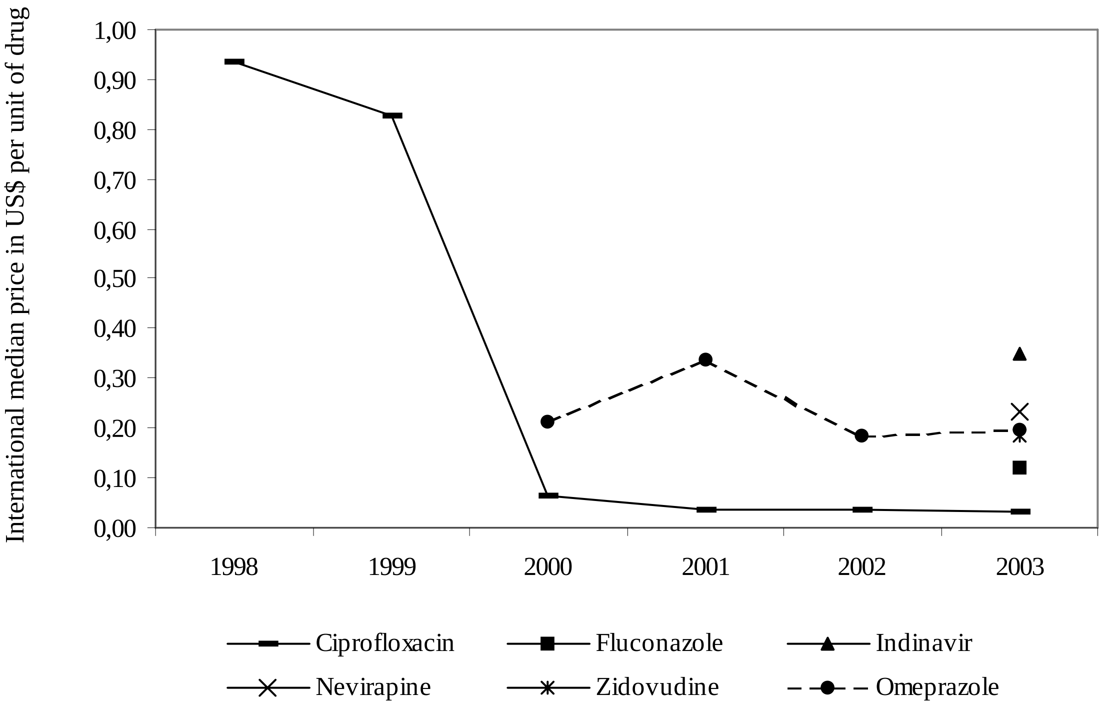

Figure 5: Comparison across international median prices for on-patent drugs provided by agencies in the period 1998-2003

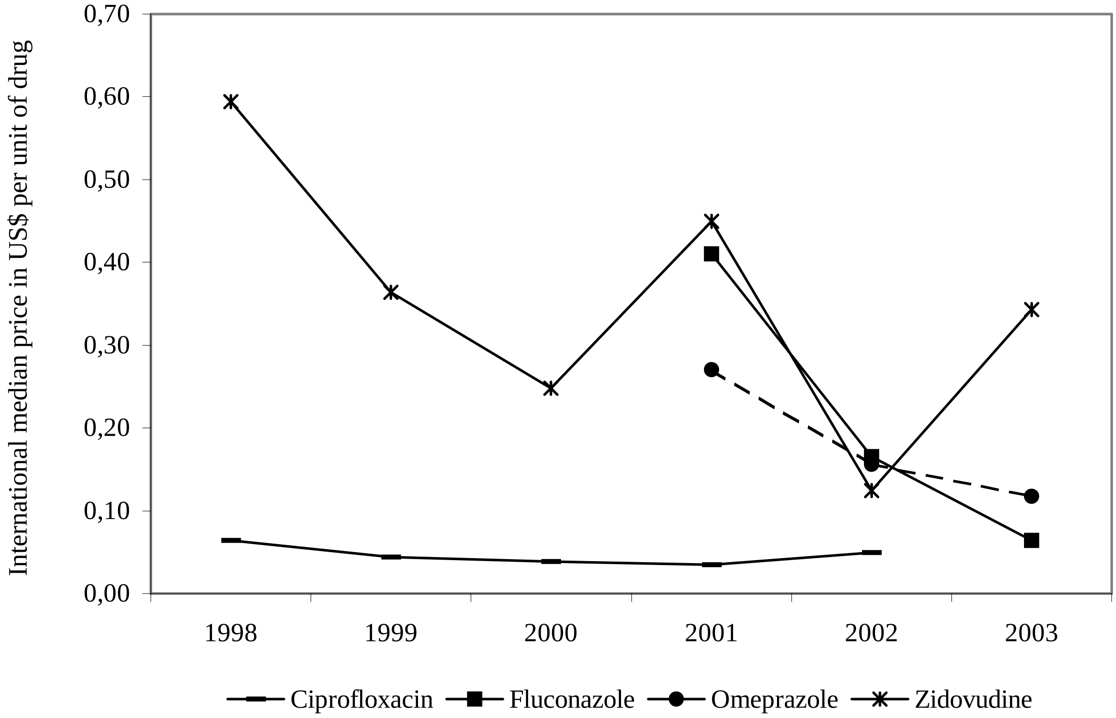

Figure 6: Comparison across international median prices for on-patent drugs provided by agencies that exhibited a remarkable behaviour in the period 1998-2003

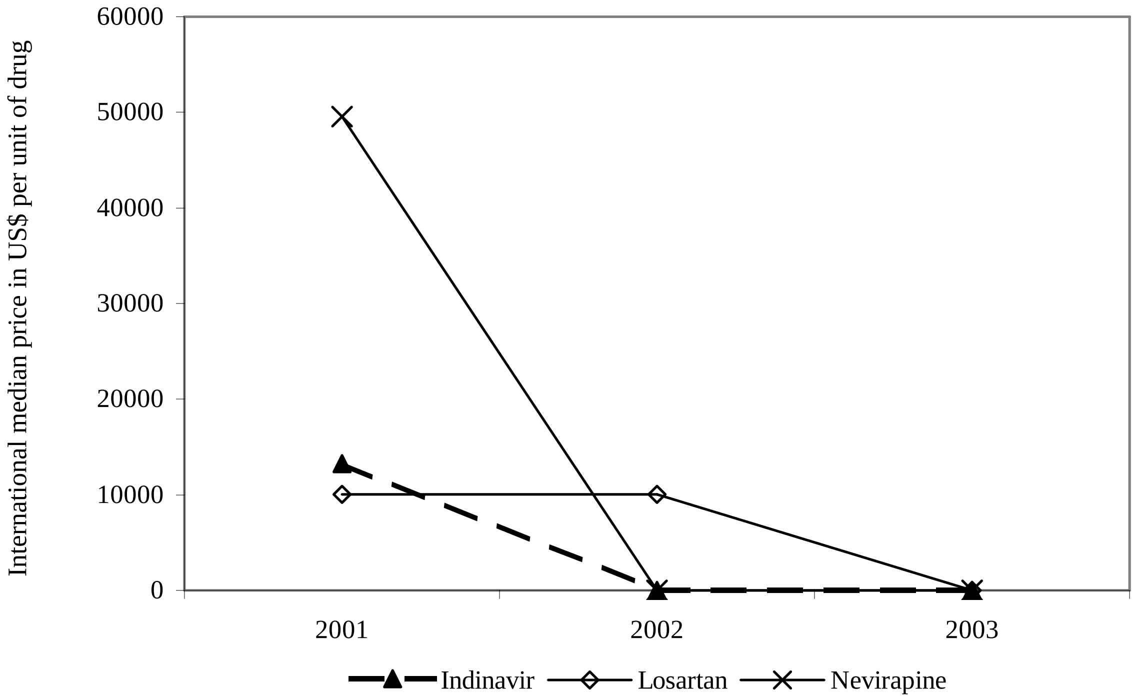

Figure 7: Cross-country comparison of the access to innovator brand and generic drugs in the year 2001

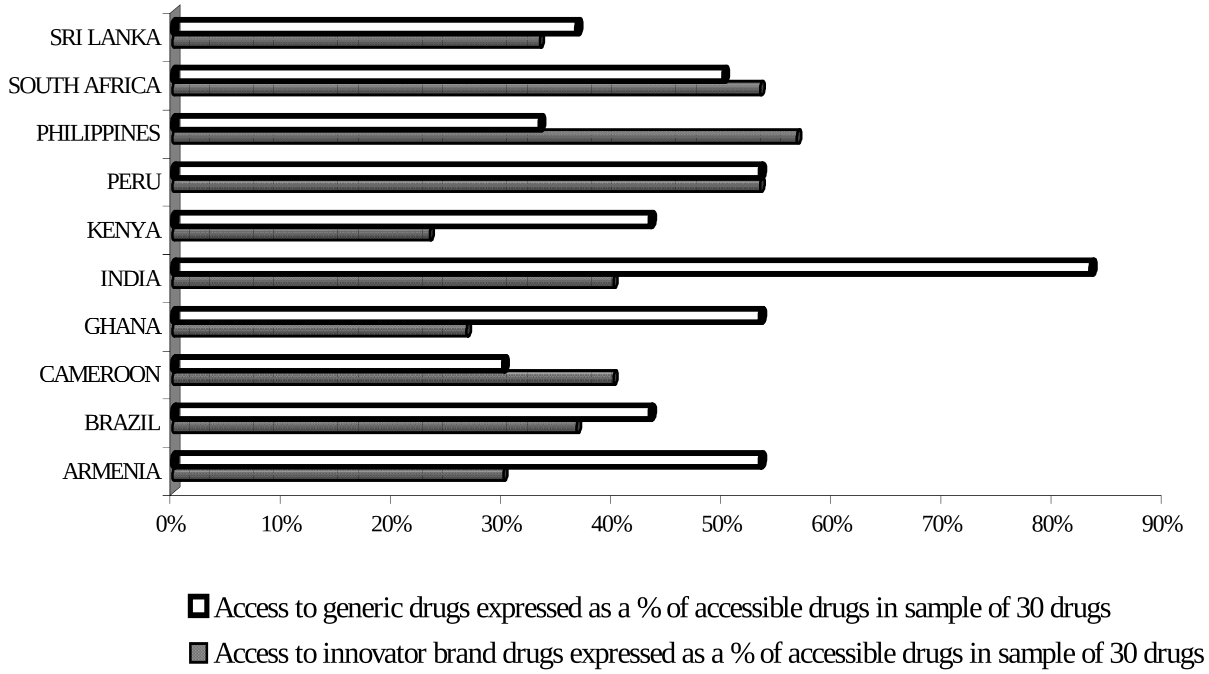

Figure 8: Comparison among median prices across ten countries between nine generic and innovator brand drugs, common to all countries in the year 2001

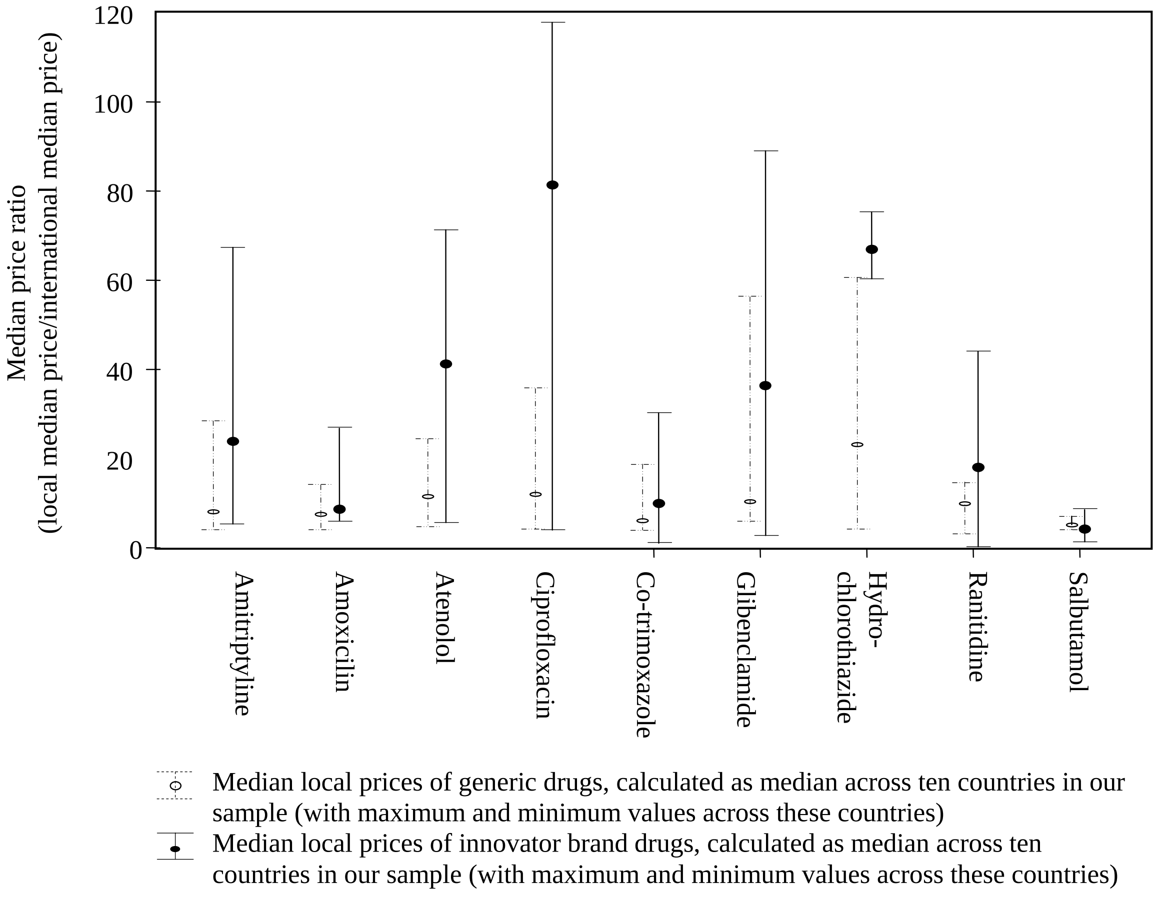

Figure 9: Cross-country comparison in variation of median price ratios across innovator brand sector and across generic sector in the year 2001

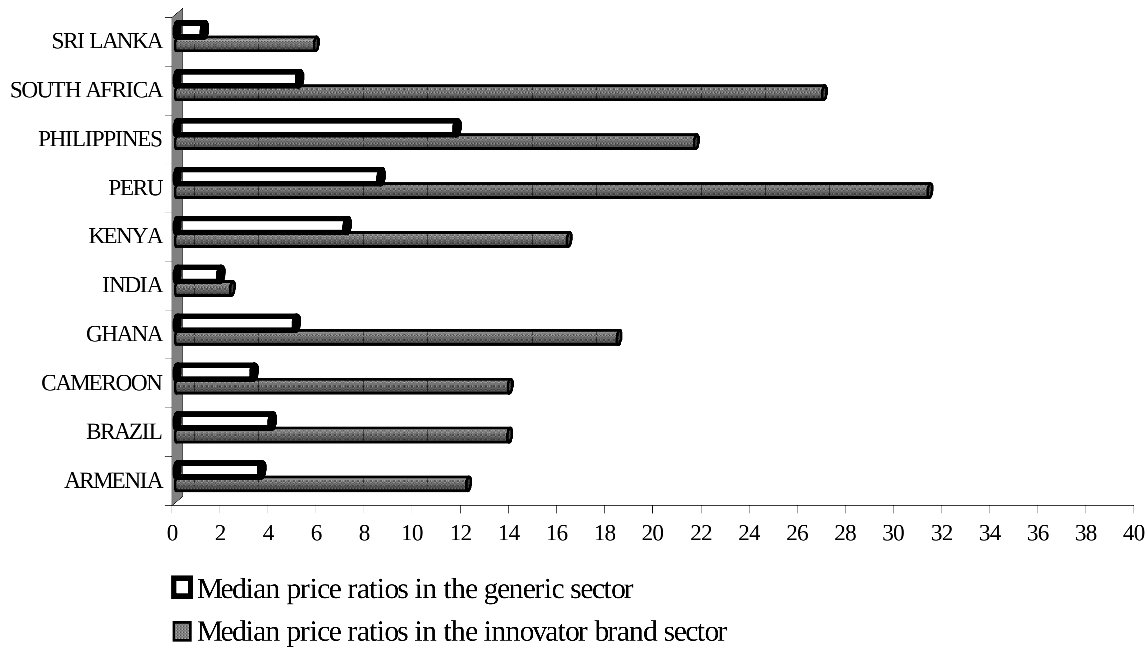

Figure 10: Scatter diagram with regression line comparing GDP per capita at current PPP to median price ratios for innovator brand drugs, in the year 2001

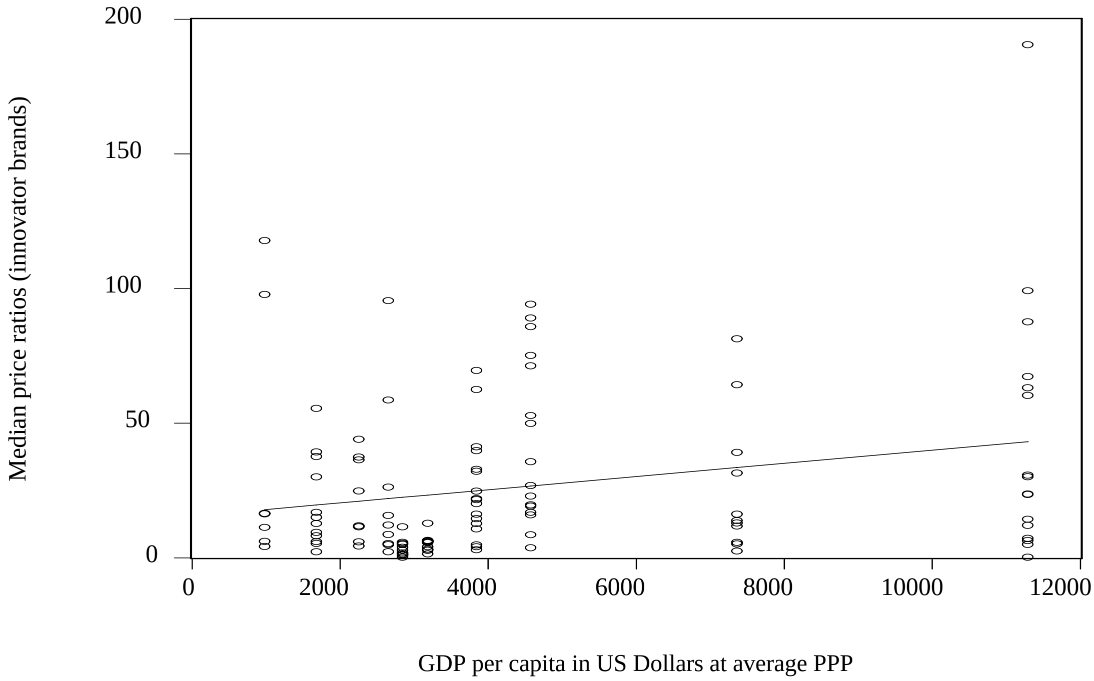

Figure 11: Scatter diagram comparing GDP per capita at current PPP to median price ratios for generic drugs, in the year 2001

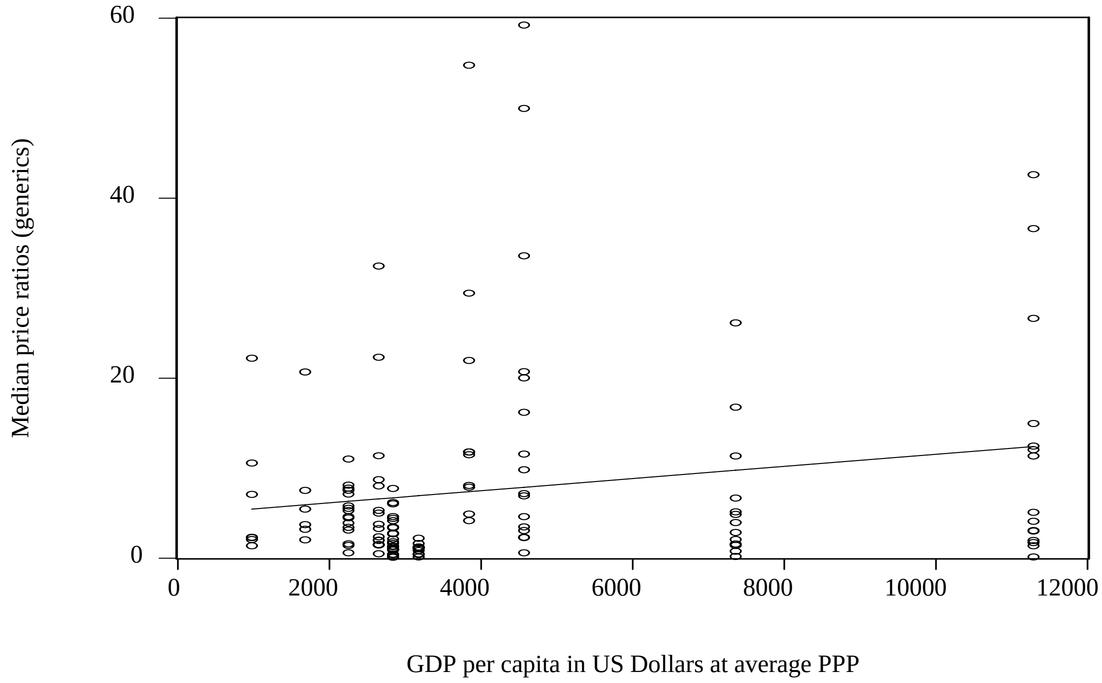

Figure 12: Scatter diagram comparing out-of-pocket expenditures (as a percent of total health expenditure) to median price ratios for innovator brand drugs, in the year 2001

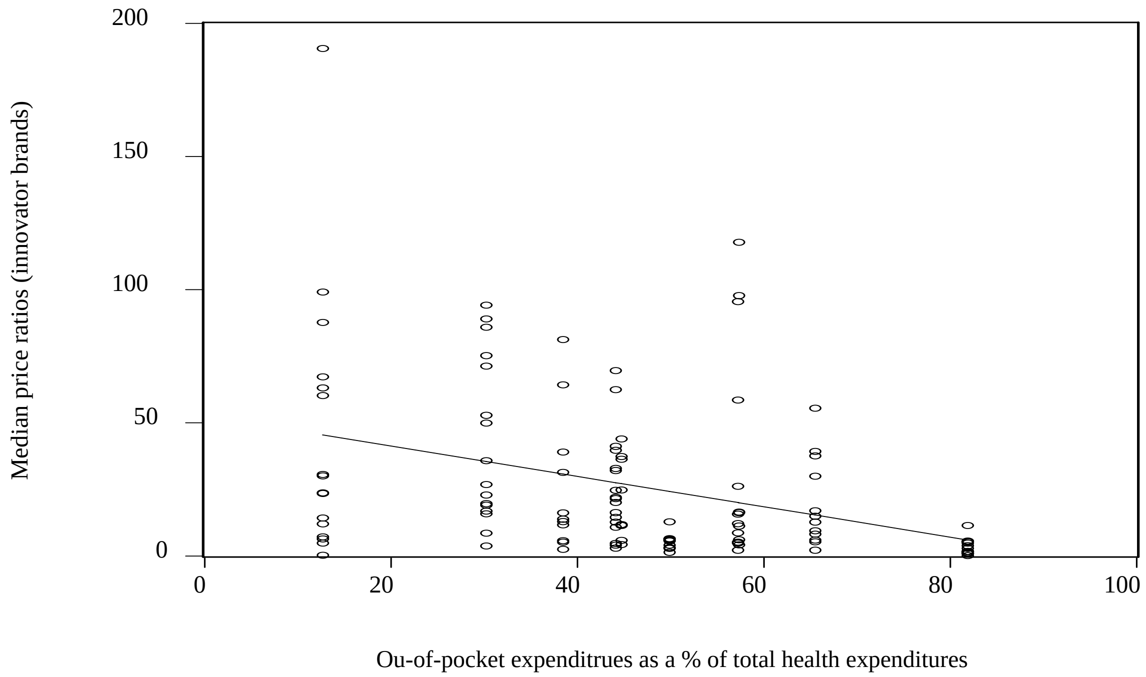

Figure 13: Scatter diagram comparing out-of-pocket expenditures (as a percent of total health expenditure) to median price ratios for generic drugs, in the year 2001

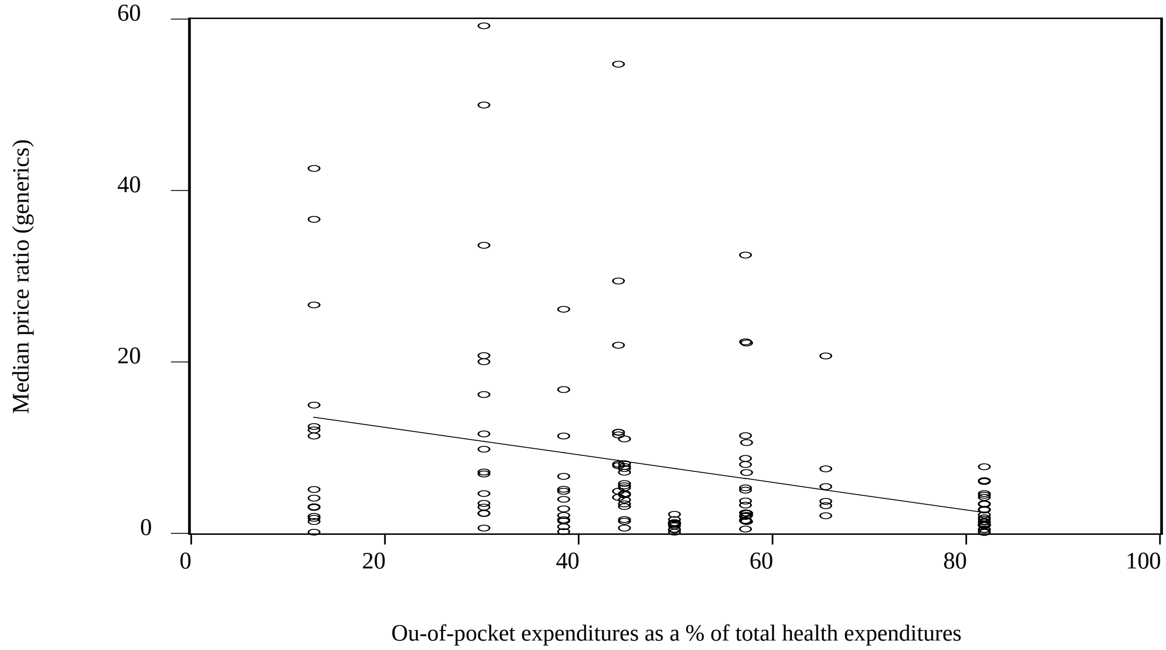

Table 1: Data on international median prices for thirty essential drugs provided by suppliers in the period 1996-2003

	Strength	Dosage Form	Unit	1996	1998	1999	2000	2001	2002	2003
Aciclovir	200 mg	Tablets-Capsules	Tab-Cap	N/A	N/A	N/A	0.0947	0.0695	0.0854	0.0969
Amitriptyline	25 mg	Tablets-Capsules	Tab-Cap	0.0061	0.0057	0.0048	0.0062	0.0057	0.0070	0.0076
Amoxicillin	250 mg	Tablets-Capsules	Tab-Cap	N/A	0.0234	0,0204	0,0171	0,0164	0,0177	0,0172
Artesunate	100 mg	Tablets-Capsules	Tab-Cap	N/A	N/A	N/A	0,5331	0,4153	0,4942	0,5599
Atenolol	50 mg	Tablets-Capsules	Tab-Cap	0,0130	0,0117	0,0102	0,0094	0,0072	0,0082	0,0093
Beclometasone	50 mcg/dose	Inhaler	Dose	0,0202	0,0140	0,0161	0,0177	0,0193	0,0163	0,0169
Captopril	25 MG	Tablets-Capsules	Tab-Cap	0,2146	0,0459	0,0400	0,0341	0,0295	0,0264	0,0264
Carbamazepine	200 mg	Tablets-Capsules	Tab-Cap	0,0255	0,0208	0,0188	0,0165	0,0158	0,0193	0,0199
Ceftriaxone	1 G	Vial	Vial	N/A	N/A	N/A	39000	14751	32468	25573
Ciprofloxacin	500 mg	Tablets-Capsules	Tab-Cap	N/A	0,9338	0,8287	0,0656	0,0371	0,0357	0,0318
Co-trimoxazole	200+40mg/5ml	Suspension	Tab-Cap	0,0057	0,0052	0,0042	0,0038	0,0037	0,0042	0,0036
Diazepam	5 mg	Tablets-Capsules	Tab-Cap	0,0031	0,0028	0,0028	0,0026	0,0025	0,0029	0,0035
Diclofenac	25 mg	Tablets-Capsules	Tab-Cap	0,0116	0,0120	0,0090	0,0084	0,0043	0,0042	0,0051
Fluconazole	200 mg	Tablets-Capsules	Tab-Cap	N/A	N/A	N/A	N/A	N/A	N/A	0,1205
Fluoxetine	20 mg	Tablets-Capsules	Tab-Cap	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Fluphenazine	25 mg/ml	Ampoule	Ml	0,3903	0,2906	0,4305	0,4305	0,3500	0,3792	0,4866
Glibenclamide	5 mg	Tablets-Capsules	Tab-Cap	0,0042	0,0040	0,0036	0,0034	0,0033	0,0049	0,0041
Hydrochlorothiazide	25 mg	Tablets-Capsules	Tab-Cap	0,0032	0,0040	0,0026	0,0026	0,0026	0,0034	0,0035
Indinavir	400 mg	Tablets-Capsules	Tab-Cap	N/A	N/A	N/A	N/A	N/A	N/A	0,3479
Losartan	50 mg	Tablets-Capsules	Tab-Cap	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Lovastatin	20 mg	Tablets-Capsules	Tab-Cap	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Metformin	500 mg	Tablets-Capsules	Tab-Cap	0,0185	0,0203	0,0158	0,0280	0,0131	0,0170	0,0178
Nevirapine	200 mg	Tablets-Capsules	Tab-Cap	N/A	N/A	N/A	N/A	N/A	N/A	0,2344
Nifedipine	20 mg	Tablets-Capsules	Tab-Cap	N/A	N/A	N/A	0,0214	0,0213	0,0239	0,0216
Omeprazole	20 mg	Tablets-Capsules	Tab-Cap	N/A	N/A	N/A	0,2142	0,3361	0,1845	0,1961
Phenytoin	100 mg	Tablets-Capsules	Tab-Cap	0,0079	0,0073	0,0062	0,0054	0,0058	0,0070	0,0070
Ranitidine	150 mg	Tablets-Capsules	Tab-Cap	0,0475	0,1114	0,0816	0,0368	0,0269	0,0716	0,0249
Salbutamol	0.1 mg/dose	Inhaler	Dose	0,0077	0,0078	0,0072	0,0057	0,0061	0,0086	0,0097
Sulfadoxine-pyrimethamine	500+25 mg	Tablets-Capsules	Tab-Cap	0,0386	0,0336	0,0272	0,0254	0,0232	0,0266	0,0257
Zidovudine	100 mg	Tablets-Capsules	Tab-Cap	N/A	N/A	N/A	N/A	N/A	N/A	0,1855

Source: Management Science for Health (MSH) International Drug Price Indicator Guide.

Prices per unit of item are calculated as international median prices provided by suppliers who maintain a warehouse and supply items directly to customers. In some cases there are more suppliers offering the same item and therefore prices differ a lot from one supplier to another supplier. To make prices internationally representative, a median prices across suppliers' offers is calculated. Data on international median prices in the year 1997 is not available at this source.

Table 2: Data on international median prices for thirty essential drugs provided by agencies in the period 1996-2003

	Strength	Dosage Form	Unit	1996	1998	1999	2000	2001	2002	2003
Aciclovir	200 mg	Tablets/Capsules	Tab/Cap	N/A	N/A	N/A	0,7851	0,1048	0,0862	0,0521
Amitriptyline	25 mg	Tablets/Capsules	Tab/Cap	0,0045	0,0047	0,0058	0,0073	0,0065	0,0067	0,0073
Amoxicillin	250 mg	Tablets/Capsules	Tab/Cap	N/A	0,0270	0,0238	0,0241	0,0222	0,0198	0,0180
Artesunate	100 mg	Tablets/Capsules	Tab/Cap	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Atenolol	50 mg	Tablets/Capsules	Tab/Cap	0,0150	0,0150	0,0130	0,0130	0,0095	0,0061	0,0104
Beclometasone	50 mcg/dose	Inhaler	Tab/Cap	0,0155	0,0092	0,0092	0,0196	0,0125	0,0104	0,0152
Captopril	25 MG	Tablets/Capsules	Tab/Cap	0,0330	0,0220	0,0200	0,0203	0,0274	0,0139	0,0118
Carbamazepine	200 mg	Tablets/Capsules	Tab/Cap	0,0340	0,0331	0,0311	0,0474	0,0350	0,0169	0,0200
Ceftriaxone	1 G	Vial	Vial	N/A	N/A	80000	63800	23850	20800	0,8500
Ciprofloxacin	500 mg	Tablets/Capsules	Tab/Cap	N/A	N/A	0,0640	0,0441	0,0384	0,0350	0,0495
Co-trimoxazole	200+40mg/5ml	Suspension	Tab/Cap	0,0075	0,0048	0,0056	0,0055	0,0049	0,0028	0,0048
Diazepam	5 mg	Tablets/Capsules	Tab/Cap	0,0024	0,0031	0,0047	0,0042	0,0046	0,0033	0,0073
Diclofenac	25 mg	Tablets/Capsules	Tab/Cap	N/A	N/A	N/A	0,0162	0,0122	0,0085	0,0082
Fluconazole	200 mg	Tablets/Capsules	Tab/Cap	N/A	N/A	N/A	N/A	0,4100	0,1650	0,0641
Fluoxetine	20 mg	Tablets/Capsules	Tab/Cap	N/A	N/A	N/A	0,0417	0,0246	0,0276	0,0295
Fluphenazine	25 mg/ml	Ampoule	Ml	0,9795	10600	10345	0,4190	0,4983	0,8500	0,7034
Glibenclamide	5 mg	Tablets/Capsules	Tab/Cap	0,0061	0,0051	0,0057	0,0061	0,0044	0,0037	0,0049
Hydrochlorothiazide	25 mg	Tablets/Capsules	Tab/Cap	0,0052	0,0041	0,0041	0,0040	0,0040	0,0041	0,0065
Indinavir	400 mg	Tablets/Capsules	Tab/Cap	N/A	N/A	N/A	N/A	13235	0,3900	0,5143
Losartan	50 mg	Tablets/Capsules	Tab/Cap	N/A	N/A	N/A	N/A	10032	10032	0,9449
Lovastatin	20 mg	Tablets/Capsules	Tab/Cap	N/A	N/A	N/A	N/A	0,0248	0,1439	0,0986
Metformin	500 mg	Tablets/Capsules	Tab/Cap	0,0169	0,0178	0,0172	0,0182	0,0117	0,0083	0,0147
Nevirapine	200 mg	Tablets/Capsules	Tab/Cap	N/A	N/A	N/A	N/A	49587	0,5167	0,5907
Nifedipine	20 mg	Tablets/Capsules	Tab/Cap	N/A	N/A	N/A	N/A	N/A	0,0030	0,3704
Omeprazole	20 mg	Tablets/Capsules	Tab/Cap	N/A	N/A	N/A	N/A	0,2707	0,1563	0,1176
Phenytoin	100 mg	Tablets/Capsules	Tab/Cap	0,0261	0,0240	0,0220	0,0732	0,0209	0,0063	0,0211
Ranitidine	150 mg	Tablets/Capsules	Tab/Cap	0,0539	0,0398	0,0349	0,0336	0,0569	0,0244	0,0182
Salbutamol	0.1 mg/dose	Inhaler	Dose	0,0059	0,0052	0,0052	0,0104	0,0107	0,0077	0,0102
Sulfadoxine-pyrimethamine	500+25 mg	Tablets/Capsules	Tab/Cap	N/A	N/A	N/A	N/A	0,0603	0,0499	0,0229
Zidovudine	100 mg	Tablets/Capsules	Tab/Cap	N/A	0,5943	0,3639	0,2481	0,4500	0,1242	0,3430

Source: Management Science for Health (MSH) International Drug Price Indicator Guide.

Prices per unit of item are calculated as international median prices provided by agencies that negotiate prices and place purchase orders for client nongovernmental organizations (NGOs), private voluntary organizations (PVOs) and Ministries of Health. These agencies may additionally charge a fee for their service over and above the drug's CIF price. In some cases there exist more agnecies offering the same item and consequently prices differ from one agency to another agency. To make prices internationally representative, a median prices across agencies' offers is calculated. Data on international median prices in the year 1997 is not available at this source.

Table 3: Patent situation for thirty essential drugs

Molecule generic name	Medicine strengh	Basic Patent priority date (launch date)	patent expiry date (max. 20 years)	US patent expiry date	European or Frnch patent expiry date	Countries where similar patetns have been filed or granted	Number of countries in our sample with access to drug	
							Innovator brands	Generics
Aciclovir	*200 mg*	*before 1998*	*before 1998*	*before 1998*	*N/A*	*N/A*	*7*	*6*
Amitriptyline	25 mg	before 1998	before 1998	before 1998	N/A	N/A	7	8
Amoxicillin	250 mg	before 1998	before 1998	before 1998	N/A	N/A	6	9
Artesunate	100 mg	before 1998	before 1998	before 1998	N/A	N/A	1	0
Atenolol	50 mg	before 1998	before 1998	before 1998	N/A	N/A	5	7
Beclometasone	0.05 mg/dose	before 1998	before 1998	before 1998	N/A	N/A	8	5
Captopril	25 mg	before 1998	before 1998	before 1998	N/A	N/A	4	10
Carbamazepine	200 mg	before 1998	before 1998	before 1998	N/A	N/A	2	1
Ceftriaxone	*1 g/vial*	*1978*	*between 1998 and 2005*	*27/04/1999*	*EP 30/05/1999*	*Brazil, Kenya, Philippines, South Africa*	*7*	*7*
Ciprofloxacin	*500 mg*	*1980*	*between 2001 and 2004*	*09/12/2003*	*EP 21/08/2001, Fr. ext. until 29/10/2004*	*Kenya, South Africa*	*9*	*8*
Co-trimoxazole suspension	8+40 mg/ml	before 1998	before 1998	before 1998	N/A	N/A	8	8
Diazepam	5 mg	before 1998	before 1998	before 1998	N/A	N/A	2	1
Diclofenac	25 mg	before 1998	before 1998	before 1998	N/A	N/A	8	9
Fluconazole	*200 mg*	*1981*	*between 1998 and 2005*	*01/06/2002, ext. until 29/01/2004*	*EP 22/04/2002, Fr. ext. until 07/03/ 2005*	*Brazil, Kenya, Philippines, South Africa*	*2*	*1*
Fluoxetine	20 mg	2000	between 1998 and 2005	N/A	N/A	N/A	5	7
Fluphenazine	25 mg/ml	before 1998	before 1998	before 1998	N/A	N/A	1	0
Glibenclamide	5 mg	before 1998	before 1998	before 1998	N/A	N/A	5	5
Hydrochlorothiazide	25 mg	before 1998	before 1998	before 1998	N/A	N/A	5	7
Indinavir	*400 mg*	*1991*	*after 2005*	*07/05/2013*	*EP 02/11/2012*	*Brazil, South Africa*	*1*	*0*
Losartan	50 mg	2001	after 2005	N/A	N/A	N/A	1	1
Lovastatin	20 mg	before 1998	between 1998 and 2005 (basic patent expired in 2000)	N/A	N/A	N/A	1	1
Metformin	500 mg	before 1998	before 1998	before 1998	N/A	N/A	1	1
Nevirapine	*200 mg*	*1989*	*after 2005*	*22/11/2011*	*EP 16/11/2010*	*South Africa*	*2*	*2*
Nifedipine	20 mg	2000	before 1998	before 1998	N/A	N/A	6	9
Omeprazole	20 mg	before 1998	between 1998 and 2005	N/A	N/A	N/A	7	7
Phenytoin	100 mg	before 1998	before 1998	before 1998	N/A	N/A	1	1
Ranitidine	150 mg	before 1998	before 1998	before 1998	N/A	N/A	10	9
Salbutamol	0.1 mg/dose	before 1998	before 1998	before 1998	N/A	N/A	9	10
Sulfadoxine-pyrimethamine	*500+25 mg*	*before 1998*	*before 1998*	*before 1998*	*N/A*	*N/A*	*1*	*3*
Zidovudine	*100 mg*	*1985*	*between 1998 and 2005*	*17/09/2005*	*EP 14//042006*	*Philippines, South Africa*	*0*	*1*

Source: The data is compiled from different sources, i.e. Health Action International, Orange Book of Patents, Thomson Delphion and WHO.

The data expressed in italic letters refers to HIV/AIDS-related drugs. A markation N/A refers to non-available data, since we could not obtain complete and/or reliable data on patent expiry dates for all countries and for all drugs.

Table 4: Cross-country regression results for different models including different explanatory variables, countries and drugs

	All observations, all countries, all 30 drugs		All observations, adjusting outliers, all countries, all 30 drugs		All countries, 9 drugs		African 4 countries, all 30 drugs		African 4 countries, 9 drugs	
	(1) OLS	(2) OLS	(3) OLS	(4) OLS	(5) OLS	(6) OLS	(7) OLS	(8) OLS	(9) OLS	(10) OLS
Explanatory variables	Innovator brands	Generics	Innovator brands (threshold 50)	Generics (threshold 30)	Innovator brands	Generics	Innovator brands	Generics	Innovator brands	Generics
Constant	15.4685***	4.7750***	15.1882***	4.5368***	17.7770**	6.9416***	22.4440**	4.8860**	25.7229**	5.7290
	(3.1380)	(2.9661)	(5.4217)	(3.7489)	(2.6554)	(2.8711)	(2.6117)	(2.4566)	(2.6479)	(3.3605)
GDPPC	2.4503***	0.6762**	1.2231***	0.5594***	2.7296**	0.6730	1.9527	0.6022**	1.7388	0.3875
	(2.7311)	(2.1780)	(2.3989)	(2.3963)	(2.1378)	(1.3584)	(1.5957)	(2.0496)	(2.8673)	(1.3088)
Number of Observations	118	135	118	135	60	70	43	44	21	29
R^2	(0.0604)	0.0344	0.0473	0.0414	0.0730	0.0264	0.0585	0.0909	0.0693	0.0597
Akaike Criterion	9.6755	7.5650	8.5453	6.9941	9.6466	7.8323	10.1290	7.2277	9.7982	6.6761
Constant	13.0618**	3.6464*	14.3521***	4.0341***	16.5172*	4.5761*	19.9571**	4.4074**	23.7139**	5.3229***
	(2.2452)	(1.9309)	(4.3322)	(2.8258)	(2.0005)	(1.6870)	(2.1624)	(2.0740)	(2.1670)	(2.8307)
WAGE	4.9252***	1.5062**	2.3254**	1.0847**	4.7686*	2.1254**	4.6280*	1.3362**	3.9240	0.8877
	(2.6473)	(2.4267)	(2.1949)	(2.3119)	(1.7832)	(2.1254)	(1.7500)	(2.1142)	(1.1971)	(1.3697)
Number of Observations	118	135	118	135	60	70	43	44	21	29
R^2	0.0570	0.0424	0.0399	0.0386	0.0520	0.0623	0.0695	0.0962	0.0701	0.0650
Akaike Criterion	9.6792	7.5565	8.5530	6.9970	9.6690	7.7948	10.1173	7.2219	9.7973	6.6704
Constant	52.6117***	15.5827***	36.7032***	13.3062***	59.7234***	19.3189***	49.4035***	12.4931***	49.1244***	10.2430***
	(7.6572)	(6.8763)	(9.5934)	(7.8418)	(6.3112)	(5.0763)	(4.2091)	(4.2689)	(3.3249)	(3.3118)
OOPX	-0.5688***	-0.1609***	-0.3489***	-0.1297***	-0.6439***	-0.1986***	-0.4109	-0.1181*	0.3547	-0.0668
	(-4.1174)	(-3.7876)	(-4.5357)	(-4.7502)	(-3.4530)	(-2.7427)	(-1.6991)	(-1.7547)	(-1.1518)	(-1.0446)
Number of Observations	118	135	118	135	60	70	43	44	21	29
R^2	0.1275	0.0974	0.1506	0.1110	0.1705	0.0996	0.0608	0.0683	0.0653	0.0388
Akaike Criterion	9.6014	7.4973	8.4304	6.9187	9.5355	7.7542	1.0127	7.2523	9.8025	6.6980
Constant	35.5708***	10.7997***	24.8723***	9.4325***	38.8373***	13.4353***	46.6194***	11.8215***	44.2770***	10.1429***
	(7.1746)	(6.6661)	(8.8275)	(7.7359)	(5.4863)	(5.0993)	(4.9863)	(5.2606)	(3.7815)	(4.2966)
POVR	-0.4927**	-0.1522**	-0.2268*	-0.1216**	-0.5111	-0.1811*	-0.6290*	-0.1546**	-0.4756	-0.1066
	(-2.2055)	(-2.33020	(-1.7862)	(-2.4738)	(-1.5738)	(-1.7335)	(-1.8695)	(-2.1397)	(-1.0784)	(-1.4148)
Number of Observations	118	135	118	135	60	70	43	44	21	29
R^2	0.0403	0.0392	0.0268	0.0440	0.0410	0.0423	0.0786	0.0983	0.0577	0.0690
Akaike Criterion	9.6968	7.5598	8.5666	6.9914	9.6806	7.8158	10.1075	7.2196	9.8106	6.6661

The values in parentheses represent significance values of tests (* statistically significant at the 10% level, ** statistically significant at the 5% level and *** statistically significant at the 1% level). Number of observations vary across models, since not all drugs are available in these ten countries or there is incomplete coverage of data on drug prices in specific countries as it is shown in the Figure 7.

MEASURES. GDPPC represents GDP per capita measured in US$ 1000 at average PPP; WAGE represents a yearly wage of a civil servant measured in US$ at current exchange rates; OOPX represents out-of-pocket expenditures as a % of total health expenditures; POVR represents the poverty ratio expressed as a % of population living below 1$ per day poverty line; PREV_HIV represents the prevalance rate of HIV/AIDS measured as a % of people afflicted by this disease.

	(1) OLS	(2) OLS	(3) OLS	(4) OLS	(5) OLS	(6) OLS	(7) OLS	(8) OLS	(9) OLS	(10) OLS
Constant	15,5130***	4,7543***	15,1995***	4,5698***	1,7531**	7,3887***	13,7101	3,7124	23,7124	4,5225
	(3,1555)	(2,9184)	(5,4096)	(3,7320)	(2,5878)	(3,0374)	(0,9242)	(1,4499)	(1,1689)	(1,7625)
GDPPC	1,8050*	0,6966*	1,0602*	0,5268*	2,5229*	0,9203*	0,9603	0,3590	1,5770	0,2341
	(1,7562)	(1,8662)	(1,8053)	(1,8776)	(1,8095)	(1,7354)	(0,5214)	(0,8089)	(0,7627)	(0,6086)
PREV_HIV	0,5480	-0,0158	0,1383	0,0255	0,2173	-0,2760	1,0123	0,2012	0,1956	0,1538
	(1,2780)	(-0,0989)	(0,5640)	(0,2115)	(0,3845)	(-1,2693)	(0,7244)	(0,7340)	(0,1138)	(0,6348)
No. of Observations	118	135	118	135	60	70	43	44	21	29
R^2	0,0736	0,0345	0,0499	0,0417	0,0754	0,0493	0,0707	0,1027	0,0700	0,0740
Akaike Criterion	9,6784	7,5795	8,5595	7,0731	9,6773	7,8371	10,1625	7,2601	9,8927	6,7296
Constant	12,7963**	3,6650*	14,2633***	4,0940***	15,8181*	5,1357*	14,5668	3,6965	24,1702	4,5237
	(2,2141)	(1,9289)	(4,3017)	(2,8540)	(1,8963)	(1,8559)	(0,9771)	(1,4436)	(1,1797)	(1,7605)
WAGE	3,7826*	1,4669**	1,9432**	0,9584*	4,2524	2,3537**	2,9626	0,8724	4,0319	0,5578
	(1,9130)	(2,1496)	(1,7130)	(1,8602)	(1,5335)	(2,3899)	(0,6615)	(0,7832)	(0,7653)	(0,5761)
PREV_HIV	0,6467*	0,0206	0,2163	0,0662	0,4032	-0,2621	0,7241	0,1619	-0,0520	0,1290
	(1,7643)	(0,1409)	(0,9453)	(0,6006)	(0,7427)	(-1,2773)	(0,4632)	(0,5078)	(-0,0266)	(0,4645)
No. of Observations	118	135	118	135	60	70	43	44	21	29
R^2	0,0781	0,0425	0,0473	0,0413	0,0611	0,0846	0,0745	0,1018	0,0702	0,0727
Akaike Criterion	9,6735	7,5711	8,5622	7,0091	9,6927	7,7993	10,1584	7,2611	9,8925	6,7311
Constant	47,6573***	16,6982***	36,5342***	13,7605***	5,8706***	2,3120***	2,8732	7,0572	40,5179	6,6154
	(5,7584)	(5,8957)	(7,8886)	(6,4811)	(5,3041)	(5,2902)	(1,0761)	(1,3223)	(1,1555)	(1,3451)
OOPX	-0,5085***	-0,1755***	-0,3468***	-0,1356***	-0,6327***	-0,2399***	-0,2444	-0,0611	-0,2926	-0,0380
	(-3,4116)	(-3,6599)	(-4,1582)	(-3,7722)	(-3,1972)	(-3,1794)	(-0,7680)	(-0,7483)	(-0,7511)	(-0,5358)
PREV_HIV	0,4176	-0,0958	0,0142	-0,0390	0,0943	-0,3458*	1,0093	0,2709	0,4190	0,1984
	(1,0723)	(-0,6591)	(0,0653)	(-0,3580)	(0,1815)	(-1,6987)	(0,8626)	(1,2150)	(0,2721)	(0,9498)
No. of Observations	118	135	118	135	60	70	43	44	21	29
R^2	0,1362	0,1003	0,1507	0,1119	0,1710	0,1368	0,0779	0,1007	0,0691	0,0711
Akaike Criterion	9,6084	7,5089	8,4473	6,9326	9,5682	7,7406	10,1547	7,2624	9,8936	6,7328
Constant	29,8924***	10,2871***	22,7485***	8,8011***	35,4110***	14,7605***	69,7718	15,4591	82,1385	11,5483
	(5,3585)	(5,5085)	(7,0982)	(6,2742)	(4,4728)	(4,9533)	(0,9987)	(0,9042)	(0,9100)	(0,7725)
POVR	-0,4117*	-0,1429**	-0,1965	-0,1102**	-0,4707	-0,1963*	-1,0059	-0,2197	-1,0772	-0,1311
	(-1,8422)	(-2,1138)	(-1,5302)	(-2,1690)	(-1,4366)	(-1,8567)	(-0,8545)	(-0,7045)	(-0,7224)	(-0,4878)
PREV_HIV	0,7986**	0,0765	0,2987	0,0943	0,5145	-0,1946	-1,0751	-0,6741	-1,7488	-0,0630
	(2,1091)	(0,5562)	(1,3730)	(0,9123)	(0,9686)	(-0,9541)	(-0,3345)	(-0,2147)	(-0,4232)	(-0,0953)
No. of Observations	118	135	118	135	60	70	43	44	21	29
R^2	0,0760	0,0415	0,0425	0,0500	0,0565	0,0552	0,0811	0,0993	0,0670	0,0693
Akaike Criterion	9,6758	7,5722	8,5673	6,9999	9,6976	7,8309	10,1512	7,2639	9,8959	6,7347

The values in parentheses represent significance values of tests (* statistically significant at the 10% level, ** statistically significant at the 5% level and *** statistically significant at the 1% level). Number of observations vary across models, since not all drugs are available in these ten countries or there is incomplete coverage of data on drug prices in specific countries as it is shown in the Figure 7.

MEASURES. GDPPC represents GDP per capita measured in US$ 1000 at average PPP; WAGE represents a yearly wage of a civil servant measured in US$ at current exchange rates; OOPX represents out-of-pocket expenditures as a % of total health expenditures; POVR represents the poverty ratio expressed as a % of population living below 1$ per day poverty line; PREV_HIV represents the prevalance rate of HIV/AIDS measured as a % of people afflicted by this disease.