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Inequality and Pharmaceutical Drug Prices: An Empirical Exercise

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Abstract:

Several studies report that in both developed and developing countries, poorer individuals go without medical care, including pharmaceuticals. This is associated with both low income and inequality in income. Data also show that pharmaceutical prices in developing countries are sometimes higher than those in developed countries for identical products. While several studies find that per capita income has a significant and positive effect on pharmaceutical prices, the effect of income inequality has not been tested. The purpose of this paper is to estimate the effects of income inequality and per capita income on disaggregated prices of pharmaceutical drugs across countries. I find that inequality has a statistically significant and positive effect on prices. Per capita income, on the contrary, does not add significance to the model.

I. Introduction

Several studies report that in both developed and developing countries, poorer individuals go without medical care, including pharmaceuticals.[1] This is associated with both low income and inequality in income. Data also show that pharmaceutical prices in developing countries are sometimes higher than those in developed countries for identical products. While several studies find that per capita income has a significant and positive effect on pharmaceutical prices, the effect of income inequality has not been tested. The purpose of this paper is to estimate the effects of income inequality and per capita income on disaggregated prices of pharmaceutical drugs across countries. I find that inequality has a statistically significant and positive effect on prices. Per capita income, on the contrary, does not add significance to the model.

This paper tests the hypotheses put forth in Wong (2002). Individual demand is non-homothetic, resulting in a price elasticity of demand that decreases (in absolute value) with income. When aggregating across individuals, the equilibrium price is a function of per capita income and inequality. Rising inequality lowers the price elasticity of market demand because the incomes of the rich are increasing. Assuming a monopoly supplier of pharmaceuticals whose markup is based on the price elasticity of demand, the equilibrium price increases with inequality.

The data for this project are from IMS Health. The sample consists of drug prices in seven anatomical therapeutic categories in thirteen high- and middle-income countries for 1994 and 1998. Descriptive statistics show that the median prices in these countries are all lower than the median price in the United States. At drug product levels, however, prices are sometimes

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[1] Feachem et al (1992), Mapelli (1993), Castro-Leal et al (2000), Makinen et al (2000).

higher in other countries, including the middle-income, high-inequality countries such as Brazil and South Africa.

The regression is a linear reduced-form of the structural equation taken from Wong (2002). Initial results show that income inequality has a positive and significant effect on drug prices. Specifically, a one percent increase in the Gini coefficient increases the price of a pharmaceutical drug product by 0.71%. Including per capita GNP as an additional regressor does not add significance to the model. In excluding the Gini coefficient, however, income per capita has a significant and positive effect. This is most likely the result of multicollinearity of the Gini coefficient and income per capita.

The preliminary results are robust to an alternative inequality measure and additional demographic variables that account for other distributional issues. Using the income share of the richest 20% of the population does not change the results qualitatively. Rural population density, as a proxy for the lack of medical care/pharmaceuticals available to the poor, is not significant. The proportion of elderly in each country also does not add significantly to the model.

II. Related Literature

Several researchers have proposed that drugs may be priced toward specific populations within an economy.[2] To my knowledge, this hypothesis has not been investigated empirically.

Pharmaceutical Literature

There are several studies that explain why drug prices vary across countries. Using price

[2] Scherer and Watal (2001) and Maskus (2001), for example.

indexes, Danzon and Chao (2000) and Danzon (1997) show that drug prices in the United States are not the highest among developed countries. Germany and Canada have higher drug price indexes. The latter study also shows Switzerland and Sweden have higher prices than the United States. Studies by the U.S. General Accounting Office, on the other hand, show that US prices are 32-60% higher than prices in Canada and the United Kingdom.[3] A House of Representatives Minority Staff Report shows US prices are 70-102% higher than prices in Canada and Mexico.[4]

Maskus (2001) presents evidence that price differentials exist, even at the drug product level where the problems encountered in calculating indexes are not present.[5] Using 1998 drug price data from IMS Health, Maskus compares prices bilaterally between the following countries: United States, Canada, Mexico, United Kingdom, Spain, Italy, the Czech Republic, Sweden, India, Japan, Thailand, South Africa, Brazil, and Korea. For 20 major brand name drugs, prices are higher in developing countries, particularly Mexico and Brazil, than developed countries, including the United States. This result may be due to price and profit controls in Canada, UK, Italy, and Spain. He suggests the possibility that firms price toward high-income populations in poor countries because they do not have the ability to price discriminate within a country. There may also be monopolistic behavior in the distribution of drugs. This may arise either because the governments of developing countries require only a single distributor, or that the infrastructure does not support a competitive distribution market.

Cross-country studies that look at the effects of income, regulatory regimes, and preferences on drug prices are limited. Of these studies, most estimate the elasticity of demand

[3]GAO (1992, 1994).
[4]House of Representatives (1998).
[5]See also Ballance et al (1992) and Lanjouw (1998) for examples of international price differentials.

for pharmaceuticals.[6] This allows testing whether firms conduct Ramsey pricing strategies, in which prices are set to the inverse of the elasticity of demand. This approach tests whether prices are high due to inelastic demand for pharmaceuticals.

The first cross-country study to use income as an explanatory variable in drug pricing is Schut and van Bergeijk (1986). Their price variable is an index of "drugs and medical preparations," using the United States as the base country. They estimate a linear reduced-form equation and find that income has a significant and positive effect on drug prices. They suggest that people with higher purchasing power have less elastic demand.

Scherer and Watal (2001) estimate the effects of income per capita, HIV prevalence, and drug patent enforcement on HIV/AIDS drug prices in 18 middle- and low-income countries. Income has a significant and positive effect; as an individual gains US$1,000 in annual income, the relative price of an anti-retroviral drug rises 1.8%, relative to US prices. When income is interacted with a time dummy, income has a significant and negative effect. The authors suggest that this is evidence of declining prices, although one could also associate it with a decline in inequality.

Health Inequality Literature

A related topic is explaining health inequality using income inequality. Health inequality is often defined as child mortality rates among different social classes, or expected years of life at birth. My research complements this literature in that pharmaceuticals are a specific and

[6] Danzon and Chao (2000), Maskus (2001), Alexander et al (1994), and Scherer and Watal (2001). For studies on US elasticity of demand, see Ellison et al (1997), Berndt et al (1995),and Baye et al (1997).

significant part of health.[7]

Le Grand (1987) uses several measures of income inequality, including the Gini coefficient, to explain mortality rates in 22 high-, middle-, and low-income countries. He finds that as income is more unequally distributed, inequalities in health rise. Rodgers (1979) plots life expectancy at birth against per capita GDP and finds a positive, concave relationship. With that, he concludes that the reciprocal of average income explains life expectancy. In a simple regression, the reciprocal of average income is significant and negative, implying average income raises life expectancy. The Gini coefficient also has a significant and negative effect, implying that greater income inequality lowers life expectancy. When using the sample of less developed countries only, the Gini has an even larger negative effect on life expectancy.

Flegg (1982) uses a log-linear specification to estimate the effects of the Gini coefficient and GDP per capita on infant mortality rates for 46 underdeveloped countries. The Gini has a significant, positive effect on infant mortality. Flegg suggests that it has an indirect effect on infant mortality through the distribution of food, housing, medical care, and the like. GDP per capita is not significant. The number of doctors and nurses (per capita) is significant and negative. These results are robust to changes in the sample and the measure of inequality used.

Pritchett and Summers (1996) control for causality by using an instrumental variables approach. First, they regress infant mortality rates on GDP per capita and years of schooling for countries with a GDP per capita less than US$6,000, between 1960-1985. Both variables have a significant and negative effect, suggesting that average income and education lower infant mortality rates. The authors then use four instruments for GDP per capita, taken from the

[7] Frech and Miller (1999) show that pharmaceuticals have a positive and significant effect on life expectancy in their sample of 16 European countries.

economic growth literature: terms of trade, investment-GDP ratio, black market premium, and deviations of exchange rates from purchasing power parity levels. The results are robust: all instruments have significant and negative effects, although the magnitudes differ slightly. Because these instruments are arguably exogenous to health status, they conclude that the direction of causality is one-way: income influences health, and not the other way around.

The studies reviewed above show that per capita income and income inequality play a statistically significant role in health inequalities. Specifically, higher income inequality and low per capita income lead to worse health for poorer people. Pharmaceuticals are a significant component of better health; the lack of access to appropriate pharmaceutical products may also lead to worse health. One reason for the lack of access could be that income inequality increases drug prices. If income inequality leads to higher drug prices, then the low-income population may not have affordable access to drugs. Health status may decline as a result. Thus, my research is complementary to this literature in that it examines one component of rising health inequalities.

Health inequalities may also result from unequal distribution of particular goods, including medical facilities. In developing countries, for example, rural populations must travel a longer distance to clinics than urban dwellers. Most people living in rural areas are also low-income. They are less likely to incur the cost of travel as well as lost wages for making the visit. Thus, low-income, rural inhabitants are less likely to receive medical care, including pharmaceuticals. I attempt to control for some of these distributional issues using demographic variables, including the rural population density and the elderly population (who are usually poorer[8]).

III. IMS Price Data

The pharmaceutical price data used in this study are from IMS Health. Prices are reported in US dollars, converted using exchange rates effective at the time of sales. Prices are defined as the standard unit average price of a calender year, reported as the ex-manufacturer's selling price.

The sample consists of prices and sales in 13 countries: United States, Mexico, Canada, United Kingdom (UK), Italy, Spain, the Czech Republic, Sweden, Japan, Republic of Korea (henceforth, Korea), Thailand, Brazil, South Africa, and Sweden.[9] The data are given for two years, 1994 and 1998.

There are 36 drugs selected. A "drug" is defined as a molecule (i.e., active ingredient), classified by its one-digit anatomical therapeutic category (ATC) *and* its treatment of indications. For example, two products may be composed of the same molecule but are used for different diagnoses and are considered distinct drugs. A "product" is further defined as a drug with a specific form (e.g., tablet, capsule, syringe, etc.) and a specific strength (e.g., 5 mg, 10 mg, 10%, etc.). Thus, Pfizer's drug Norvasc, A tablets, 5 mg, is defined as a drug product. The 10 mg strength version is considered a separate product.

The drug products included treat the following indications: hypertension, angina, cholesterol, asthma, immune system infections (from organ transplants), pulmonary infections, typhoid fever, gonorrhea, diarrhea, heart failure, prostate and breast cancer, hormone deficiency,

[8]Kinsella and Ferreira (1997).

[9]Swedish data are provided by Mattias Ganslandt.

fungal infections (including meningitis associated with AIDS), allergies, emphysema, smoking, psychosis, acid/peptic disorders, depression, insomnia, liver cirrhosis, schizophrenia and migraines. The drug products fall into seven one-digit ATC categories, given in the following table with the total number of drug products in the sample (pooled for both years and across countries):

A–Heartburn/ulcer	201
C–Cardiovascular	499
G–Sex hormones	37
J–Antibiotics	237
L–Immune system	161
N–Central Nervous system	355
R–Respiratory	401

While some of the indications listed predominantly result from lifestyle choices (e.g., smoking, liver cirrhosis, and high cholesterol), some exist because of a genetic disposition. There is no conclusive evidence that individuals with lower incomes are more or less susceptible to particular diseases. Rather, there are strong correlations. For example, many of these diseases are prevalent among poor communities. Emphysema and liver cirrhosis are on the rise in developing countries as tobacco smoking and consumption of spirits increase. Typhoid fever, gonorrhea, diarrhea, and other respiratory diseases are also widespread.

The following analysis shows there are large price differentials between low-income and high-income countries.

IV. Descriptive Statistics

To illustrate the richness of the data, I compare prices at the product level using ratios. This allows comparison across countries taking into consideration forms and strengths. Some of the literature on pharmaceutical pricing focuses on the inaccuracies of price measurement.[10] A representative price, usually calculated as an index, may be used to compare prices across markets and countries. Price indexes are influenced by the weights used. In addition, the forms and strengths available differ across countries, which may affect the index. In this analysis, a 5 mg A-tablet is the same in all countries in which it is available and thus avoids these issues. This section follows the methods used in Maskus (2001).

The total number of drug products available in each country (pooled for both years) is given below:

United States	184
United Kingdom	219
Japan	81
Italy	141
Spain	160
Brazil	133
Mexico	135
Czech Republic	140
Canada	185
Korea	89
Thailand	124
South Africa	155
Sweden	149

The number of products varies between countries partly because of different product safety regulations and other product standards that may exist.

A. Regional Comparisons

The rationale for comparing countries within a region is that similarities apply to people's preferences for a particular form or strength. For example, drugs in Europe are prescribed in

[10]See, for example, Berndt, et al (2000), Danzon (1997), Danzon and Chao (2000).

higher strengths per dosage.[11] Limiting comparisons to drug products that are available in every country is not feasible because there are not many observations.

North America

The sample is restricted such that a price for each drug product must exist in at least two of the following three countries: United States, Canada, and Mexico. This gives us a sample of 21 drugs and 51 products in 1994, and 25 drugs and 83 products in the 1998 sample. Relative prices are listed in Table 1.

Of the 23 products available in the United States and Mexico in 1994, eight (35%) were priced higher in Mexico. In 1998, this figure dropped to 25% (9 of 36); five of these drugs were not available in 1994. Drugs that were more expensive were classified as cardiovascular (C), immunosuppresive (L), and of the central nervous system (N). The average price in Mexico in this sample was lower in both years. In 1994, the median price was 29% lower; in 1998, 26% lower.

Nine of the 36 products available in the United States and Canada were priced higher in Canada in 1994. Only three of 54 products were priced higher in Canada in 1998, all of which were available in 1994. The more expensive drugs were classified as those affecting the alimentary tract (A), cardiovascular drugs, antibiotics (J), immunosuppresive, and nervous system drugs. The median drug price in Canada in 1994 was 23% lower. In 1998, the median Canadian price was 44% lower than average US prices.

Finally, 67% (14 of 21) of products available in Canada and Mexico were more expensive

[11] Schweitzer (1997).

in Mexico in 1994, and this percentage rose to 71% (22 of 31) in 1998. Thirteen of the drugs in Mexico in 1998 were unavailable in 1994. The expensive drugs fell into all available ATC categories, except sex hormones (G). The median Mexican drug price was 24% higher than Canadian prices. In 1998, it was16% higher.

The fact that Canada has lower prices on average than Mexico arises from the situation that Canada used price controls throughout the sample. This may also explain the relatively low prices between Canada and the United States. Mexico also had substantial price controls with a history of implementing price freezes in the late 1980s. Prices are reportedly subject to established maximum levels.[12]

Europe

The sample is restricted such that a price for each drug product must exist in at least two of the following five countries: UK, Italy, Spain, Czech Republic, and Sweden. This yields a sample of 27 molecules and 92 products for 1994, and 34 molecules and 130 products for 1998. For both samples, the UK is the benchmark country for price comparisons because there are more observations for the UK than any other country. The UK does have a system of profit controls (specifically, returns on capital), physician drug utilization reviews, and low copayments for beneficiaries. It is considered one of the least restrictive countries in Europe on pharmaceutical price regulation.[13] The relative prices are listed in Table 2.

For all of the countries sampled, the number of drugs priced higher in those countries relative to the UK fell between 1994 and 1998. In 1994, 35% (11 of 31) of common drugs were

[12]USITC (2000).

[13]Danzon and Chao (2000).

priced higher in Italy than in the UK. This proportion fell to 14% (8 of 56) in 1998. The decrease may be explained by Italy's use of international price comparisons, which help keep Italian prices relatively low.[14] Only two of the more expensive drugs in 1998 were unavailable in 1994. The median Italian drug price was lower than British prices by 12% in 1994, and 23% in 1998. The more expensive drugs in Italy were predominantly those that treated cardiovascular and central nervous system disorders.

The number of higher-priced drugs in Spain fell from 26% (11 of 43) to 7% (4 of 60) between 1994 and 1998. Only two of the more expensive drugs in 1998 were unavailable in 1994. The more expensive drugs fell into all ATC categories, except G. The median Spanish drug price was lower than British prices by 15% in 1994, and 28% in 1998. Spain also uses price and profit controls.[15]

In 1994, 52% (16 of 31) of Czech drugs were priced higher relative to UK drugs. The proportion fell to 13% (8 of 63) in 1998. The median Czech price was higher than Britain's by 2% in 1994, but was lower by 25% in 1998. One drug in particular was priced three and one-half times more than the same drug in the UK. Ockova (1997) describes the Czech Republic's compliance with world intellectual property regulations, but the government also imposes extensive price and profit regulations. She reports average price levels to be "much lower" than the average world price for pharmaceuticals. In my sample, this does not appear to be the case. Main product lines include antibiotics, anti-diabetics, and hypertension drugs.

Finally, 61% (19 of 31) of the common drugs between Sweden and the UK were priced higher in Sweden in 1994. This figure decreased to 36% (20 of 55) in 1998. The median price in

[14]Danzon (1997).

[15]Ballance et al (1992).

Sweden was higher than in the UK by 4% in 1994, but was lower by 4% in 1998. Sweden had a system of substantial price controls as of 1992.[16]

Asia

The sample is restricted such that a price for each drug product must exist in at least two of the following three countries: Japan, Korea, and Thailand. Relative prices are listed in Table 3.

Eighty percent (4 of 5) of the drugs in Japan were priced higher than in Thailand in 1994, whereas 82% (9 of 11) were priced higher in 1998. Japan uses a system of drug reimbursement which creates incentives for drug firms to limit their prices to levels considered low by industrialized country standards. Drug consumption is also the highest in the world.[17] Parallel imports of patented drugs are allowed.[18]

Seventy-one percent (12 of 17) of the common drugs were priced higher in Korea than in Thailand in 1994. This proportion fell to 56% (18 of 32) in 1998. On average, drug prices in both Japan and Korea were greater than in Thailand. Japanese drugs were priced more than two times higher in both years. Korean drugs were priced 20-24% higher on average. These results probably reflect the lack of intellectual property enforcement in Thailand. Many branded drugs are imported but at reportedly lower quality.[19] Price controls exist for essential drugs.[20] Substantial price controls also exist in Korea.[21]

[16]Ballance et al (1992).
[17]Danzon (1997).
[18]Maskus (2001).
[19]Espicom (1995).
[20]Ballance et al (1992).
[21]Ballance et al (1992)

B. Comparisons by Income

To see how this sample fits into the literature, I compare prices of drugs that are available bilaterally with the United States. In 1994, there is a maximum of 54 relative prices for each country-comparison. In other words, there are only 54 drugs that are available in the United States and at least one other country in the sample. In 1998, there is a maximum of 88 relative prices. The sample is divided into high-income and middle-income economies compared to the United States.

High-Income Countries

The sample of high-income, or industrialized, countries includes the UK, Japan, Italy, Spain, Canada, and Sweden. Relative prices are listed in Table 4.

On average, drug prices in these countries were lower than average prices in the United States. Exceptions are the average drug prices in Japan and Canada in 1994. The majority of drugs whose prices were higher relative to US prices were drugs classified as cardiovascular, immunosuppressive, antibiotic, and those treating disorders of the central nervous system. For both years, Spain did not have any drugs priced above US levels.

Middle-Income Countries

The sample of middle-income countries includes Brazil, Mexico, the Czech Republic, Korea, Thailand and South Africa. Relative prices are listed in Table 5. In 1994, all countries had at least one higher-priced drug than in the United States. Two of 18 common drugs were priced higher in Brazil than in the United States. This proportion increased to 5 of 41 drugs in

1998. Brazil has a system of limited price controls.[22] Specifically, drugs for long-term use are subject to controls. The Czech Republic had higher prices for 10% of its drugs for both years. For both Korea and Thailand, the proportion of higher-priced drugs fell, but is still positive.

South African drug prices, were on average 3% more expensive than US drugs in 1994. Thirty-six percent (8 of 22) of drugs in 1994, and 14% (6 of 42) in 1998, were more expensive in South Africa. The government allows parallel imports of patented drugs.[23]

While it may be argued that for the majority of drugs included in the present sample prices are lower in developing countries compared to the United States, the expenditure share of these drugs must also be considered. Ganslandt, Maskus and Wong (2001) show that for several branded anti-retroviral (HIV/AIDS) drugs, prices in South Africa are a fraction of US prices. When the cost of a year's treatment is calculated as a share of annual per capita income, however, the budget share of HIV/AIDS drugs is not different from that of an infected individual in the United States. Depending on the brand of drug, the budget share in South Africa may be even higher.

V. Theoretical Hypotheses

This paper tests the hypotheses put forth in Wong (2002). Wong develops a variation on the Stone-Geary utility function that generates non-homothetic preferences. Pharmaceuticals are a luxury good and consumption requires a minimum income level. The price elasticity of demand is a function of individual income unlike standard models of homothetic preferences. Specifically, the price elasticity of demand decreases (in absolute value) with income level. This

[22] Ballance et al (1992).

[23] Source?

is the key feature of the model. Assuming a monopoly supplier who bases his markup on the price elasticity of demand, an increase in per capita income raises the equilibrium price of pharmaceuticals.

When aggregating across consumers, Wong shows that an increase in income inequality also increases the equilibrium price for pharmaceuticals. Rising inequality increases some individuals's incomes and thus decreases their price elasticities of demand. In turn, the price elasticity of market demand decreases (in absolute value). The monopolist raises his equilibrium price in response. This result is supported in three types of income dispersion. The first involves a first-order stochastically dominant change in the distribution of income. The other two model increasing dispersion as mean preserving spreads. The relationship between drug price and inequality may be either concave or convex, depending on the type of distribution.

In maximizing the utility function, solving for aggregate demand and maximizing the monopolist's profit function, the equilibrium price is:

$$p_{ij}^{*}(\delta) = \frac{m_i}{4} + \frac{1}{2}\left(\frac{m_i^2}{4} + \frac{2m_i\alpha_{ij}(w_j^u + \delta_j)}{\beta_{ij}C_j}\right)^{\frac{1}{2}} \quad \textbf{(1)}$$

where:

p^*_{ij} equilibrium price of drug i in country j

m_i marginal cost of drug i

w_j^u upper income level in country j

α_{ij} budget share of drug i in country j

β_{ij} $1 - \alpha_{ij}$

δ_j inequality in country j

C_j shift parameter (part of the minimum income requirement).

Equation (1) results from either a first-order stochastic change or a mean preserving spread in dispersion. That is, this equilibrium price is identical for both types of increases in income inequality. It is straightforward to show that an increase in w_j^u implies an increase in per capita income, holding population size constant. Equation (1) says that drug prices will rise with per capita income and income inequality. This relationship is also nonlinear with respect to inequality.

Because it is nonlinear and taking the logarithm of both sides does not produce a log-linear regression equation, I first estimate a reduced-form version of (1) to produce initial estimates. Aside from the per capita income and inequality variables, data do not exist for the other variables listed. I exclude them from the initial regressions, the results of which I present in the next section. It is my intention to accumulate these data and estimate (1) using nonlinear estimation techniques.

VI. Preliminary Econometric Specification and Results

Basic Regression

The basic reduced-form equation estimated is:

$$\log p_{ij} = \alpha_0 \log G_j + \alpha_1 (\log G_j)^2 + \alpha_2 D_{98} + \sum_{j-1}^{K} \beta_j D_j + \sum_{l=1}^{7} \delta_l D_l + \gamma_1 \log X_j + \gamma_2 \log Z_{mj} + \epsilon_{ij} \qquad \textbf{(1)}$$

where p_{ij} is the price of drug product i in country j, $j=\{1,...,K\}$. G is the Gini coefficient, defined to be between zero and one hundred.[24] As G approaches 100, income is more unequally distributed. D's are dummy variables: D_{98} is an indicator for observations in 1998; D_j are country dummy variables; D_l are dummy variables for drug i in ATC category l, $l = \{A, C, G, J, L, N, R\}$. They control for drug effects that are independent of any country effects. X_j are other demographic variables, such as life expectancy, elderly population, and population densities. Z_{mj} are market power variables, such as the market shares of company m in country j, and the Herfindahl index in country j. ϵ is an error term, identically and independently distributed across both drugs and countries. Logs are used to normalize drug prices because they fluctuate widely between countries. The constant is excluded to avoid perfect multicollinearity among the dummy variables.

Equation (1) is estimated using ordinary least squares (OLS). It captures the nonlinear relationship between inequality (Gini) and pharmaceutical prices hypothesized in the theoretical model. The omitted country dummy k serves as the benchmark country to which the other country effects β are compared. β may be interpreted as the effect of price/profit regulations, enforcement of drug patents, and/or presence of social health insurance programs on prices in that country, relative to the omitted country. Because these issues are not systematically measured, the use of categorical variables to represent the existence of regulations and health insurance does not substantively add to the analysis and are thus omitted.[25]

Because the correlation coefficient between the log of Gini and its square is close to one

[24]Data on Gini coefficients are from the World Bank Development Indicators (2001) for the last year available. There are only 13 Gini coefficients in the dataset. In order to transform the Gini coefficients using logarithms, I multiplied by 100. (Gini coefficients are calculated naturally as a number between zero and one.)

[25]A summary of regulations and existence of parallel trade activity is included in the appendix.

(0.99), multicollinearity becomes an issue in estimating (1). One solution is to simply drop one of these variables. In doing so, the resulting estimated effect of Gini on prices is biased. To see this, take the partial derivative of (1) with respect to log G:

$$\frac{\partial \log p_{ij}}{\partial \log G_j} = \alpha_0 + 2\alpha_1 \log G_j \qquad \textbf{(2)}$$

Dropping $(\log G)^2$, expression (2) is simply α_0. Dropping logG, (2) becomes $2\alpha_1 \log G$.

In the following analysis, I first drop the squared term before running the regression (which is now linear). Following this, I re-run the regression using only the squared term (and dummies). Both of these are initially run without the demographic or market power variables *X* and *Z*. The omitted country dummy is the United States.

Linear Regression: "Linear Model"

The regression equation is:

$$\log p_{ij} = \alpha_0 \log G_j + \alpha_2 D_{98} + \sum_{j-1}^{K} \beta_j D_j + \sum_{l=1}^{7} \delta_l D_l + \epsilon_{ij} \qquad \textbf{(3)}$$

The marginal effect of an increase in the log of Gini on the log of prices is α_0. Results are given in Table A, column (a). The effect of the Gini coefficient on drug prices is positive and significant. This is consistent with the theory. A one percent increase in the Gini coefficient increases pharmaceutical prices by 0.71%. Recall that this estimate is biased because of the exclusion of the squared term. All of the coefficients on country dummies are negative and significant. These results possibly indicate that pricing and social health policies in these countries result in lower drug prices compared to the United States (the omitted country dummy). This is consistent with the analysis of relative prices presented in section IV. With the exception of ATC category L, drugs in all ATC categories included in the sample are on average priced lower than the United States. The adjusted R-squared statistic is 0.51.

The coefficient estimates of the country dummies may be ranked in the following order from lowest to highest: Canada, Japan, Czech Republic, Sweden, UK, Italy, Korea, Brazil, Mexico, Spain, South Africa, and Thailand. Recall that these coefficients may be interpreted as the average drug price in each country relative to the average drug price in the United States. The magnitudes partly reflect the extent of price and profit controls in each country. The above results suggest that Canada, Japan, Czech Republic and Sweden are less restrictive compared to the four countries with the highest price deviations from the United States. They also suggest that of the countries sampled, Canada has the least restrictive regulations relative to the United States. This is doubtful because Canada is known to be interventionist in its pricing policies. Mexico and Spain both had substantial price controls during the 1990s. South Africa and Thailand lack effective enforcement of intellectual property protection. Thailand and Spain allow parallel imports of pharmaceuticals. Thus, the results do support some empirical facts, although here we do not account for different national health insurance programs or effective patent enforcement, which may also affect drug prices.

Nonlinear Relationship: “Nonlinear Model”

To capture the nonlinear relationship between the Gini coefficient and drug prices as the theoretical model predicts, I estimate the following:

$$\log p_{ij} = \alpha_1 (\log G_j)^2 + \alpha_2 D_{98} + \sum_{j-1}^{K} \beta_j D_j + \sum_{l=1}^{7} \delta_l D_l + \epsilon_{ij} \qquad \textbf{(4)}$$

The marginal effect of log of G on log of prices and the curvature of this relationship are:

$$\begin{aligned} \frac{\partial \log p_{ij}}{\partial \log G_j} &= 2\,\alpha_1 \log G_j \\ \frac{\partial^2 \log p_{ij}}{\partial (\log G_j)^2} &= 2\,\alpha_1 \end{aligned} \qquad \textbf{(5)}$$

The results of regressing (4) using OLS are presented in Table A, column (b). The effect of the log of Gini on log of prices (α_1) is positive. Because $\alpha_1 \log G$ is positive, the relationship between drug price and inequality is positive-sloping. The second partial derivative in (5) shows that if α_1 is positive, then the relationship is also convex. The average effect of the log of Gini on the log of prices is 1.44%.[26] Again, this effect is biased because of the excluded *logG* term. It is also twice as large as the effect from running the linear regression. The country dummies all have negative coefficients, but the dummies for Japan, Czech Republic, Canada and Sweden are no longer statistically significant. They are, however, ranked similarly to the results from estimating the linear relationship. Thus, the results support the theoretical hypothesis that inequality and pharmaceutical prices have an increasing, convex relationship. The coefficients of the drug dummies are unchanged because the they are drug-specific and invariant to the country variable used.

[26]This figure is calculated as: $2\alpha_1(\log G)_\mu = 2(.19)(3.588)$, where $(\log G)_\mu$ is the mean of logG.

Robustness

To check that the results are robust, I use the income share of the richest 20% of the population in each country in place of the Gini coefficient. As the income share of this portion of the population rises, I expect that pharmaceutical prices rise. Results are given in Table B, columns (a) and (b). They are not qualitatively different from the previous results. The adjusted R-squares are the same as before.

Specification

A plot of the residuals against the fitted values of *log p* from both linear and nonlinear models suggests that the errors are homoskedastic. Thus, using White's robust standard errors does not change the results.

The theoretical hypothesis that per capita income affects pharmaceutical prices is tested by including the log of GNP per capita of each country. An F-test shows GNP per capita does not add significant information to the model. This result contrasts with previous empirical models that find income a significant and positive explanatory variable for pharmaceutical prices.[27,28]

The demographic and market power variables listed above were each included in both linear and nonlinear models and tested for incremental significance through F tests. The population density variables measure the spatial variation of residents. A higher number of individuals living in the urban areas would suggest that in that country, relatively more people

[27]See Schut and van Bergeijk (1986) and Scherer and Watal (2001).

[28]In this sample, the Pearson correlation coefficient between the Gini and GNP per capita is -0.55. The empirical relationship between the Gini and income is ambiguous. Some studies find income to be a significant determinant of income inequality, but this relationship may be positive or negative. Sundrum (1990) presents an excellent review of the literature. He stresses that there is no clear relationship between income and inequality.

have better access to medical care compared to other countries. Evidence in Thailand and South Africa, for example, show that medical facilities are located mainly in urban cities, and travel to these facilities are difficult for those living in the rural areas. Neither population density variables test significantly.

One-third of the total pharmaceutical consumption is attributed to the elderly in the United States. This statistic is also similar for other high-income countries. The population of the elderly (defined to be older than 65 years) as a percentage of total population may influence the price of pharmaceuticals. Typically, the elderly live on fixed incomes and prices may decrease to reflect this income constraint. On the other hand, their need for medicines may be price inelastic. This variable does not add significantly to the model, however. Because the life expectancy of many middle-income countries is lower than age 65, the elderly population may not be a good proxy. Instead, life expectancy at birth (in years) is used. Life expectancy, however, is highly correlated to the Gini coefficient. In fact, life expectancy is often used as an explanatory variable for the Gini in the health inequality literature. Thus, it also does not add significantly to the model.

Neither the market shares of individual firms nor the Herfindahl index in each country is significant.

Finally, the Ramsey RESET test was used to test for the null hypothesis that there are no omitted variables. The RESET test uses powers of the fitted values as additional explanatory variables in the model. If the adjusted R-square improves significantly, then the model is misspecified. At the 10% significance level, I cannot reject the null. That is, there are no omitted variables in my model. At the 11% level, however, I can reject the null. This is true for both linear and nonlinear models. The significance level at which I can reject is high by customary standards (less than 15%) and may reflect the omission of one of the Gini variables (the log of Gini and its square), as well as explicit control for pricing regulations.

VII. Discussion

Other Issues

Whether a drug is available over-the-counter (OTC) or by prescription only will affect the price of the drug. Generally, drugs are cheaper when they have OTC status. This status, however, is not uniform across countries. For example, the non-drowsy antihistamine Claritin is available by prescription only in the United States, but is available OTC in Canada. Thus, it is valuable to include this information in the regressions. To my knowledge, information regarding the OTC or prescription status of a drug in each country is not available.

Prices of drugs may also be influenced by the time length of usage. Lu and Comanor (1998) show that prices tend to be higher for drugs used to treat acute symptoms, and these prices decline over time. Conversely, prices for drugs used to treat chronic symptoms are set relatively low, and increase over time. Incorporating this type of information in this dataset is problematic because drugs are often used to treat more than one symptom. These symptoms may be categorized as acute, chronic or both, which is difficult for coding.

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Appendix. Summary of Pharmaceutical Regulations by Country (1994-1998 period)

United Kingdom	profit controls[b], price controls (limited)[a]
Japan	drug reimbursement limits[b], parallel trade[c]
Italy	price controls, parallel trade[b]
Spain	price and profit controls (substantial)[a]
Brazil	price controls (limited)[a], lack of IP enforcement
Mexico	price controls (substantial), price freezes[a]
Czech Republic	price and profit controls (extensive)[d]
Canada	price controls (limited)[a]
Korea	price controls (substantial)[a]
Thailand	price controls on essential drugs[a], lack of IP enforcement, parallel trade[e]
Sweden	price controls (substantial)[a]
South Africa	lack of IP enforcement
United States	price controls on drugs in Medicare/Medicaid/VA programs

[a] Ballance et al (1992)
[b] Danzon (1997)
[c] Maskus (2001)
[d] Ockova (1997)
[e] Espicom (1995)

Table 1: North American Drug Price Comparisons, 1994 and 1998

			Mexican Price/US Price		Canadian Price/US		Mexican/Canadian Price	
Brand	Form	Strength	1994	1998	1994	1998	1994	1998
Norvasc	tablet	5 mg	0.738	0.734	1.009	0.812	0.731	0.905
Norvasc	tablet	10 mg			0.866	0.716		
Lipitor	tablet	10 mg				0.718		
Lipitor	tablet	20 mg				0.579		
Lipitor	tablet	40 mg				0.515		
Pulmicort	powder	100Y						1.085
Pulmicort	powder	200Y				0.432		
Sandummune	capsule	100 mg	1.513	1.172	1.004		1.507	
Sandummune	capsule	25 mg	1.658	1.338	1.022		1.623	
Sandummune	capsule	50 mg			0.939			
Sandummune	liquid	100 mg	1.480	1.457	0.894		1.655	
Sandummune	ampoule	50 mg	1.768	0.565				
Neoral	capsule	25 mg		1.719		0.032		53.972
Neoral	capsule	50 mg						2.282
Neoral	capsule	100 mg		1.639		0.784		2.091
Neoral	liquid	100 mg		1.547		0.624		2.480
Cipro	liquid	500 mg				0.520		
Cipro	infusion	2 mg						1.099
Cipro	tablet	250 mg			0.743	0.558		
Cipro	tablet	500 mg			0.733	0.542		
Cipro	tablet	750 mg			0.780	1.001		
Vasotec	vial	1.25 mg			0.961	0.846		
Plendil	tablet	5 mg	1.064	0.896				
Diflucan	tablet	50 mg			0.987	0.885		
Diflucan	tablet	100 mg			1.132	0.995		
Diflucan	capsule	150 mg						1.343
Diflucan	liquid	50 mg						1.226
Lasix	ampoule	20 mg	0.339	0.562				
Lasix	tablet	20 mg	0.178	0.308	0.415	0.315	0.429	0.978
Lasix	tablet	40 mg	0.323	0.474	0.468	0.352	0.689	1.348
Lasix	tablet	80 mg			0.683	0.498		
Lasix	liquid	10 mg	0.144		1.193	0.770	0.121	
Lasix	vial	10 mg			3.050			
Zoladex	syringe	3.6 mg	0.846	0.974				
Atrovent	press	20Y					0.321	0.652
Atrovent	liquid	0.03%				0.002		
Atrovent	liquid	0.06%				0.004		
Atrovent	liquid	250Y						0.512
Imdur	tablet	60 mg					1.114	
Claritin	tablet	10 mg			0.404	0.318		
Claritin	liquid	1 mg				0.187		
Cozaar	tablet	50 mg		0.908		0.756		1.201
Cozaar	tablet	25 mg				0.763		
Seloken	tablet	50 mg			0.442	0.332		
Seloken	tablet	100 mg	0.573	0.398	0.456	0.386	1.256	1.032
Zyprexa	tablet	5 mg				0.516		
Zyprexa	tablet	10 mg				0.679		
Zyprexa	tablet	7.5 mg				0.773		

Zyprexa	tablet	2.5 mg				0.300		
Prilosec	capsule	10 mg		0.325				
Prilosec	capsule	20 mg	0.707	0.549	0.545		1.298	
Prilosec	capsule	40 mg		0.727				
Pravachol	tablet	10 mg	1.043	0.896	0.824	0.651	1.265	1.376
Pravachol	tablet	20 mg	1.811	1.588	0.922	0.727	1.965	2.185
Pravachol	tablet	40 mg				0.533		
Zantac	tablet	150 mg	0.257	0.190				
Zantac	tablet	300 mg	0.280	0.210				
Zantac	liquid	15 mg			8.435	22.333		
Zantac	tablet	150 mg			0.657	0.522		
Zantac	tablet	300 mg			0.607	0.517		
Zantac	capsule	300 mg			0.561			
Zantac	capsule	150 mg			0.620	0.679		
Zantac	vial	25 mg			0.342	0.636		
Risperdal	tablet	1 mg	0.455	0.275				
Risperdal	tablet	2 mg	0.547	0.333				
Risperdal	tablet	3 mg	0.657	0.419				
Risperdal	liquid	1 mg				0.330		
Zoloft	capsule	50 mg					1.261	0.938
Zoloft	capsule	100 mg					1.668	1.904
Zocor	tablet	5 mg		0.524	0.692	0.453		1.156
Zocor	tablet	10 mg	0.959	0.818	0.898	0.740	1.068	1.106
Zocor	tablet	20 mg	1.064	0.926	0.607	0.520	1.752	1.782
Zocor	tablet	40 mg				0.656		
Imitrex	tablet	50 mg		0.326		0.719		0.453
Imitrex	tablet	100 mg					1.023	0.795
Imitrex	syringe	6 mg	0.410	0.228	0.460	0.314	0.892	0.726
Imitrex	liquid	20 mg		0.002		0.093		0.019
Imitrex	liquid	5 mg				0.514		
Imitrex	vial	6 mg			1.256	0.743		
Bricanyl	tablet	5 mg					0.873	1.141
Bricanyl	powder	500Y					1.240	2.043
Effexor	tablet	75 mg		1.226	1.397	1.091		1.124
Effexor	tablet	37.5 mg		0.755	0.760	0.595		1.269
Effexor	tablet	50 mg		0.875				
Effexor	capsule	75 mg		0.739		0.570		1.296
Effexor	capsule	150 mg		1.199				
Effexor	capsule	37.5 mg				0.321		
		count	23	36	36	54	21	31
		average	0.818	0.773	1.049	0.959	1.131	2.952
		st dev	0.528	0.464	1.347	2.974	0.489	9.486
		median	0.707	0.737	0.770	0.564	1.240	1.156

Source: IMS Health

Table 2: European Drug Price Comparisons, 1994 and 1998

			Italian/UK Price		Spanish /UK Price		Czech/UK Price		Swedish/UK Price	
Brand	Form	Strength	1994	1998	1994	1998	1994	1998	1994	1998
Norvasc	tablet	5 mg		0.946	0.829	0.686	0.979	0.686	1.002	0.925
Norvasc	tablet	10 mg	1.009	0.833	0.837	0.693	1.058	0.731	1.105	1.072
Lipitor	tablet	10 mg				0.842				0.961
Lipitor	tablet	20 mg								0.891
Lipitor	tablet	40 mg								0.871
Rhinocort	press	50Y			0.973	1.000	1.351	1.263		
Pulmicort	press	50Y			1.077	0.826	1.128	0.891	3.487	2.891
Pulmicort	press	200Y			1.008	0.815	1.248		2.884	2.526
Pulmicort	powder	100Y		0.657			0.637	0.597		
Pulmicort	powder	200Y		0.613	0.512	0.532	0.577	0.587		
Pulmicort	powder	400Y		0.607	0.513	0.423		0.559		
Pulmicort	liquid	0.25 mg			0.532	0.441		0.818		
Pulmicort	liquid	0.5 mg			0.485	0.401		0.567		
Entocort	capsule	3 mg				0.829		0.831		
Sandiummune	capsule	100 mg	0.895	0.823						
Sandiummune	capsule	25 mg	0.878	0.771						
Sandiummune	capsule	50 mg	0.881	0.816						
Sandiummune	liquid	100 mg			0.847	0.705				
Sandiummune	infusion	50 mg			1.803	0.608	4.438	3.537		
Neoral	capsule	10 mg								1.235
Neoral	capsule	25 mg		0.800		0.697		0.751		1.164
Neoral	capsule	50 mg		0.812		0.699		0.766		1.188
Neoral	capsule	100 mg		0.846		0.705		0.808		
Neoral	liquid	100 mg						0.896		
Cipro	tablet	250 mg			1.024	0.828	1.059	0.764		
Cipro	tablet	500 mg			1.106	0.869	1.719	0.825		
Cipro	tablet	750 mg			1.137	0.923				
Cipro	infusion	2 mg							0.007	0.005
Cipramil	tablet	10 mg								0.715
Cipramil	tablet	20 mg		0.846				0.699		0.824
Ovestin	tablet	0.25 mg			1.977					
Ovestin	tablet	1 mg	0.927	0.606			0.567	0.423	0.680	0.606
Ovestin	cream	0.10%					1.712	0.712		
Plendil	tablet	2.5 mg								1.456
Plendil	tablet	5 mg	1.030	0.715	0.954	0.765	0.772	0.647	1.442	1.256
Plendil	tablet	10 mg	1.416	1.056			0.900	0.953	1.342	1.269
Diflucan	infusion	2 mg					1.043	0.715	0.012	0.012
Diflucan	capsule	50 mg	0.824	0.641	0.875	0.720	1.389	0.805	1.086	1.240
Diflucan	capsule	150 mg	0.856	0.624	0.874	0.723	1.389	0.810	1.143	1.082
Diflucan	capsule	200 mg			0.866	0.714			1.038	1.184
Diflucan	liquid	50 mg			0.858	0.706		0.838		
Diflucan	liquid	200 mg			0.833	0.686		0.831		
Lasix	tablet	40 mg	1.509	0.669						
Lasix	tablet	500 mg	0.514	0.317						
Lasix	tablet	na	0.010	0.003						
Zoladex	syringe	3.6 mg	0.810	0.708	0.838	0.715			1.036	0.990
Zoladex	syringe	10.8 mg		0.722		0.788				0.885
Atrovent	liquid	0.03%						115.568		
Atrovent	liquid	0.25 mg		0.794					0.429	0.439
Atrovent	liquid	500Y				2.655				
Combivent	press	na				0.596		0.830		
Duovent	liquid	na			0.178	0.134		0.288		
Duovent	press	na	0.231	0.315			0.256	0.196		
Imdur	tablet	60 mg			0.499				0.702	0.666
Imdur	tablet	60 mg								
Claritin	tablet	10 mg	0.986	0.832	0.732	0.614	1.047	0.761	0.877	0.919

Claritin	liquid	5 mg			0.306	0.251				
Cozaar	tablet	50 mg		0.774		0.775		1.038		0.861
Seloken	tablet	50 mg							3.625	4.583
Seloken	tablet	100 mg	1.106	1.292		3.157	1.433	1.618	3.010	3.764
Seloken	tablet	200 mg	0.760	0.907		0.191			2.014	2.678
Nicorette	special sol	2 mg	1.109	1.282	1.018	0.863	0.545	1.113	0.900	0.839
Nicorette	special sol	4 mg			1.224	1.050	0.537	1.124	1.034	0.826
Nicorette	dressing	5 mg	1.057	1.117				0.796	1.099	0.940
Nicorette	dressing	10 mg	1.003	1.051				0.741	0.987	0.817
Nicorette	dressing	15 mg	1.049	1.074				0.735	0.921	0.780
Zyprexa	tablet	5 mg		0.738		0.748		0.774		0.980
Zyprexa	tablet	10 mg		0.737		0.746		0.777		0.961
Zyprexa	tablet	7.5 mg				0.746		0.724		0.980
Zyprexa	tablet	2.5 mg								0.993
Prilosec	capsule	10 mg						0.656		1.202
Prilosec	capsule	20 mg	0.876	0.899	0.919	0.893	0.829	0.760	1.278	1.093
Prilosec	capsule	40 mg								0.989
Pravachol	tablet	10 mg	0.803		0.899	0.734		0.667		
Pravachol	tablet	20 mg	0.868	0.593	0.686	0.542		0.477	0.797	0.746
Pravachol	tablet	40 mg								0.627
Zantac	ampoule	50 mg	0.472	0.468	0.353	0.336	1.101	0.674		
Zantac	tablet	150 mg	1.045	0.802	0.928	0.638	0.547	0.414		
Zantac	tablet	300 mg	1.044	0.793	0.852	0.619	0.551	0.528		
Zantac	liquid	150 mg		0.554						
Zantac	tablet	150 mg						0.444		
Risperdal	tablet	1 mg		0.569	0.820	0.658		0.573		
Risperdal	tablet	2 mg		0.572				0.581		
Risperdal	tablet	3 mg		0.592	0.838	0.674		0.586		
Risperdal	tablet	4 mg		0.592				0.604		
Zoloft	tablet	50 mg		0.668	0.706	0.584				0.747
Zoloft	tablet	100 mg			0.708	0.607				0.978
Zocor	tablet	10 mg	0.789	0.999			1.142	0.884	0.920	0.863
Zocor	tablet	20 mg	0.815	0.605			1.020	0.667	0.892	0.830
Zocor	tablet	40 mg		0.837						0.653
Imitrex	tablet	50 mg		0.591		0.705			1.240	0.797
Imitrex	tablet	100 mg	0.842	0.734				0.853	1.043	0.918
Imitrex	syringe	6 mg	0.820	0.710	0.762	0.630		0.778		
Imitrex	liquid	20 mg				0.766				
Bricanyl	tablet	5 mg			1.510	1.278				
Bricanyl	tablet	7.5 mg			1.019	0.857				
Bricanyl	powder	0.5 mg					0.348	0.405		
Bricanyl	liquid	1.5 mg			0.830	0.807				
Bricanyl	press	0.25 mg							3.500	3.263
Bricanyl	ampoule	0.5 mg			0.154	0.128	0.681	0.599		
Effexor	tablet	75 mg		1.029		0.826		1.050		1.145
Effexor	tablet	37.5 mg		0.931		0.836		0.976		0.976
Effexor	tablet	50 mg		0.903		0.795				1.006
Effexor	capsule	75 mg		0.900						
Effexor	capsule	150 mg		1.083						
Imovane	tablet	7.5 mg					0.810	0.550		
		count	31	56	43	60	31	63	31	55
		average	0.878	0.764	0.853	0.763	1.059	2.605	1.340	1.166
		st dev	0.288	0.227	0.354	0.453	0.730	14.468	0.956	0.826
		median	0.878	0.773	0.847	0.715	1.020	0.751	1.038	0.961

Source: IMS Health

Table 3: Asian Drug Price Comparisons, 1994 and 1998

			Japanese/Thai Price		Korean/Thai Price		Japanese/ Korean Price
Brand	Form	Strength	1994	1998	1994	1998	1994
Norvasc	tablet	5 mg			1.061	0.946	
Norvasc	tablet	10 mg					
Rhinocort	liquid	50Y					
Pulmicort	powder	100Y			1.392	1.173	
Pulmicort	powder	200Y			1.395	1.202	
Sandimmune	capsule	100 mg			1.089	2.730	
Sandimmune	capsule	25 mg	2.780	5.484	0.981	1.653	2.834
Sandimmune	liquid	10%					2.591
Neoral	capsule	25 mg				1.358	
Neoral	capsule	100 mg				1.362	
Cipro	tablet	250 mg					
Cipro	tablet	500 mg					
Ovestin	tablet	1 mg		1.431			
Ovestin	tablet	2 mg					
Plendil	tablet	5 mg		1.129	2.577	2.316	
Diflucan	capsule	50 mg	3.008	3.341	1.876	1.657	1.604
Diflucan	capsule	100 mg		3.868			
Lasix	ampoule	20 mg	1.634	1.692	0.534	0.388	3.060
Lasix	tablet	40 mg	2.187	2.102	0.973	1.017	2.247
Lasix	tablet	na	0.460				
Combivent	press	na				1.154	
Combivent	liquid	na				2.021	
Duovent	press	na			1.029	0.926	
Imdur	tablet	60 mg				2.410	
Claritin	tablet	10 mg					
Claritin	liquid	5 mg					
Claritin	tablet	na				2.902	
Cozaar	tablet	50 mg		1.848			
Seloken	tablet	100 mg			0.957	0.838	
Nicorette	special sol.	2 mg		5.417			
Zyprexa	tablet	5 mg				0.825	
Zyprexa	tablet	10 mg				0.834	
Prilosec	capsule	20 mg			1.358	1.078	
Prilosec	vial	40 mg				0.656	
Zantac	ampoule	50 mg			1.096	0.786	
Zantac	tablet	150 mg			1.110	0.890	
Zantac	tablet	300 mg			1.463	0.997	
Risperdal	tablet	1 mg		0.466		1.335	
Risperdal	tablet	2 mg		0.484		1.130	
Zoloft	tablet	50 mg				0.912	
Zocor	tablet	10 mg				0.728	
Imitrex	tablet	50 mg				1.146	
Imitrex	tablet	100 mg				1.007	
Bricanyl	tablet	5 mg			1.014	0.944	
Bricanyl	tablet	2.5 mg					
Bricanyl	liquid	na					
Bricanyl	ampoule	0.5 mg			0.420	0.306	
		count	5	11	17	32	5
		average	2.014	2.478	1.196	1.238	2.467
		st dev	1.020	1.801	0.490	0.626	0.569
		median	2.187	1.848	1.089	1.047	2.591

Source: IMS Health

Table 4: High-Income Countries Drug Price Comparisons, 1994 and 1998

			UK Price/ US Price		Japanese Price/ US Price		Italian Price/ US Price		Spanish Price/ US Price		Canadian Price/ US Price		Swedish Price/ US Price	
Brand	Form	Strength	1994	1998	1994	1998	1994	1998	1994	1998	1994	1998	1994	1998
Norvasc	tablet	5 mg	0.652	0.632				0.598	0.541	0.434	1.009	0.812	0.654	0.585
Norvasc	tablet	10 mg	0.566	0.564			0.572	0.470	0.474	0.391	0.866	0.716	0.626	0.604
Lipitor	tablet	10 mg						0.610				0.718		
Lipitor	tablet	20 mg										0.579		
Lipitor	tablet	40 mg						1.615				0.515		
Pulmicort	powder	200Y		0.621				0.381		0.330		0.432		
Sandiummune	capsule	100 mg	0.883	0.734			0.791	0.604			1.004			
Sandiummune	capsule	25 mg	0.948	0.789	3.212	2.034	0.832	0.608			1.022			
Sandiummune	capsule	50 mg	0.893		2.716		0.787				0.939			
Sandiummune	liquid	100 mg	0.789	0.653					0.668	0.460	0.894			
Neoral	capsule	25 mg		0.880				0.704		0.613		0.032		1.024
Neoral	capsule	100 mg		0.827				0.699		0.583		0.784		
Neoral	liquid	100 mg		0.660								0.624		
Cipro	tablet	100 mg		0.345		0.299								
Cipro	liquid	250 mg		0.423										
Cipro	liquid	500 mg										0.520		
Cipro	infusion	200 mg						1.488						
Cipro	tablet	250 mg					0.491	0.372			0.743	0.558	0.518	0.443
Cipro	tablet	500 mg					0.808	0.617			0.733	0.542	0.900	0.760
Cipro	tablet	750 mg						1.009			0.780	1.001	0.760	1.091
Vasotec	vial	1.25 mg									0.961	0.846		
Plendil	tablet	5 mg							0.520	0.433				
Diflucan	tablet	50 mg									0.987	0.885		
Diflucan	tablet	100 mg									1.132	0.995		
Lasix	ampoule	20 mg			0.570	0.425	0.331	0.270						
Lasix	ampoule	100 mg			0.490	0.254								
Lasix	tablet	20 mg	0.331	0.573	0.780	0.497					0.415	0.315		
Lasix	tablet	40 mg	0.361	0.602	1.038	0.633	0.544	0.403			0.468	0.352		
Lasix	tablet	80 mg									0.683	0.498		
Lasix	liquid	10 mg									1.193	0.770		
Lasix	vial	10 mg									3.050			
Zoladex	syringe	3.6 mg	0.657	0.879	2.156	1.982	0.532	0.622	0.550	0.628			0.680	0.870
Zoladex	syringe	10.8 mg		1.027				0.741		0.810				0.909
Atrovent	liquid	0.03%		0.001								0.002		
Atrovent	liquid	0.06%										0.004		
Claritin	tablet	10 mg	0.247	0.224			0.243	0.186	0.181	0.137	0.404	0.318	0.217	0.206
Claritin	liquid	1 mg										0.187		
Cozaar	tablet	50 mg		0.971		1.569		0.751		0.752		0.756		0.836
Cozaar	tablet	25 mg		0.977		0.826						0.763		
Seloken	tablet	50 mg	0.162	0.112							0.442	0.332	0.587	0.514
Seloken	tablet	100 mg	0.199	0.138			0.220	0.178		0.436	0.456	0.386	0.600	0.519
Seloken	tablet	200 mg	0.267	0.183			0.203	0.166		0.035			0.538	0.491
Zyprexa	tablet	5 mg		0.640				0.472		0.478		0.516		0.627
Zyprexa	tablet	10 mg		0.845				0.623		0.630		0.679		0.812
Zyprexa	tablet	7.5 mg		0.957						0.714		0.773		0.938
Zyprexa	tablet	2.5 mg		0.491								0.300		0.488
Prilosec	capsule	10 mg		0.360										0.432
Prilosec	capsule	20 mg	0.608	0.532			0.532	0.478	0.558	0.475	0.545		0.777	0.582
Prilosec	capsule	40 mg		0.660										0.653
Pravachol	tablet	10 mg	0.604	0.569			0.485		0.543	0.418	0.824	0.651		
Pravachol	tablet	20 mg	1.101	1.036			0.955	0.614	0.755	0.562	0.922	0.727	0.877	0.773
Pravachol	tablet	40 mg		0.947								0.533		0.594
Zantac	tablet	150 mg	0.478	0.490			0.500	0.392	0.444	0.312				
Zantac	tablet	300 mg	0.524	0.533			0.547	0.422	0.446	0.330				

Zantac	liquid	15 mg									8.435	22.333		
Zantac	tablet	150 mg	0.566	0.514	0.613	0.354					0.657	0.522		
Zantac	tablet	300 mg	0.527	0.530	0.563	0.359					0.607	0.517		
Zantac	liquid	300 mg									0.561			
Zantac	liquid	150 mg									0.620	0.679		
Zantac	powder	150 mg											0.554	0.591
Zantac	vial	25 mg									0.342	0.636		
Risperdal	tablet	2 mg											0.646	0.536
Risperdal	tablet	3 mg											0.775	0.677
Risperdal	tablet	4 mg											0.764	0.674
Risperdal	liquid	1 mg								0.313		0.330		0.076
Zocor	tablet	5 mg									0.692	0.453		
Zocor	tablet	10 mg	0.629	0.622			0.496	0.621			0.898	0.740	0.579	0.537
Zocor	tablet	20 mg	0.595	0.602			0.485	0.364			0.607	0.520	0.531	0.499
Zocor	tablet	40 mg		0.936				0.783				0.656		0.611
Zocor	tablet	80 mg												0.734
Imitrex	tablet	50 mg		0.628				0.371		0.442		0.719		0.501
Imitrex	syringe	6 mg	0.492	0.411			0.403	0.292	0.375	0.259	0.460	0.314		
Imitrex	syringe	12 mg												0.599
Imitrex	liquid	20 mg		0.132						0.101		0.093		
Imitrex	liquid	5 mg										0.514		
Imitrex	vial	6 mg									1.256	0.743		
Effexor	tablet	75 mg		1.132				1.165		0.936	1.397	1.091		1.296
Effexor	tablet	37.5 mg		0.738				0.686		0.616	0.760	0.595		0.720
Effexor	tablet	50 mg		0.964				0.871		0.766				0.970
Effexor	capsule	75 mg		0.731				0.657				0.570		
Effexor	capsule	150 mg		1.120				1.212						
Effexor	capsule	37.5 mg										0.321		
		count	23	47	9	11	20	37	12	28	36	54	18	36
		average	0.569	0.637	1.349	0.839	0.538	0.625	0.505	0.478	1.049	0.959	0.643	0.660
		st dev	0.245	0.279	1.056	0.685	0.209	0.331	0.144	0.216	1.347	2.974	0.158	0.236
		median	0.566	0.628	0.780	0.497	0.516	0.610	0.531	0.451	0.770	0.564	0.636	0.608

Source: IMS Health

Table 5: Middle-Income Countries Drug Price Comparisons, 1994 and 1998

			Brazilian Price/ US Price		Mexican Price/ US Price		Czech Price/ US Price		Korean Price/ US Price		Thai Price/ US Price		S. African Price/ US Price	
Brand	Form	Strength	1994	1998	1994	1998	1994	1998	1994	1998	1994	1998	1994	1998
Norvasc	tablet	5 mg	0.754	0.852	0.738	0.734	0.639	0.434	0.679	0.415	0.640	0.439	0.690	0.350
Norvasc	tablet	10 mg		0.926			0.599	0.412			0.645	0.455	0.611	0.550
Lipitor	tablet	10 mg		0.610				0.676				0.625		0.517
Lipitor	tablet	20 mg		0.685								0.596		0.503
Pulmicort	powder	200Y		0.503				0.365		0.289		0.240		0.247
Sandimmune	capsule	100 mg		0.908	1.513	1.172			1.137	0.597	1.045	0.219	1.389	0.833
Sandimmune	capsule	25 mg			1.658	1.338			1.134	0.613	1.155	0.371	1.416	0.883
Sandimmune	liquid	100 mg			1.480	1.457					1.083		1.303	1.596
Sandimmune	ampoule	50 mg			1.768	0.565					0.194	0.120		
Neoral	capsule	25 mg		1.078		1.719		0.660		0.946		0.696		0.982
Neoral	capsule	100 mg		1.000		1.639		0.668		0.957		0.703		0.997
Neoral	liquid	100 mg				1.547		0.591				0.650		0.695
Cipro	tablet	100 mg												
Cipro	infusion	200 mg	3.791	3.722			2.053	2.137			1.773	1.637	2.526	1.548
Cipro	infusion	400 mg		2.739								1.092		1.620
Cipro	tablet	250 mg							0.528	0.304				
Cipro	tablet	500 mg							0.989	0.498				
Plendil	tablet	5 mg	0.751	0.898	1.064	0.896								
Plendil	tablet	10 mg	0.821	1.066										
Plendil	tablet	2.5 mg		0.461										
Diflucan	infusion	200 mg												0.336
Lasix	ampoule	20 mg	0.368	0.375	0.339	0.562			0.186	0.098	0.349	0.251	0.375	0.083
Lasix	tablet	20 mg			0.178	0.308							1.843	1.279
Lasix	tablet	40 mg	0.633	0.668	0.323	0.474			0.462	0.306	0.475	0.301	2.111	1.086
Lasix	tablet	80 mg											2.733	2.055
Lasix	liquid	10 mg	0.129	0.086	0.144								0.695	0.610
Zoladex	syringe	3.6 mg	1.027	0.815	0.846	0.974								
Atrovent	liquid	0.03%						0.148		0.001				
Claritin	tablet	10 mg	0.327	0.349			0.259	0.170			0.177	0.141	0.304	0.380
Claritin	liquid	1 mg						0.153						
Cozaar	tablet	50 mg				0.908		1.008				0.849		0.812
Seloken	tablet	50 mg		0.645										
Seloken	tablet	100 mg	0.259	0.288	0.573	0.398	0.285	0.223	0.345	0.177	0.360	0.211		
Seloken	tablet	200 mg	0.227	0.183							0.271			
Zyprexa	tablet	5 mg		0.669				0.495		0.555		0.673		0.419
Zyprexa	tablet	10 mg		0.884				0.656		0.606		0.727		0.547
Zyprexa	tablet	7.5 mg						0.693		0.740				
Prilosec	capsule	10 mg		0.473		0.325		0.236						0.274
Prilosec	capsule	20 mg	0.912	0.808	0.707	0.549	0.504	0.404	0.748	0.408	0.551	0.379	0.610	0.400
Prilosec	capsule	40 mg		0.961		0.727								0.546
Pravachol	tablet	10 mg	0.955	0.732	1.043	0.896		0.380					0.603	0.420
Pravachol	tablet	20 mg		0.967	1.811	1.588		0.494					0.941	0.598
Pravachol	tablet	40 mg												0.392
Zantac	tablet	150 mg	0.311	0.378	0.257	0.190	0.262	0.203	0.528	0.300	0.475	0.337	0.615	0.389
Zantac	tablet	300 mg	0.339	0.446	0.280	0.210	0.288	0.281	0.668	0.312	0.457	0.313	0.830	0.504
Zantac	tablet	150 mg						0.228					0.560	0.257
Zantac	tablet	300 mg											0.598	0.348
Risperdal	tablet	1 mg			0.455	0.275								
Risperdal	tablet	2 mg			0.547	0.333								
Risperdal	tablet	3 mg			0.657	0.419								
Risperdal	tablet	4 mg												

Risperdal	liquid	1 mg		0.406										0.225
Zoloft	tablet	50 mg	0.733	0.759				0.414	0.720	0.446		0.489		
Zoloft	tablet	100 mg						0.872						
Zocor	tablet	5 mg		0.512		0.524						0.411		
Zocor	tablet	10 mg	0.561	0.638	0.959	0.818	0.719	0.550		0.425	0.866	0.583	1.069	0.793
Zocor	tablet	20 mg		0.645	1.064	0.926	0.607	0.402				0.364	0.387	0.285
Zocor	tablet	40 mg		0.957										0.583
Imitrex	tablet	50 mg		0.265		0.326				0.287		0.251		
Imitrex	syringe	6 mg	0.279	0.210	0.410	0.228		0.320				0.246	0.471	0.226
Imitrex	liquid	20 mg				0.002								0.089
Effexor	tablet	75 mg		1.177		1.226		1.189						0.830
Effexor	tablet	37.5 mg		0.884		0.755		0.720						0.456
Effexor	tablet	50 mg		0.905		0.875								0.577
Effexor	capsule	75 mg				0.739								
Effexor	capsule	150 mg				1.199								
		count	18	41	23	36	10	30	12	21	16	29	22	42
		average	0.732	0.793	0.818	0.773	0.621	0.539	0.677	0.442	0.657	0.496	1.031	0.646
		st dev	0.814	0.632	0.528	0.464	0.533	0.395	0.296	0.246	0.429	0.318	0.703	0.441
		median	0.597	0.685	0.707	0.737	0.551	0.424	0.674	0.415	0.513	0.411	0.692	0.531

Source: IMS Health

Table A

		a	b
	Dependent Var:	log P	log P
Regressors:			
	log Gini	0.712***	-
		{4.018}	
	(Log Gini)^2	-	0.192***
			{4.018}
	D98	0.081	0.081
		{1.317}	{1.317}
Country Dummies	UK	-0.709***	-0.625***
		{-5.502}	{-4.759}
	Japan	-0.368**	-0.063
		{-2.005}	{-0.283}
	Italy	-0.735***	-0.48**
		{-4.739}	{-2.55}
	Spain	-0.958***	-0.806***
		{-6.714}	{-5.229}
	Brazil	-0.799***	-1.089***
		{-4.785}	{-5.158}
	Mexico	-0.936***	-1.118***
		{-5.986}	{-6.287}
	Czech Rep.	-0.404**	-0.11
		{-2.505}	{-0.538}
	Canada	-0.36***	-0.188
		{-2.613}	{-1.229}
	Korea	-0.743***	-0.574***
		{-4.376}	{-3.146}
	Thailand	-1.218***	-1.228***
		{-8.011}	{-8.054}
	South Africa	-1.05***	-1.343***
		{-6.483}	{-6.459}
	Sweden	-0.454***	-0.152
		{-2.846}	{-0.74}
Drug Dummies (ATC1)	A	-1.719***	-1.719***
		{-2.628}	{-2.628}
	C	-2.506***	-2.506***
		{-3.854}	{-3.854}
	G	-3.415***	-3.415***
		{-5.004}	{-5.004}
	J	-0.302	-0.302
		{-0.462}	{-0.462}
	L	0.007	0.007
		{0.011}	{0.011}
	N	-1.508**	-1.508**
		{-2.314}	{-2.314}
	R	-3.837***	-3.837***
		{-5.898}	{-5.898}
	constant	-	-
	No. obs.	1895	1895
	R2	0.5155	0.5155
	Adj. R2	0.5101	0.5101
	F-statistic	94.96	94.96
		{0.00}	{0.00}

Numbers in brackets are t-statistics
*** significant at 1% level
** significant at 5% level
* significant at 10% level

		a	b
	Dependent Var:	log P	log P
Regressors:			
	log Top	0.688***	-
		{4.018}	
	(log Top)^2	-	0.179***
			{4.018}
	D98	0.081	0.081
		{1.317}	{1.317}
Country Dummies	UK	-0.744***	-0.693***
		{-5.772}	{-5.365}
	Japan	-0.539***	-0.371**
		{-3.119}	{-2.026}
	Italy	-0.852***	-0.694***
		{-5.806}	{-4.36}
	Spain	-1.022***	-0.929***
		{-7.274}	{-6.448}
	Brazil	-0.745***	-0.973***
		{-4.628}	{-5.083}
	Mexico	-0.902***	-1.047***
		{-5.878}	{-6.221}
	Czech Rep.	-0.565***	-0.4**
		{-3.808}	{-2.475}
	Canada	-0.429***	-0.32**
		{-3.189}	{-2.284}
	Korea	-0.811***	-0.701***
		{-4.84}	{-4.077}
	Thailand	-1.236***	-1.266***
		{-8.086}	{-8.188}
	South Africa	-1.014***	-1.264***
		{-6.428}	{-6.519}
	Sweden	-0.599***	-0.411**
		{-4.083}	{-2.494}
Drug Dummies (ATC1)	A	-1.719***	-1.719***
		{-2.628}	{-2.628}
	C	-2.506***	-2.506***
		{-3.854}	{-3.854}
	G	-3.415***	-3.415***
		{-5.004}	{-5.004}
	J	-0.302	-0.302
		{-0.462}	{-0.462}
	L	0.007	0.007
		{0.011}	{0.011}
	N	-1.508**	-1.508**
		{-2.314}	{-2.314}
	R	-3.837***	-3.837***
		{-5.898}	{-5.898}
	constant	-	-
	No. obs.	1895	1895
	R2	0.5155	0.5155
	Adj. R2	0.5101	0.5101
	F-statistic	94.96	94.96
		{0.00}	{0.00}

Table B: Richest Quintile