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Inequality and Pharmaceutical Drug Prices: An Empirical Exercise

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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.

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

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

[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.

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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

[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

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.

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

[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).

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

[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 tha lu-10.9(5)1..5(r b29.5(po)9.5(oveodnd W)nsidumpon ofrequir are minimumncome, lelop The g)ice coelaillc

[22]Ballance et al (1992).
[23]Source?

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where p_{ij} is the price of drug product *i* in country *j*, $j=\{1,...,K\}$. *G* is the Gini coefficient, defined

[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.

[redacted]

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

[26] This figure is calculated as: 2 $_1$(logG) =2(.19)(3.588), where (logG) 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.9(co)-5ttr.4(9s)5eachplac the rich8.1iftte sAs income share of the ripor in e0(T0.00007 Tc80.

[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 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 Coso be

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WHO.

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)

[redacted]

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

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

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