A comparative analysis of medicine prices in Latin America[1]

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Abstract

This paper compares medicine prices in the six largest economies in Latin America. Using a panel-based econometric model with country fixed effects and controlling for variables related to the medicines' characteristics, the comparison covers 19,741 units sold during the 2010–2015 period and has been carried out at the wholesale and retail levels and by type of medication (innovative, branded generic and generic). At the aggregate level and at the retail pharmacy level, the classification from least to most expensive is: Peru, Mexico, Argentina, Chile, Colombia and Brazil. In innovative medicines, Argentina and Peru have the lowest prices. In branded generic medicines, Mexico and Argentina have the lowest prices, while for pure generics, Peru and Chile appear to be the least expensive. The classification does not change substantially if ex-factory prices are compared.

Keywords

Pharmaceutical industry, pharmaceuticals, prices, comparative analysis, econometric models, statistical data, Latin America

JEL classification

L16, L65

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I. Introduction

This paper compares medicine prices in different Latin American countries. Pharmaceuticals are a not inconsiderable proportion of health spending and as such is an issue that has been analysed by international organizations in order to facilitate the population's access to these products.[2]

This comparative price analysis covers the largest economies in the region: Argentina, Brazil, Chile, Colombia, Mexico and Peru. We compare the prices of all medicines and also disaggregate them by category. We use the category classifications commonly employed in the sector: innovative, branded generic and pure generic. In Latin America, unlike the United States and Europe, there is a significant presence of branded generic medicines in the market. Therefore, it is appropriate to include such medicines in the analysis as a special category.

The data were provided by IMS Health (now known as IQVIA). A panel of monthly observations made between October 2010 and November 2015 was used, corresponding to a total of 19,741 units sold in the six countries examined. A panel-based econometric model with country fixed effects was used, controlling for the variables related to products' selling format, to obtain a classification of countries by prices. The statistics provided by IMS Health allow comparisons to be made at the wholesale level —meaning ex-factory sales— and at the retail level.

Price comparison or benchmarking studies are useful as they underpin countries' policies on access to medicines. Economies with pharmaceutical price regulation mechanisms —such as Brazil and Colombia— rely on international comparisons to set price limits. In that regard, this study contributes on multiple fronts. Firstly, the econometric specification used takes advantage of the panel's extensive data on the variety and number of units of medicines sold in each country and their selling format. Secondly, the comparison is performed at different stages of the production chain and also by type of medicine.

The results are described below. In terms of ex-factory sales for all medicines, the classification of countries, from the least to most expensive, is as follows: Argentina, Peru, Mexico, Chile, Colombia and Brazil. In innovative products, Argentina appears as the least expensive country and Brazil the second least. In branded generics, Argentina is found to have the lowest prices, followed by Mexico. Lastly, in pure generics, Peru is the least expensive country, followed by Chile. The relative positions of the countries do not change substantially when retail prices are compared.

The classification of prices should be interpreted as the country effect on the price, which is obtained by comparing products that are as similar as possible. Therefore, in the comparative analysis, controls are applied for various factors, other than country of sale or manufacture, that affect prices.

The price differences detected that are attributable to the country effect can have various causes, including input costs, tariff barriers, taxes, industry regulations, participants' market power or consumer preferences. This paper only compares prices among countries, without assessing the factors that could explain these differences. It is one of the first studies to use a sample of several countries over an extended period of time. In addition, a large group of variables relating to the medicines' characteristics are controlled for in the comparisons.

The paper is structured as follows: section II describes the data used in the analysis. Section III outlines the econometric methodology. The results are presented in section IV, both by type of pharmaceutical and by stage in the value chain. Lastly, section V contains the conclusions.

[2] According to OECD (2011), medical goods account for 19% of total health spending in OECD countries, on average.

II. Data

The data on prices and other product characteristics were provided by IMS Health, a company specialized in gathering key information in the health sector worldwide and the main source of data for medicine price studies, as well as for the commercial management of market participants. The period studied covers the 60 months from October 2010 to November 2015.

The comparison was made by selecting 80% of the best-selling oral solid molecules in Chile. The sample contains 118 different molecules, of which 103 were available in the six countries for at least one month of the study period. The term "molecule" refers to the set of active ingredients in a single tablet, capsule or other dosage format, marketed under a brand name or as a generic.

IMS Health's price data are collected at different points in the production chain in the countries analysed. A proper comparison must be made between prices at the same stage, at the vertical level. To obtain the prices, both retail and ex-factory, the factors recommended by IMS Health for each country were used, which are considered invariable over time.[3] For the retail market, information is obtained at the pharmacy level, and therefore excludes purchases made and allocated to patients through the public health system.

For the Chilean market, differentiated factors were used for prescription medicines, over-the-counter (OTC) and generic medicines. Differentiated factors were also used for direct sales, through one of the three pharmacy chains, and indirect sales, through independent pharmacies. Table 1 shows the factors used in each country to obtain the retail and ex-factory prices.

Table 1
Latin America (6 countries): price conversion factors

Country	Factor Retail price		Factor Ex-factory price
Argentina	1.5125		0.87
Brazil	1.3574		0.85
Colombia	1.3300		0.92
Mexico	1.2150		0.84
Peru	1.2000		0.89
	Direct sales	Indirect sales	
Chile			1.00
Prescription	1.428	1.671	
OTC	1.618	1.733	
Generic	1.761	1.779	

Source: Prepared by the authors, on the basis of data from IMS Health.

To apply each factor, we have details of direct and indirect sales for each medicine as of October 2015. Based on this, percentages sold through each channel were calculated for each product and this percentage was applied for all the periods. It has been assumed for each product that the percentage sold through each channel does not vary over time.

The quantity data corresponds to normal units, representing the number of packs sold in the month, and standard units, representing the quantity of pills. For the purposes of this study, unit retail prices are calculated by dividing the dollar price into standard units.

[3] The factors recommended by IMS Health, estimated on the basis of its knowledge of local wholesale and retail markets and the margins applied by the various segments, are an imperfect but useful substitute for measurement at the same stage of the production chain.

The database contains information on a number of variables relating to the products' characteristics that may affect their selling price. Using these variables allows us to isolate the country effect from other factors that may influence the pharmaceuticals' price. The following characteristics are taken into account.

Firstly, the format, as the active ingredient of the medicine can be presented in coated tablets, capsules, special formats, tablets, powders and ointments. The total sample includes only the solid formats. Table 2 shows distribution by country. For all the countries except Brazil, tablets accounted for the majority of the products analysed.

Table 2
Latin America (6 countries): format by country, total sample

	Argentina	Brazil	Chile	Colombia	Mexico	Peru	Total
Capsules	547	783	382	625	931	330	3 598
Special	0	2	1	1	0	1	5
Coated tablets	1 739	2 056	873	738	459	722	6 587
Tablets	2 077	1 633	895	1 585	2 485	876	9 551
Total	4 363	4 474	2 151	2 949	3 875	1 929	19 741

Source: Prepared by the authors, on the basis of data from IMS Health.

Regarding classification by type of medication, the information provided by IMS Health allows for division into innovative, branded generic, and generic medicines. The term "innovative" refers to originator medicines, first marketed under patent, regardless of whether the patent remains valid. Branded generic products have the same active ingredient as the innovative medicines, but are sold under a different trademark. Lastly, generic medication is sold under the name of the compound or active ingredient it contains.

The original database contains the categories "generic", "branded generics" and "branded". According to IMS Health, the "branded" category contains both branded generics and innovative medicines. To differentiate between the two types of pharmaceuticals, we divided the "branded" category by classifying branded products from national laboratories as branded generics and products from multinational laboratories as innovative products. This was done because the data used does not allow us to identify the national laboratories that have patents, so an approximation has been used. According to the information provided by IMS Health, 98% of the innovative products come from multinational laboratories.[4] Table 3 shows the distribution by type of medication. As can be seen, products classified as branded generics predominate in the total sample, and in each country.

Table 3
Latin America (6 countries): types of medication by country, total sample

	Argentina	Brazil	Chile	Colombia	Mexico	Peru	Total
Innovative	654	449	426	828	823	388	3 568
Branded generic	3 200	2 299	1 592	1 153	1 768	1 096	11 108
Generic	509	1 726	133	968	1 284	445	5 065
Total	4 363	4 474	2 151	2 949	3 875	1 929	19 741

Source: Prepared by the authors, on the basis of data from IMS Health.

The medicines come in different formats; this may be a factor behind price differences for the same pharmaceutical. The sample includes 1,114 types of packaging; one example is the 10 mg x 30 pack. Table 4 shows the number of observations, different molecules and different forms of packaging by country. As the table illustrates, there is a great variety in all the countries.

[4] The list of multinational and national laboratories was also provided by IMS Health.

Table 4
Latin America (6 countries): packaging formats

	Observations	Molecules	Packaging
Argentina	4 363	114	492
Brazil	4 474	109	581
Chile	2 151	117	401
Colombia	2 949	112	467
Mexico	3 875	112	489
Peru	1 929	110	371
Total	19 741	674	2 801

Source: Prepared by the authors, on the basis of data from IMS Health.

Table 5 shows the number of instances when packaging types were the same in different countries. The numbers indicate how many forms of packaging are the same in the different country and the diagonal shows the total number of different packaging formats in each country. As shown, there is a significant degree of overlap, which is useful for the comparison of prices among countries. For example, of the 492 types of packaging that exist in Argentina, more than half are available in the other countries analysed.

Table 5
Latin America (6 countries): packaging matches between countries, total sample

	Argentina	Brazil	Chile	Colombia	Mexico	Peru
Argentina	492	291	249	266	278	239
Brazil		581	244	286	275	233
Chile			401	226	236	203
Colombia				467	269	238
Mexico					489	236
Peru						371

Source: Prepared by the authors, on the basis of data from IMS Health.

III. Methodology

One of the main shortcomings of straightforward price comparisons is that medicines have very heterogeneous characteristics. This situation becomes even more complicated when comparing prices between countries and over time. The specialized literature indicates that product prices may differ among countries for various reasons: for example, owing to differences in the unit of measurement or type of packaging (Cameron and others, 2009; Danzon and Furukawa, 2011).

It is therefore necessary to control for the largest possible number of characteristics, to achieve a better comparison. In our study, this is possible because there is a wealth of information available on the characteristics of the medicines described in the preceding section. The following equation was used to determine whether there are price differences among countries for similar products:

$$LogP_{mct} = \delta_c + \delta_t + \sum_{k=1}^{K} \beta_k X_{km} + \varepsilon_{mct}$$

where P is the price of the molecule,[5] c is the country and t is time. δ_c is a specific country fixed effect that captures the price differences among countries, defined as a categorical variable with a value of 1 if the molecule is sold in country c and 0 if it is not. These price differences are obtained after controlling for time effect variables (δ_t) and the variables relating to the characteristics of the molecules (summarized in vector X).

[5] Prices are expressed in United States dollars, as a common unit.

Vector X is composed of a set of categorical variables defined by molecule (more than 100 different molecules per country), format (coated pills, capsules, special and tablets), the medicine's effect (immediate or delayed), packaging (more than 1,000 varieties) and type (innovative, branded generic and generic). In all cases, a base category is excluded from the estimate. Given the large number of parameters associated with these categorical variables, the parameters do not appear in the results tables.

The price differences captured by the country fixed effects summarize everything that affects prices and varies between countries. Examples include differences in margins, taxes and preferences, which are assumed not to change over time. For the purposes of this study, given the short time period analysed, this assumption is considered reasonable.[6]

The specific country fixed effect is interpreted as the percentage price difference —since the price is expressed in logarithm— of country c compared to that used as a reference, which in our estimates is Argentina.[7]

Tables 6A and 6B show the descriptive statistics of the prices (logarithm of dollar prices) used in the estimates, as well as the number of observations available. For both the retail price and the ex-factory price, the highest averages are in Chile, surpassed only by Colombia. Figures 1 and 2 plot movements in average retail and ex-factory prices over time, showing a downward trend and convergence towards smaller differences at the end of the period analysed.

Table 6
Latin America (6 countries): descriptive statistics of the logarithm of the unit price
(Logarithm of United States dollar prices)

A. Retail

Country	Observations	Mean	Standard deviation	Minimum	Maximum
Argentina	192 676	1.42	3.97	0	301.7
Brazil	181 698	1.76	3.73	0.0034	149.3
Chile	87 802	1.88	4.21	0.006	111.4
Colombia	123 974	2.75	6.85	0.006	144.4
Mexico	131 903	1.66	4.23	$7.59x10^{-6}$	162.7
Peru	75 879	1.58	4.95	0.0000286	173.1

Source: Prepared by the authors, on the basis of data from IMS Health.

B. Ex-factory

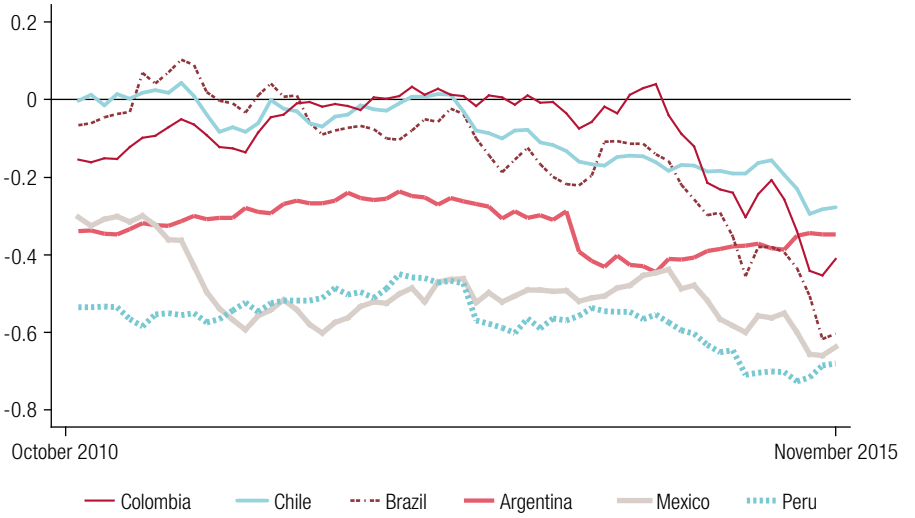
Country	Observations	Mean	Standard deviation	Minimum	Maximum
Argentina	192 676	-0.88	1.07	-9.58	5.16
Brazil	181 698	-0.61	1.13	-6.16	4.54
Chile	92 551	-0.49	1.195	-5.69	4.35
Colombia	123 974	-0.46	1.61	-5.48	4.60
Mexico	131 903	-0.87	1.57	-12.16	4.72
Peru	75 879	-0.87	1.52	-10.76	4.85

Source: Prepared by the authors, on the basis of data from IMS Health.

[6] We reviewed these countries for substantive regulatory changes and found no evidence of such changes.

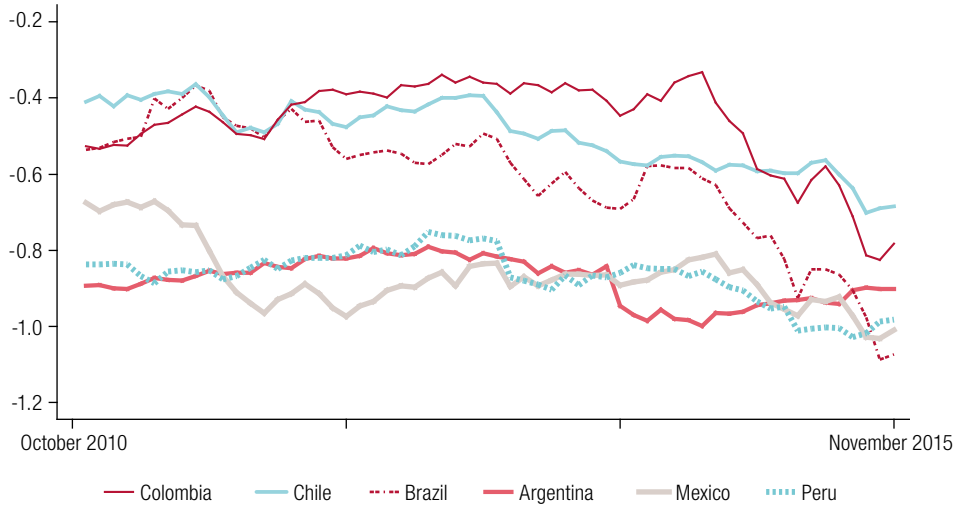
[7] Argentina was chosen as it is first in the alphabetical order. The choice of base country does not change the results of the estimate, it only changes the interpretation of the parameter.

Figure 1
Latin America (6 countries): retail prices of medicines, October 2010–November 2015
(Logarithm of the unit price in United States dollars)



Source: Prepared by the authors, on the basis of data from IMS Health.

Figure 2
Latin America (6 countries): ex-factory prices of medicines, October 2010–November 2015
(Logarithm of unit price in United States dollars)



Source: Prepared by the authors, on the basis of data from IMS Health.

IV. Results

The price equation was estimated for the whole sample at two points in the chain —ex-factory and retail— and for the three types of medication mentioned. The econometric results for the total sample are shown in table 7 for ex-factory prices and in table 8 for retail prices. The control variables relating to the characteristics of the products have been entered into columns (1) to (5). Column (5) includes all the control variables.

Table 7
Latin America (6 countries): ex-factory prices at the aggregate level

Variables	(1)	(2)	(3)	(4)	(5)
Brazil	0.267***	0.359***	0.368***	0.323***	0.539***
	(0.000870)	(0.00187)	(0.00478)	(0.0131)	(0.0940)
Chile	0.387***	0.255***	0.255***	0.237***	0.201***
	(0.000482)	(0.0205)	(0.0217)	(0.0259)	(0.0219)
Colombia	0.419***	0.371***	0.392***	0.394***	0.451***
	(0.000370)	(0.0171)	(0.0211)	(0.0232)	(0.0807)
Mexico	0.0107***	0.112**	0.157**	0.123*	0.148*
	(0.00152)	(0.0417)	(0.0503)	(0.0559)	(0.0695)
Peru	0.0140***	-0.0692**	-0.0585**	0.104	0.111
	(0.000457)	(0.0172)	(0.0170)	(0.0535)	(0.0567)
Constant	-0.836***	-1.115**	-0.946**	-0.700**	-1.379**
	(0.0353)	(0.291)	(0.321)	(0.261)	(0.375)
Observations	798 681	798 681	798 681	798 681	798 681
R-squared	0.021	0.554	0.568	0.680	0.751
Time	Yes	Yes	Yes	Yes	Yes
Molecules	No	Yes	Yes	Yes	Yes
Format	No	No	Yes	Yes	Yes
Effect	No	No	Yes	Yes	Yes
Packaging	No	No	No	Yes	Yes
Type	No	No	No	No	Yes

Source: Prepared by the authors, on the basis of data from IMS Health.
Note: Standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1.

Table 8
Latin America (6 countries): retail prices at the aggregate level

Variables	(1)	(2)	(3)	(4)	(5)
Brazil	0.182***	0.272***	0.281***	0.238***	0.451***
	(0.000877)	(0.00137)	(0.00524)	(0.0133)	(0.0930)
Chile	0.236***	0.0966***	0.0959***	0.0724**	0.0369
	(0.00127)	(0.0220)	(0.0234)	(0.0259)	(0.0216)
Colombia	0.235***	0.186***	0.206***	0.209***	0.265**
	(0.000372)	(0.0163)	(0.0205)	(0.0233)	(0.0802)
Mexico	-0.173***	-0.0725	-0.0277	-0.0620	-0.0384
	(0.00154)	(0.0419)	(0.0504)	(0.0562)	(0.0693)
Peru	-0.240***	-0.323***	-0.312***	-0.150**	-0.145*
	(0.000457)	(0.0175)	(0.0173)	(0.0540)	(0.0567)
Constant	-0.281***	-0.571	-0.402	-0.167	-0.837*
	(0.0360)	(0.283)	(0.314)	(0.255)	(0.372)
Observations	793.932	793.932	793.932	793.932	793.932
R-squared	0.021	0.555	0.569	0.680	0.751
Time	Yes	Yes	Yes	Yes	Yes
Molecules	No	Yes	Yes	Yes	Yes
Format	No	No	Yes	Yes	Yes
Effect	No	No	Yes	Yes	Yes
Packaging	No	No	No	Yes	Yes
Type	No	No	No	No	Yes

Source: Prepared by the authors, on the basis of data from IMS Health.
Note: Standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1.

In the case of ex-factory medicine prices (table 7), in Chile the prices are higher overall than in Argentina, with a difference of nearly 20% that has been stable over time. Prices in Chile are also higher than those in Mexico and Peru, but lower than in Colombia and Brazil. In retail prices (table 8), the results are quite similar: Chile does not have retail medicine prices that are statistically different to those in Argentina, which is the base country, but its retail prices are higher than those in Mexico and Peru. Again, prices in Chile appear to be lower than those in Colombia and Brazil.

Fisher's exact test was applied to determine whether the differences in the rankings are statistically significant. The results indicate that in the total sample for ex-factory prices, Chile is not statistically less or more expensive than Mexico or Peru (see annex 1). With respect to retail prices in the total sample, Chile's position does not appear to differ from that of Colombia or Mexico.

Tables 9–14 show the results by type of medication, broken down into innovative, branded generics and generics. For innovative medicines, the estimates indicate that Argentina has the lowest prices, well below those countries that are ranked second and third: Brazil and Chile in ex-factory, and Peru and Chile in retail prices. For branded generics, Argentina and Mexico have the lowest average prices in both the wholesale and retail markets, although retail prices in Mexico are 12% below those in Argentina. Lastly, for generic medicines, Peru has the lowest retail prices, followed by Chile, and the two countries share the lowest ex-factory prices in the comparison.

Table 9
Latin America (6 countries): ex-factory prices for innovative medicines

Variables	(1)	(2)	(3)	(4)
Brazil	0.695***	0.595***	0.580***	0.534***
	(0.000681)	(0.0240)	(0.0232)	(0.0254)
Chile	0.787***	0.685***	0.675***	0.625***
	(0.000932)	(0.0331)	(0.0314)	(0.0346)
Colombia	1.091***	1.087***	1.101***	1.034***
	(0.000915)	(0.0306)	(0.0299)	(0.0283)
Mexico	0.781***	0.750***	0.768***	0.717***
	(0.00129)	(0.0314)	(0.0327)	(0.0279)
Peru	0.738***	0.679***	0.678***	0.644***
	(0.00172)	(0.0265)	(0.0248)	(0.0239)
Constant	-0.633***	-1.314**	-1.330**	-0.843**
	(0.0269)	(0.365)	(0.360)	(0.223)
Observations	161 925	161 925	161 925	161 925
R-squared	0.088	0.772	0.783	0.875
Time	Yes	Yes	Yes	Yes
Molecules	No	Yes	Yes	Yes
Format	No	No	Yes	Yes
Effect	No	No	Yes	Yes
Packaging	No	No	No	Yes

Source: Prepared by the authors, on the basis of data from IMS Health.
Note: Standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1.

Table 10
Latin America (6 countries): retail prices for innovative medicines

Variables	(1)	(2)	(3)	(4)
Brazil	0.610***	0.510***	0.495***	0.448***
	(0.000682)	(0.0240)	(0.0232)	(0.0258)
Chile	0.619***	0.503***	0.492***	0.440***
	(0.000370)	(0.0336)	(0.0318)	(0.0351)
Colombia	0.906***	0.903***	0.917***	0.850***
	(0.000915)	(0.0305)	(0.0299)	(0.0283)
Mexico	0.597***	0.566***	0.584***	0.533***
	(0.00129)	(0.0313)	(0.0327)	(0.0282)
Peru	0.484***	0.425***	0.423***	0.389***
	(0.00172)	(0.0265)	(0.0248)	(0.0238)
Constant	-0.0767**	-0.765*	-0.780*	-0.294
	(0.0274)	(0.362)	(0.358)	(0.225)
Observations	161 218	161 218	161 218	161 218
R-squared	0.063	0.765	0.776	0.871
Time	Yes	Yes	Yes	Yes
Molecules	No	Yes	Yes	Yes
Format	No	No	Yes	Yes
Effect	No	No	Yes	Yes
Packaging	No	No	No	Yes

Source: Prepared by the authors, on the basis of data from IMS Health.
Note: Standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1.

Table 11
Latin America (6 countries): ex-factory prices for branded generic medicines

Variables	(1)	(2)	(3)	(4)
Brazil	0.0768***	0.278***	0.290***	0.240***
	(0.000242)	(0.0164)	(0.0154)	(0.00952)
Chile	0.366***	0.266***	0.265***	0.259***
	(0.000664)	(0.0185)	(0.0191)	(0.0363)
Colombia	0.847***	0.725***	0.717***	0.681***
	(0.00144)	(0.0313)	(0.0375)	(0.0303)
Mexico	0.00591**	0.0917*	0.0997**	0.0678*
	(0.00201)	(0.0378)	(0.0385)	(0.0272)
Peru	0.363***	0.242***	0.244***	0.326***
	(0.00110)	(0.0161)	(0.0181)	(0.0228)
Constant	-0.839***	-0.969***	-0.859***	-0.464**
	(0.0198)	(0.189)	(0.204)	(0.173)
Observations	447 017	447 017	447 017	447 017
R-squared	0.056	0.628	0.635	0.748
Time	Yes	Yes	Yes	Yes
Molecules	No	Yes	Yes	Yes
Format	No	No	Yes	Yes
Effect	No	No	Yes	Yes
Packaging	No	No	No	Yes

Source: Prepared by the authors, on the basis of data from IMS Health.
Note: Standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1.

Table 12
Latin America (6 countries): retail prices for branded generic medicines

Variables	(1)	(2)	(3)	(4)
Brazil	0.00817***	0.190***	0.202***	0.155***
	(0.000246)	(0.0156)	(0.0146)	(0.0102)
Chile	0.205***	0.0999***	0.0991***	0.0867*
	(0.00160)	(0.0179)	(0.0188)	(0.0374)
Colombia	0.662***	0.539***	0.532***	0.497***
	(0.00146)	(0.0305)	(0.0373)	(0.0307)
Mexico	-0.178***	-0.0926*	-0.0841*	-0.117***
	(0.00203)	(0.0378)	(0.0386)	(0.0272)
Peru	0.109***	-0.0113	-0.00915	0.0703**
	(0.00110)	(0.0167)	(0.0188)	(0.0231)
Constant	-0.285***	-0.421*	-0.313	0.0700
	(0.0210)	(0.186)	(0.203)	(0.184)
Observations	443 149	443 149	443 149	443 149
R-squared	0.042	0.623	0.630	0.744
Time	Yes	Yes	Yes	Yes
Molecules	No	Yes	Yes	Yes
Format	No	No	Yes	Yes
Effect	No	No	Yes	Yes
Packaging	No	No	No	Yes

Source: Prepared by the authors, on the basis of data from IMS Health.
Note: Standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1.

Table 13
Latin America (6 countries): ex-factory prices for generic medicines

Variables	(1)	(2)	(3)	(4)
Brazil	0,808***	0,450***	0,440***	0,456***
	(0,00392)	(0,0655)	(0,0697)	(0,0272)
Chile	-1,181***	-1,164***	-1,168***	-1,236***
	(0,00332)	(0,0181)	(0,0212)	(0,0357)
Colombia	-0,382***	-0,650***	-0,663***	-0,671***
	(0,00107)	(0,0412)	(0,0424)	(0,0316)
Mexico	-0,432***	-0,569***	-0,571***	-0,587***
	(0,00518)	(0,0173)	(0,0215)	(0,0342)
Peru	-1,173***	-1,449***	-1,454***	-1,278***
	(0,00173)	(0,0286)	(0,0313)	(0,0621)
Constant	-1,366***	-1,644***	-1,504***	-0,945*
	(0,0300)	(0,218)	(0,142)	(0,426)
Observations	189 739	189 739	189 739	189 739
R-squared	0,242	0,700	0,702	0,796
Time	Yes	Yes	Yes	Yes
Molecules	No	Yes	Yes	Yes
Format	No	No	Yes	Yes
Effect	No	No	Yes	Yes
Packaging	No	No	No	Yes

Source: Prepared by the authors, on the basis of data from IMS Health.
Note: Standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1.

Table 14
Latin America (6 countries): retail prices for generic medicines

Variables	(1)	(2)	(3)	(4)
Brazil	0.723***	0.364***	0.354***	0.370***
	(0.00391)	(0.0651)	(0.0692)	(0.0266)
Chile	-1.160***	-1.161***	-1.165***	-1.239***
	(0.00409)	(0.0176)	(0.0204)	(0.0349)
Colombia	-0.566***	-0.835***	-0.848***	-0.857***
	(0.00107)	(0.0410)	(0.0421)	(0.0314)
Mexico	-0.616***	-0.753***	-0.756***	-0.774***
	(0.00517)	(0.0171)	(0.0208)	(0.0337)
Peru	-1.427***	-1.703***	-1.709***	-1.534***
	(0.00173)	(0.0286)	(0.0313)	(0.0619)
Constant	-0.812***	-1.091***	-0.952***	-0.386
	(0.0298)	(0.218)	(0.141)	(0.421)
Observations	189 565	189 565	189 565	189 565
R-squared	0.267	0.709	0.712	0.802
Time	Yes	Yes	Yes	Yes
Molecules	No	Yes	Yes	Yes
Format	No	No	Yes	Yes
Effect	No	No	Yes	Yes
Packaging	No	No	No	Yes

Source: Prepared by the authors, on the basis of data from IMS Health.
Note: Standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1.

The scope of this study does not extend to explaining the causes of price differences among the countries. Nonetheless, we will compare our results to the price control policies of the sample countries. The countries with both the highest ex-factory and retail prices —Brazil and Colombia— are also the only ones with formal medicine price regulation mechanisms. If we focus on innovative products, which are more susceptible to regulation because they face less competition, Colombia appears the most expensive in both stages of the vertical chain. However, Brazil's position improves substantially, making it the second least expensive after Argentina in terms of ex-factory prices and third in retail.

Since 2003, Brazil has had a system under which the price of regulated pharmaceuticals cannot exceed the lowest price in a group of benchmark countries.[8] In Colombia, which medicines are regulated is determined based on considerations concerning competition, which is measured in terms of concentration in the respective market. International reference price (IRP) is then calculated for each medicine based on a sample of 16 countries, including economies of the Organization for Economic Cooperation and Development (OECD) and from Latin America. The maximum regulated price is equivalent to the twenty-fifth percentile of the lowest sample prices.[9]

The observed relationship between high prices and price regulation policies may seem counter-intuitive. It appears to show that price controls are not achieving the desired effects on the medicines market, or that pharmaceutical companies are reacting in an unexpected way to regulatory regimes. An alternative hypothesis, which is consistent with the results obtained, is that regulation is more necessary in economies where prices tend to be higher.

[8] See Law No. 10.742, which "defines regulatory standards for the pharmaceutical sector, creating the Medication Market Regulation Chamber - CMED", (Presidency of the Republic, 2003). The benchmark countries are Australia, Canada, France, Greece, Italy, New Zealand, Portugal, Spain, the United Kingdom, the United States and the country of origin of the medicine.

[9] See National Committee on Prices of Medicines and Medical Devices (2003).

Furthermore, reference pricing systems affect prices in the countries used as benchmarks. Indeed, if a laboratory wishes to lower the price of a medicine in a certain country that is used as a benchmark by another country, then the laboratory will also be forced to cut the price of its pharmaceutical in the country with regulated prices. Naturally, this reduces the incentives for laboratories to lower prices, since they will have to pass on at least part of the reduction to countries with regulated pricing. A similar pattern occurs with price rises. Price increases in benchmark countries allow laboratories to increase the price of the same medicine in the country that has regulated pricing. This is another possible reason to expect prices in countries with regulated pricing to be lower than those with no medication price controls.

As the data show, the effects of price regulation can be varied and raise interesting research questions. Using the available data, it is difficult to reach a conclusion regarding the impact of regulation on prices, but we believe that this work provides a useful background for future research on this topic.

V. Conclusions

This study compares medicine prices among Argentina, Brazil, Chile, Colombia, Mexico and Peru, both overall and disaggregated by the categories commonly used in the sector: innovative products, branded generics and generics.

A panel of monthly observations made between October 2010 and November 2015 was used, corresponding to a total of 19,741 units sold in the six countries examined, according to data provided by IMS Health. A panel-based econometric model with country fixed effects was used, controlling for the variables related to products' characteristics and selling format, to obtain a classification of the countries by prices. The comparisons are made at the ex-factory and retail levels.

Our results indicate that when ranked by ex-factory prices, at the aggregate level, the order of the countries, from the least to most expensive, is as follows: Argentina, Peru, Mexico, Chile, Colombia and Brazil. In this regard, Chile's position does not differ in statistical terms from that of Mexico. For retail prices, only the order of the least expensive countries changes, with the cheapest being Peru, followed by Mexico and then Argentina, while the rest of the countries maintain their positions. In terms of the magnitude of the price differential, the difference between the most and least expensive countries is 54% in ex-factory sales and 60% in pharmacy sales.

For ex-factory innovative products, Argentina, Brazil and Chile, in that order, have the lowest prices in the sample. For branded generics, Argentina, Mexico and Brazil are the least expensive, while for pure generics, Chile and Peru share the lowest prices, as there is no statistically significant difference in their position. The countries are ranked in the same order when comparing retail prices for the three categories of medicine analysed.

Notably, the two countries with the highest prices at the aggregate level —Brazil and Colombia— are also the countries that have formal medicine price control systems. However, the analysis performed does not allow a causal relationship to be established between the two factors since, as previously mentioned, price differences between countries depend on a number of variables in addition to the regulatory system, such as trade tariffs and the degree of competition among producers and among retailers. However, regulations may be established in response to high prices, thus explaining the correlation between the two.

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Annex A1

Fisher's exact test

The results of the Fisher's exact test for Chile with respect to the rest of the countries, corresponding to each sample, are presented below. To interpret the values, it should be noted that probability values greater than 0.05 do not reject the null hypothesis that the means are statistically equal, with a 95% confidence interval.

For example, for the retail price (table A1.1):

- For the total sample, Chile's coefficient, with a 95% confidence interval, is statistically different from the coefficients of Brazil and Peru, but not from the coefficients of Mexico and Colombia.

Table A1.1
Fisher's exact test of retail prices

Prob > F	Retail price			
Chile	Total sample	Generics	Innovative	Branded generics
Brazil	0.0111	0.0000	0.7455	0.1660
Colombia	0.0546	0.0001	0.0000	0.0002
Mexico	0.4125	0.0000	0.0108	0.0156
Peru	0.0373	0.0162	0.0500	0.5196

Source: Prepared by the authors, on the basis of data from IMS Health.

For the ex-factory price (table A1.2):

- For the total sample, Chile's coefficient, with a 95% confidence interval, is statistically different from the coefficients of Brazil and Colombia, but not from the coefficients of Mexico and Peru.

Table A1.2
Fisher's exact test of ex-factory prices

Prob > F	Ex-factory			
Chile	Total sample	Generics	Innovative	Branded generics
Brazil	0.0244	0.0000	0.0091	0.6673
Colombia	0.0404	0.0000	0.0000	0.0001
Mexico	0.5528	0.0000	0.0104	0.0186
Peru	0.2158	0.6341	0.3485	0.0303

Source: Prepared by the authors, on the basis of data from IMS Health.

The fact that the difference between two coefficients is not statistically significant means that nothing conclusive can be said about this difference. In a classification they could be in the same position since their distributions are not that different.