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Affordability of beer and sugar-sweetened beverages in 15 Latin American countries*

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ABSTRACT

Objective. *The objective of this study was to look at trends in the affordability of beer and sugar-sweetened beverages (SSBs) in 15 Latin American countries.*

Methods. *The data correspond to government statistics on price indices for beer and SSBs, the consumer price index, and the monthly nominal wage index. The methods involved performing an econometric analysis, using time series to measure the expected rate of increase in the absolute affordability indicator (using nominal prices) or the relative affordability indicator (using general prices) for SSBs and beers.*

Results. *In nine of the 15 countries analyzed, the affordability of SSBs or beer (whether absolute or relative) has shown a statistically significant increase. In the case of SSBs, absolute affordability increased in five countries (Chile, Colombia, Costa Rica, Ecuador, and Uruguay) and decreased in Mexico. In the case of beer, it increased in Colombia and Ecuador, remained unchanged in Argentina, Brazil, Chile, Costa Rica, and Uruguay, and dropped in Mexico.*

Conclusions. *Although most countries levy taxes on beer and SSBs, the effect of such taxes on price has not been enough to reduce the affordability of these products in all countries in the sample. Taxes should be modified to make these beverages less affordable and have an impact on their consumption.*

Keywords Health economics; alcoholic drinks; sugar-sweetened beverages; Latin America.

The negative health impacts of consuming alcoholic drinks and sugar-sweetened beverages (SSBs) have been reliably established in the literature. Alcohol use is associated with physical disorders involving damage to various organs (1-3), psychological disorders associated with excessive consumption and violent behavior (4), traffic accidents (5), unwanted pregnancies, and sexually transmitted diseases, among others (6, 7). Recent estimates show that the consumption of pure alcohol per adult in the Region of the Americas is higher than the world average, causing a high burden of disease: 4.7% of deaths and 6.7% of healthy years of life lost (YLL) can be attributed directly to alcohol use (8).

In the case of the SSBs, the situation is similar. Consumption is directly linked to an increase in bodyweight and caloric intake, even beyond the direct effect of these beverages (due to the effects of reduced satiety) (9). Furthermore, it is directly associated with deaths and healthy YLL caused by cardiovascular diseases, cancers, and diabetes. The percentage of healthy YLL directly associated with sugary beverage consumption in Latin America (1.4% of total healthy YLL) is double the world average and is higher than in any other region (10).

Total consumption both of beer and carbonated SSBs (respectively, the alcoholic and sugar-sweetened beverage most consumed in the Region) has grown in per capita terms. Between 2002 and 2016, for example, total beer

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consumption in 13 countries of the Region (Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, the Dominican Republic, Ecuador, Guatemala, Mexico, Peru, Uruguay, and Venezuela) grew at an average annual rate of 2.9%, well above the average annual rate of population growth (1.2%) (11, 12). Only Venezuela saw negative average annual growth in beer consumption; in the rest of the countries the increase ranged from 1.7% (Argentina) to 10.4% (Guatemala).

The average annual consumption of sugar-sweetened beverages in these 13 countries grew at a rate of 1.7% between 2002 and 2016. Only Venezuela had negative average annual growth; among the other countries, Ecuador had the lowest average annual growth (0.03%) and Uruguay had the highest (9%) (11).

As is the case with all goods, two key variables explain consumption of these beverages: their relative price and the real income of consumers. All other things being equal, if these beverages have a higher relative price, this should discourage consumption, while, for normal goods, higher (lower) real consumer income increases the demand for them. If consumer income rises proportionately more than the price of a beverage, its affordability increases (for example, fewer minutes of work are needed to purchase a unit of beverage) and, according to the existing evidence for alcohol (13, 14) and tobacco (15), demand increases. There are no known studies that have measured this effect on sugary beverage consumption, but it seems reasonable to assume that relation is also found for this group of goods.

The magnitude of the relative change in consumption resulting from changes in prices and income depends on price elasticities and income on the demand side. The few studies conducted in Latin America show that alcoholic beverages are inelastic (although price elasticity depends on the specific alcoholic beverage), while SSBs are elastic (16-21). Much less is known about income elasticity, although the existing evidence in the Region suggests that both types of beverages are normal goods (16, 21). This would suggest, among other things, that taxes applied to these beverages would have an impact on their consumption, and that this would be more significant in the case of SSBs (22, 23).

A sizable number of Latin American countries tax alcoholic drinks and SSBs, but it is not known if these taxes have been effective in reducing the affordability of these goods. The main objective of this study was to use an econometric analysis of time series to study the trends in the affordability of beer (as a proxy for alcoholic beverages) and carbonated drinks (as a proxy for SSBs) in a group of countries in the Region. In the 15 countries of the Region for which Euromonitor International compiles data, beer consumption represents, on average, 85% of all alcoholic beverages, while carbonated drinks represent 77% of all SSBs (11).

Materials and methods

The compiled data correspond to official statistics on price indices for beer and SSBs/carbonated beverages, the general consumer price index (CPI), and the nominal wage index in 15 Latin American countries. This study analyzed the tax-related situation of alcoholic and SSBs in 15 countries: Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Dominican Republic, Ecuador, El Salvador, Guatemala, Honduras, Mexico, Paraguay, Peru, and Uruguay. All of these countries tax alcoholic beverages and only two (Colombia and the Dominican Republic) do not tax SSBs. The series are all expressed in monthly frequency and come from national statistics institutes or central banks, as indicated in Table 1.

In most of the countries, beer and soft drink prices are taken from the index for these products included within the CPI. Argentina uses a similar component of the Wholesale Industrial Price Index (IPIM) due to serious doubts about CPI measurements since 2007 (24). There are no doubts in this regard about the IPIM. Peru uses nominal prices compiled by the National Statistics Institute and Informatics in the metropolitan Lima area.

With regard to wages, monthly information was found for only eight countries. In most cases, they correspond to general nominal wage indexes, with the exception of Costa Rica, for which a minimum wage index was obtained. Colombia has an average wage index in the manufacturing industry for two types of jobs (workers and employees), with data to December 2014, and another for the manufacturing industry as a whole, with data starting January 2014. This study uses a simple average of the two available indices until December 2014, then continues with the data for the industry as a whole. Table 2 shows descriptive statistics for the data used, which include the number of samples of each index per country, as well as the mean, standard deviation, and median.

The method used involves measuring the expected rate of growth of the affordability indicator for SSBs and for beer in each of the 15 countries in the sample. For a specific country, the growth rate is defined as:

$$\gamma_t^A = 100 * \left[\frac{R_t - R_{t-j}}{R_{t-j}} \right] = 100 * \left[\frac{R_t}{R_{t-j}} - 1 \right]$$

where

$$\mathrm{R_t} = \frac{W_t}{P_t}$$

indicates the monthly affordability of the good in question, defined as the ratio of the nominal wage (W_t) and the price of the good (P_t). In the absence of wage data, the affordability indicator is constructed as the ratio of the CPI to the price of the good. This is considered a relative affordability indicator. In our case, the value of j may be: j = 1, j = 6, or j = 12. In the first case, the monthly growth rate of affordability is analyzed; in the second, the semiannual rate, and in the third, the annual rate. The choice of a j-value for each country and beverage depends on two technical considerations: the need to eliminate seasonal components from the series and the need to work with seasonal affordability rates to avoid spurious results. In order to eliminate seasonal elements of an additive nature, it is natural to work with annual affordability rates. However, the Phillips-Perron unit root test does not rule out the null hypothesis of the unit root in all the annual series. It does, however, rule out the null hypothesis of the unit root in all the series of monthly affordability rates (j = 1) and in most of the semiannual series, at the usual levels of significance statistical. In light of this, we opted to work with annual affordability rates wherever the Phillips-Perron test rejected the existence of the unit root for these series. When it was not rejected, we opted to work with semiannual affordability rates, also provided that the existence of unitary root was rejected. Finally, if for a given country and beverage it was not possible to reject the

TABLE 1. Sources and type of data used for the study, by country, variable, and time period

Country	Variable	Data used	Start-End	Source
Argentina	Beer	Wholesale Domestic Price Index	Oct 2001-Oct 2015	INDEC
	General	Wholesale Domestic Price Index	Oct 2001-Oct 2015	INDEC
	Wages	Nominal Average Wage Index	Oct 2001-Oct 2015	INDEC
Bolivia	Beer	Consumer Price Index	Mar 2008-May 2016	INE
	General	Consumer Price Index	Mar 2008-May 2016	INE
Brazil	Beer	National Consumer Price Index	Mar 2002-Feb 2016	CIDER
	General	National Consumer Price Index	Mar 2002-Feb 2016	CIDER
	Wages	Nominal average income from main job	Mar 2002-Feb 2016	CIDER
Chile	Beer	Consumer Price Index	Jan 2009-May 2016	INE
	Sugar-sweetened beverages	Consumer Price Index	Jan 2009-May 2016	INE
	General	Consumer Price Index	Jan 2009-May 2016	INE
	Wages	Nominal Wage Index	Jan 2009-May 2016	INE
Colombia	Beer	Consumer Price Index	Jan 2009-Apr 2016	DANE
	Sugar-sweetened beverages and malts	Consumer Price Index	Jan 2009-Apr 2016	DANE
	General	Consumer Price Index	Jan 2009-Apr 2016	DANE
	Wages	Nominal average wage index (industry)	Jan 1990-Apr 2016	Bank of the Republic of Colombia
Costa Rica	Bottled beer	Consumer Price Index	Jul 2006-Jun 2016	INEC
	Sugar-sweetened beverages	Consumer Price Index	Jul 2006-Jun 2016	INEC
	General	Consumer Price Index	Jul 2006-Jun 2016	INEC
	Wages	Nominal minimum wage index	Jul 2006-Jun 2016	INEC
Ecuador	Beer	Consumer Price Index	Jan 2005-Jun 2016	INEC
	Sugar-sweetened beverages	Consumer Price Index	Jan 2005-Jun 2016	INEC
	General	Consumer Price Index	Jan 2005-Jun 2016	INEC
	Wages	General Wage Index	Jan 2003-Jun 2016	INEC
El Salvador	Beer	Consumer Price Index	Jan 2006-May 2016	Central Bank of El Salvador
	Sugar-sweetened beverages	Consumer Price Index	Jan 2006-May 2016	Central Bank of El Salvador
	General	Consumer Price Index	Jan 2006-May 2016	Central Bank of El Salvador
Guatemala	Beer	Consumer Price Index	Apr 2011-Jun 2016	INE
	Artificial refreshments	Consumer Price Index	Apr 2011-Jun 2016	INE
	General	Consumer Price Index	Apr 2011-Jun 2016	INE
Honduras	Beer in can	Consumer Price Index	Jan 2012-May 2016	INE
	Bottled refreshments	Consumer Price Index	Jan 201-May 2016	INE
	General	Consumer Price Index	Jan 201-May 2016	INE
Mexico	Beer	Consumer Price Index	Jan 2007-mar 2016	INEGI
	Bottled refreshments	Consumer Price Index	Jan 2007-Mar 2016	INEGI
	General	Consumer Price Index	Jan 2007-Mar 2016	INEGI
	Wages	Average per capita wage index	Jan 2007-Mar 2016	Bank of Mexico
Paraguay	Beer	Consumer Price Index	Dec 2007-Sep 2016	Central Bank of Paraguay
	Sugar-sweetened beverages	Consumer Price Index	Dec 2007-Sep 2016	Central Bank of Paraguay
	General	Consumer Price Index	Dec 2007-Sep 2016	Central Bank of Paraguay
Peru	White beer	Nominal price in Lima	Jan 1996-Nov 2016	INEI
	Sugar-sweetened beverages	Nominal price in Lima	Jan 1996-Nov 2016	INEI
	General	Consumer Price Index for Lima	Jan 1996-Nov 2016	INEI
R. Dominican	Bottled beer	Consumer Price Index	Jan 2011-Jun 2016	ONE
	Refreshments	Consumer Price Index	Jan 2011-Jun 2016	ONE
	General	Consumer Price Index	Jan 2011-Jun 2016	ONE
Uruguay	Beer	Consumer Price Index	Mar 1997-May 2016	INE
	Refreshments	Consumer Price Index	Mar 1997-May 2016	INE
	General	Consumer Price Index	Mar 1997-May 2016	INE
	Wages	Average Wage Index	Mar 1997-May 2016	INE

INDEC: National Statistics and Census Institute; INE: National Statistics Institute; SIDRA: IBGE automatic recovery system; DANE: National Statistics Department; INEGI: National Statistics and Geography Institute; INEI: National Statistics and Informatics Institute; INEI: National Statistics Office.

existence of a unit root for an annual or semiannual series, we worked with monthly affordability rates. This was the case with the Dominican Republic for SSBs and Guatemala and Honduras for beers.

In the interest of homogeneity, the tables show annualized values to facilitate interpretation and comparison

TABLE 2. Descriptive statistics for wage and price indices in each country

Country	Number of reports	Average	Standard deviation	Median	Minimum	Maximum
Carbonated beverages/sugar-sweetened beverages price index						
Chile	91	116.2	12.1	113.4	100.0	142.1
Colombia	90	120.4	10.1	124.2	100.0	136.2
Costa Rica	125	146.6	23.9	153.5	100.0	175.6
Ecuador	138	129.4	26.5	121.6	94.4	212.2
El Salvador	125	107.1	16.4	100.7	81.9	142.4
Guatemala	63	110.1	6.1	110.9	100.0	119.9
Honduras	53	111.8	7.5	115.6	100.0	125.5
Mexico	119	128.4	20.3	123.4	100.0	164.2
Paraguay	102	122.4	14.8	120.7	97.9	148.6
Peru	251	91.9	10.4	92.2	73.8	113.6
Dominican Rep.	66	105.7	2.3	105.4	100.0	109.3
Uruguay	232	150.5	61.9	129.5	83.0	302.5
Beer price index						
Argentina	169	371.5	138.6	369.5	98.0	665.6
Bolivia	99	161.1	34.6	166.6	100.0	208.0
Brazil	173	170.9	53.2	146.6	100.0	278.3
Chile	91	113.2	13.6	108.5	97.4	143.6
Colombia	90	113.3	4.8	114.1	100.0	120.8
Costa Rica	125	156.3	30.0	159.5	100.0	193.1
Ecuador	138	126.7	22.3	123.7	99.2	185.0
El Salvador	125	110.0	6.3	112.8	99.6	119.8
Guatemala	63	97.8	5.6	95.2	92.0	106.8
Honduras	53	106.1	4.8	107.2	100.0	114.1
Mexico	119	133.4	21.1	132.4	99.4	165.7
Paraguay	102	143.3	23.3	146.6	100.0	172.7
Peru	251	136.1	15.2	134.7	100.0	166.0
Dominican Rep.	66	121.4	16.2	121.7	100.0	146.1
Uruguay	232	257.7	120.4	229.0	100.0	537.9
General price index						
Argentina	169	403.7	202.6	348.7	98.4	914.1
Bolivia	101	128.8	16.5	128.5	100.0	157.5
Brazil	173	169.0	41.0	163.0	100.0	262.6
Chile	91	108.3	7.9	107.1	97.8	129.1
Colombia	90	111.8	8.1	111.0	100.0	131.8
Costa Rica	125	144.7	22.0	147.9	100.0	171.3
Ecuador	138	128.0	18.0	127.1	100.0	157.0
El Salvador	125	118.5	8.2	119.4	100.0	127.9
Guatemala	63	110.4	5.8	110.8	100.0	120.8
Honduras	54	112.4	6.6	113.8	100.0	122.2
Mexico	119	122.7	13.5	123.4	99.9	145.4
Paraguay	102	122.2	13.2	124.5	100.0	144.9
Peru	251	152.8	26.6	148.1	100.0	205.9
Dominican Rep.	66	112.7	5.5	114.4	100.0	119.6
Uruguay	232	244.6	106.4	224.4	100.0	485.4
Wage index						
Argentina	169	409.3	345.3	277.7	99.3	1423.0
Brazil	168	172.2	55.5	163.5	100.0	277.9
Chile	89	120.4	14.9	119.2	100.0	147.4
Colombia	89	131.3	14.7	128.1	100.0	163.1
Costa Rica	120	153.8	31.3	155.3	100.0	198.1
Ecuador	134	217.6	83.3	204.5	100.0	360.8
Mexico	118	130.3	17.2	128.3	99.9	182.5
Uruguay	231	256.3	141.5	197.8	100.0	599.8

between countries. (The tables with the unit root analysis are not shown in order to save space, but are available from the authors upon request.) Using a first-order Taylor expansion around x = 0, the growth rate of affordability can be estimated as:

$$\gamma_t^A \cong 100 * \left(\left[In \frac{R_t}{R_{t-j}} \right] \right)$$
$$= 100 * \left(\ln(R_t) - \ln(R_{t-j}) \right)$$

Based on the properties of the natural logarithm, it can be affirmed that:

$$\gamma_t^A \cong 100 * \left(\ln(R_t) - \ln(R_{t-j}) \right)$$
$$= 100 * \left\{ \left[\ln(W_t) - \ln(W_{t-j}) \right] - \left[\ln(P_t) - \ln(P_{t-j}) \right] \right\}$$

OR, in summary:

$$\gamma_t^A \cong \gamma_t^W - \gamma_t^P$$

where:

$$\gamma_t^P = 100 * \left([\ln(P_t) - \ln(P_{t-j})] \right)$$
$$\gamma_t^W = 100 * \left([\ln(W_t) - \ln(EW_{t-j})] \right)$$

In other words, the affordability growth rate can be calculated as the difference between the logarithmic estimate of the growth rate of nominal wages and of the price of the beverages.

As it has already been pointed out, the affordability rate is usually estimated by considering the population's purchasing power (25, 26). However, monthly information on wages/income is not available for all countries; in these cases, the affordability rate is considered to be the inverse of the relative price of the good in question with respect to the average price of the goods included in the calculation of the CPI. In these cases, if the relative price of the good decreases over time, its relative affordability is considered to have increased. On the other hand, if the relative price increases, the conclusion is that its relative affordability has declined.

Under the assumption of stationarity for the series γ_t^A, its expected value does not depend on time, which means that it can be denoted simply as μ:

$$\mu \equiv E(\gamma_t^A)$$

Thus, statistical inference focuses on μ. A positive value for this parameter can be interpreted as greater affordability of the beverage in question. A negative μ parameter leads to the opposite result: the goods are less affordable for the population. Clearly, a null value of the parameter is interpreted as affordability that does not vary over time.

Formally, the analysis focuses on the following null hypothesis:

$$H_0 : \mu = 0$$

evaluated in contrast to the alternative:

$$H_A : \mu \neq 0$$

Unlike an independently and identically distributed sample, data from time series are characterized by a pattern of dependency that voids inference processes that omit this reality. Nevertheless, if the assumed stationarity of γ_t^A is complemented with the absolute additionability of its autocovariances, the result is the following version of the central limit theorem (27):

$$\sqrt{T}\left[\frac{1}{T}\sum_{t-1}^{T}\gamma_t^A - \mu\right] \xrightarrow{D} N(0, V^*)$$

where V * denotes the long-term variance of γ_t^A, and T denotes the sample size of the time series. If σ(T) denotes a robust estimator of V *, then, under the null hypothesis, T has an asymptotically standard normal distribution:

$$\frac{\left[\frac{I}{T}\Sigma_{t-1}^{T}\gamma_t^A\right]}{\sigma(T)/\sqrt{T}} \xrightarrow{D} N(0,1)$$

Robust estimators of the long-term variance of a time series abound in the literature, although the proposed estimator by Newey and West (28) is recognized as a pioneer. This estimator requires the selection of a parameter of bandwidth, which in this study was selected following the suggestion of Newey and West (29).

A simple way of constructing this statistic consists of estimating a regression between the variable γ_t^A and a constant, taking into account that standard errors need a robust estimator of long-term variance, i.e., the statistic proposed by Newey and West (28). The method used in this study includes a slight modification of this strategy, since it consists of estimating the following model for γ_t^A:

$$\gamma_t^A = \delta + \varepsilon_t - \theta\varepsilon_{t-12} \qquad (A)$$

where ε_t is white noise with zero expectation and constant variance. From the previous model, it follows that

$$\mu \equiv E(\gamma_t^A) = \delta$$

which means that inference on parameter μ is equivalent to inference on the intercept δ in the model used here. The reason for introducing the moving average $\theta\varepsilon\, e_{t-12}$ is to control, at least partially, certain seasonal effects common to price series, even when annual rates are used in these series (30). If such as seasonal effect is not relevant, parameter q would be expected to be close to zero and would not substantially affect the estimates. The equation (A) is estimated using conditional least squares, and the standard errors of the coefficients are constructed using the aforementioned estimator proposed by Newey and West (28).

Results

Table 3 shows the results of the estimate of equation (A) for the 12 countries for which monthly data were available for soft drink prices. Specifically, for each country, the table shows the estimated parameter δ in equation (A), its standard error (in parenthesis) and the corresponding t-statistic.

The results obtained are mixed. Of the six countries for which affordability was measured in terms of wages (the proper way to measure affordability), in five of them (Chile, Colombia, Costa Rica, Ecuador, and Uruguay) the null hypothesis was ruled out with a level of statistical significance of 5%, and the coefficient is positive, which implies increased affordability of SSBs. For Mexico, the null hypothesis is also ruled out, with a high level of statistical significance (1%), but the coefficient is negative, which implies reduced affordability. Both Ecuador and Uruguay show especially high increases in affordability rates: 6.37% per year in Ecuador and 3.54% in Uruguay.

In the rest of the countries, there are no data on wages, leaving only a suboptimal indicator of affordability, which we have named 'relative affordability'. In these countries, the obtained results are somewhat less conclusive. In El Salvador, Guatemala, and Honduras, it is not possible to rule out the null hypothesis that there were no changes in relative affordability. In the Dominican Republic and Peru, relative affordability increased in statistical terms (the null hypothesis is ruled out at 10% and the coefficient is positive). In Paraguay, the null hypothesis was ruled out in favor reduced relative affordability.

Table 4 is analogous to Table 3, but it shows the results of affordability for beers in all countries in the sample. A larger number of countries are considered for beer, but again, with mixed results. For the group of countries with available information on wages and where affordability can be measured

TABLE 3. Seasonally adjusted rate of annual growth in sugar-sweetened beverages affordability, by country

	Chile	Colombia	Costa Rica	Ecuador	El Salvador	Guatemala
Annual growth rate	1.27***	2.75***	1.50***	6.37***	-0.57	0.09
Standard error	(0.40)	(0.80)	0.31	(1.51)	(1.25)	(0.46)
t-statistic	3.17	3.43	4.81	4.23	0.45	0.19
	Honduras	Mexico	Paraguay	Peru	Dominican Republic	Uruguay
Annual growth rate	-0.83	-1.07***	-0.49 *	2.93 *	3.28 **	3.54 **
Standard error	(0.53)	(0.21)	(0.26)	(1.76)	(1.66)	(1.65)
t-statistic	-1.55	-5.05	1.92	1.66	1.97	2.14

Notes:

[1] Robust standard errors under heteroskedasticity and autocorrelation have been calculated in accordance with the Newey and West method (28, 29).

[2] For Chile, Colombia, Costa Rica, Ecuador, Mexico, and Uruguay, affordability is measured in relation to the wage index. For the rest of the countries, it is measured in relation to the Consumer Price Index.

[3] For Chile, Colombia, Ecuador, and Guatemala, the analysis was based on the semiannual growth rate. This means that the reported annual rate is simply double the semiannual growth rate. For the Dominican Republic, the analysis was based on the monthly growth rate. This means that the reported annual growth rate is 12 times the monthly growth rate.

[4] * $P < 0.10$, ** $P < 0.05$, *** $P < 0.01$.

TABLE 4. Seasonally adjusted rate of growth annual of the affordability in beers per country

	Argentina	Bolivia	Brazil	Chile	Colombia
Annual growth rate	4.73	-4.07***	0.10	0.65	4.09***
Standard error	(5.45)	(1.32)	(0.99)	(1.19)	(1.46)
t-statistic	0.87	3.08	0.10	0.55	2.80
	Costa Rica	Ecuador	El Salvador	Guatemala	Honduras
Annual growth rate	0.53	7.26***	0.50	5.26 **	1.42 *
Standard error	(036)	(1.50)	(0.62)	(2.64)	(0.80)
t-statistic	1.18	4.85	0.81	2.00	1.79
	Mexico	Paraguay	Peru	Dominican Republic	Uruguay
Annual growth rate	-1.18 *	-2.30	1.11	-5.04***	0.61
Standard error	(0.64)	(1.47)	(0.91)	0.40	(1.73)
t-statistic	-1.84	-1.57	1.21	-12.58	0.32

Notes:
[1] Robust standard errors under heteroskedasticity and autocorrelation have been calculated in accordance with the Newey and West method (28, 29).
[2] For Argentina, Brazil, Chile, Colombia, Costa Rica, Ecuador, Mexico, and Uruguay, affordability is measured in relation to the wage index. For the rest of the countries, it is measured in relation to the Consumer Price Index.
[3] For Argentina, Bolivia, Chile, Colombia, Ecuador, El Salvador, Paraguay, and Uruguay the analysis was based on the semiannual growth rate. This means that the reported annual rate is double the semiannual growth rate. For Guatemala and Honduras, the analysis was based on the monthly growth rate. This means that the reported annual rate is 12 times the monthly growth rate.

better, affordability was found to increase significantly in Colombia and Ecuador: in Colombia, at an annual rate of 4.09% and in Ecuador at 7.26%. In Argentina, Brazil, Chile, Costa Rica, and Uruguay, the affordability growth rate was not statistically different than zero, while Mexico showed a 1.18% reduction in annual affordability (with a level of statistical significance of 10%).

For the countries without a wage series (Guatemala and Honduras), there was an observed increase in statistically significant relative affordability (10% in both). In Peru and El Salvador, an increase in relative affordability was also observed, but not a statistically significant one. In Bolivia and the Dominican Republic, there was a statistically significant drop in relative affordability, and also in Paraguay, but without statistical significance.

Discussion

The increase in consumption of products with negative effects on health is a public health concern. The loss of healthy years of life and the increase in health expenditures associated with this consumption are reason for concern both in developed and developing countries. To the extent that the affordability of these goods is reduced, it can be expected, given the available evidence (13, 14), that their consumption will decline. The results of this study show that, both in the case of beers and SSBs, the overall trend in the Region is toward increased or stable affordability. In 12 of 15 countries, the affordability of beer increased or remained unchanged in statistical terms; and this was also the case with SSBs in 10 of 12 countries. Based on the existing evidence (13-15), it is not surprising that, in most countries, there has been a steady per capita increase in the consumption of both goods.

Taxation is a policy that has proven effective in reducing consumption of this type of goods (31-33). However, while in the great majority of countries in the Region, sugary and alcoholic beverages are taxed, this study shows that the application of these taxes has, to date, been insufficient to significantly reduce their affordability.

It is clear that in certain countries these taxes have been implemented to increase revenue, rather than correct unhealthful behaviors. For example, countries such as Argentina, Peru, and Uruguay tax SSBs as well as healthy alternatives like bottled water. Other countries, such as Chile or Ecuador, have raised taxes on these beverages, but insufficiently and in the context of tax reforms motivated, again, by fiscal needs. Only in Mexico, where there is extraordinary consumption of these beverages, resulting in enormous health costs (10), the 2014 tax increase seems to have been truly motivated by public concerns, since it was discussed and analyzed in the context of a series of complementary measures (restrictions on advertising, labeling, etc.). Although the tax increase has been relatively moderate (around 10% of the average price of SSBs), it may have been effective in reducing affordability. The analyzed sample also shows that Mexico is the country with the lowest growth in affordability.

If there is truly a desire to reduce consumption, it is recommended that the countries of the Region advance decidedly in the implementation of these taxes, using health criteria. As the case of tobacco has demonstrated, specific taxes (a per-unit amount, based on volume, quantity of critical nutrients, etc.) are the most effective way to modify behavior (34).

It would be desirable for taxes on SSBs to bear some relation to the amount of critical nutrients they contain (for example, added sugars). Thought could then be given to taxing beverages that have a specific component (monetary amount per gram of added sugar), thereby penalizing beverages that have the greatest amount of these components and encouraging consumers to replace them with healthier alternatives, while encouraging producers to reformulate them. None of the countries in this study have this type of tax.

For alcoholic beverages, consideration could be given to a specific tax per gram of alcohol, so that consumers are encouraged to reduce consumption of those with the highest alcoholic content, replace them with those of lower content, or stop consuming them altogether. Only three countries among those considered here have this type of tax: Colombia, Ecuador, and the Dominican Republic.

The way a tax works depends on the objective for which it is imposed. In the case at hand, the objective should be, primarily, to reduce the consumption of substances that are hazardous to health. Tax design is fundamental, and it must be aligned with this objective.

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REFERENCES

1. Dreyfus PM, Victor M. Effects of Thiamine Deficiency on the Central Nervous System. Am J Clin Nutr. 1961;9(4):414–25.
2. Victor M, Adams RD, Mancall EL. A restricted form of cerebellar cortical degeneration occurring in alcoholic patients. AMA Arch Neurol. 1959;1(6):579–688.
3. Smyth A, Teo KK, Rangarajan S, O'Donnell M, Zhang X, Rana P, et al. Alcohol consumption and cardiovascular disease, cancer, injury, admission to hospital, and mortality: a prospective cohort study. Lancet. 2015;386(10007):1945–54.
4. Grant BF, Dawson DA. Age at onset of alcohol use and its association with DSM-IV alcohol abuse and dependence: results from the National Longitudinal Alcohol Epidemiologic Survey. J Subst Abuse. 1997;9(1):103–10.
5. Gawryszewski VP, Monteiro MG. Mortality from diseases, conditions and injuries where alcohol is a necessary cause in the Americas, 2007–09. Addiction. 2014; 109(4):570–7.
6. Reardon DC, Coleman PK, Cougle JR. Substance Use Associated with Unintended Pregnancy Outcomes in the National Longitudinal Survey of Youth. Am J Drug Alcohol Abuse. 2004;30(2): 369–83.
7. Stueve A, O'Donnell LN. Early alcohol initiation and subsequent sexual and alcohol risk behaviors among urban youths. Am J Public Health. 2005;95(5):887–93.
8. Shield K, Monteiro M, Roerecke M, Smith B, Rehm J. Alcohol consumption and burden of disease in the Americas in 2012: implications for alcohol policy. Rev Panam Salud Publica. 2015;38(6):442–9.
9. Vartanian LR, Schwartz MB, Brownell KD. Effects of soft drink consumption on nutrition and health: a systematic review and meta-analysis. Am J Public Health. 2007; 97(4):667–75.
10. Singh GM, Micha R, Khatibzadeh S, Lim S, Ezzati M, Mozaffarian D. Estimated Global, Regional, and National Disease Burdens Related to Sugar-Sweetened Beverage Consumption in 2010. Circulation. 2015; 132(8):639–66.
11. Euromonitor International. Passport data 2017. Disponible en: https://www.portal.euromonitor.com/portal/magazine/homemain. Cited 15 September 2017.
12. The World Bank. The World Bank Database. Washington, DC: The World Bank; 2017. Disponible en: http://data.worldbank.org/ Acceso el 21 de mayo de 2017.
13. Rabinovich L, Brutscher P, de Vries H, Tiessen J, Clift J, Reding A. The affordability of alcoholic beverages in the European Union: Understanding the link between alcohol affordability, consumption and harms. Santa Monica, CA: RAND Corporation; 2009.
14. Nelson JP. Alcohol Affordability and Alcohol Demand: Cross-Country Trends and Panel Data Estimates, 1975 to 2008. Alcoholism: Clin Exper Res. 2014;38(4): 1167–75.
15. Blecher EH, van Walbeek CP. An international analysis of cigarette affordability. Tobacco Control. 2004;13(4):339–46.
16. Araya D. El impacto del precio en el consumo de bebidas alcohólicas en Chile. Santiago de Chile: Universidad Adolfo Ibañez; 2016.
17. Colchero MA, Salgado JC, Unar-Munguía M, Hernández-Ávila M, Rivera-Dommarco JA. Price elasticity of the demand for sugar sweetened beverages and soft drinks in Mexico. Econ Human Biol. 2015;19(1):129–37.
18. Claro RM, Levy RB, Popkin BM, Monteiro CA. Sugar-Sweetened Beverage Taxes in Brazil. Am J Public Health. 2012;102(1): 178–83.
19. Guerrero-López CM, Unar-Munguía M, Colchero MA. Price elasticity of the demand for soft drinks, other sugar-sweetened beverages and energy dense food in Chile. BMC Public Health. 2017;17(1):180.
20. Nakhimovsky SS, Feigl AB, Avila C, O'Sullivan G, Macgregor-Skinner E, Spranca M. Taxes on Sugar-Sweetened Beverages to Reduce Overweight and Obesity in Middle-Income Countries: A Systematic Review. PloS one. 2016; 11(9):e0163358.
21. Paraje G. The Effect of Price and Socio-Economic Level on the Consumption of Sugar-Sweetened Beverages (SSB): The Case of Ecuador. PloS one. 2016;11(3): e0152260.
22. Gallet CA. The demand for alcohol: a meta-analysis of elasticities. Austral J Agric Resource Econ. 2007;51(2):121–35.
23. Thow AM, Downs S, Jan S. A systematic review of the effectiveness of food taxes and subsidies to improve diets: Understanding the recent evidence. Nutr Rev. 2014;72(9):551–65.
24. International Monetary Fund. Statement by the IMF Executive Board on Argentina [press release]. Washington, DC: IMF; 2013.
25. Guindon GE, Tobin S, Yach D. Trends and affordability of cigarette prices: ample room for tax increases and related health gains. Tobacco Control. 2002; 11(1):35.
26. Blecher EH, van Walbeek CP. Cigarette affordability trends: an update and some methodological comments. Tobacco Control. 2009;18(3):167–75.
27. Hamilton J. Time Series Analysis. Princeton: Princeton University Press; 1994.
28. Newey WK, West KD. A Simple, Positive Semi-Definite, Heteroskedasticity and Autocorrelation Consistent Covariance Matrix. Econometrica. 1987;55(3):703–8.
29. Newey WK, West KD. Automatic Lag Selection in Covariance Matrix Estimation. Rev Econ Studies. 1994;61(4):631–53.
30. Pincheira P, Medel C. Forecasting Inflation with a Simple and Accurate Benchmark: The Case of the US and a Set of Inflation Targeting Countries. Czech J Econ Finance (Finance a uver). 2015; 65(1):2–29.
31. Colchero MA, Popkin BM, Rivera JA, Ng SW. Beverage purchases from stores in Mexico under the excise tax on sugar sweetened beverages: observational study. Br Med J. 2016;352.
32. Silver LD, Ng SW, Ryan-Ibarra S, Taillie LS, Induni M, Miles DR, et al. Changes in prices, sales, consumer spending, and beverage consumption one year after a tax on sugar-sweetened beverages in Berkeley, California, US: A before-and-after study. PLoS medicine. 2017;14(4): e1002283.
33. Elder RW, Lawrence B, Ferguson A, Naimi TS, Brewer RD, Chattopadhyay SK, et al. The Effectiveness of Tax Policy Interventions for Reducing Excessive Alcohol Consumption and Related Harms. Am J Prev Med. 2010;38(2):217–29.
34. International Agency for Research on Cancer. Effectiveness of Tax and Price Policies for Tobacco Control. Lyon: World Health Organization; 2011.

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RESUMEN

Asequibilidad de cerveza y bebidas azucaradas para 15 países de América Latina

Objetivos. El objetivo de este trabajo fue analizar la evolución de la asequibilidad de la cerveza y de las gaseosas para quince países de América Latina.
Métodos. Los datos corresponden a estadísticas oficiales de índices de precios de cerveza y gaseosas/refrescos, índice de precios al consumidor e índice de salarios nominales en frecuencia mensual. El método se basa en realizar un análisis econométrico, mediante series temporales, para medir el valor esperado de la tasa de crecimiento del indicador de asequibilidad absoluta (utilizando salarios nominales) o relativa (usando precios generales) de las gaseosas y de las cervezas.
Resultados. En nueve de los quince países analizados, la asequibilidad (absoluta o relativa), ya sea de bebidas azucaradas o cervezas, ha aumentado de forma estadísticamente significativa. En el caso de las bebidas azucaradas, la asequibilidad absoluta aumentó en cinco países (Chile, Colombia, Costa Rica, Ecuador y Uruguay) y disminuyó en México. En el caso de la cerveza, aumentó en Colombia y Ecuador, se mantuvo inalterada en Argentina, Brasil, Chile, Costa Rica y Uruguay, y se redujo en México.
Conclusiones. A pesar de que la mayoría de los países poseen impuestos a la cerveza y a las bebidas azucaradas, su efecto en los precios no ha sido suficiente para reducir su asequibilidad en todos los países de la muestra. Los impuestos deberían modificarse para reducir la asequibilidad de estas bebidas y afectar su consumo.

Palabras clave Economía de la salud; bebidas alcohólicas; bebidas gaseosas; América Latina.

RESUMO

Acessibilidade a cervejas e refrigerantes em 15 países da América Latina

Objetivos. Analisar a evolução da acessibilidade a cervejas e refrigerantes em 15 países da América Latina.
Métodos. Os dados representam estatísticas oficiais dos índices de preços de cervejas e refrigerantes, índice de preços ao consumidor e índice mensal do salário nominal. A metodologia do estudo foi uma análise econométrica com séries temporais para avaliar a taxa esperada de crescimento do indicador de acessibilidade absoluta (com base no salário nominal) ou relativa (com base nos preços gerais) de cervejas e refrigerantes.
Resultados. Houve um aumento significativo da acessibilidade (absoluta ou relativa) a cervejas ou refrigerantes em 9 dos 15 países analisados. Com relação aos refrigerantes, houve um aumento da acessibilidade absoluta em cinco países (Chile, Colômbia, Costa Rica, Equador e Uruguai), com uma redução observada no México. Com relação às cervejas, houve um aumento da acessibilidade na Colômbia e Equador, não se observou mudança na Argentina, Brasil, Chile, Costa Rica e Uruguai e ocorreu uma redução no México.
Conclusões. Embora exista tributação para cervejas e refrigerantes na maioria dos países, o efeito nos preços não tem sido suficiente para reduzir a acessibilidade a estes produtos em todos os países da amostra estudada. É preciso reformar a tributação a fim de reduzir a acessibilidade e o consumo destas bebidas.

Palabras-chave Economia da saúde; bebidas alcoólicas; bebidas gasosas; América Latina.