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Carlos M. Guerrero-López, Mariana Molina, M. Arantxa Colchero

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Employment changes associated with the introduction of taxes on sugar-sweetened beverages and nonessential energy-dense food in Mexico

Carlos M. Guerrero-López[1], Mariana Molina[1], M. Arantxa Colchero[1]*

[1] Center for Health Systems Research, Instituto Nacional de Salud Pública, Universidad No. 655 Colonia Santa María Ahuacatitlán, Cerrada Los Pinos y Caminera C.P. 62100, Cuernavaca, Mor. Mexico

Carlos M Guerrero-López: cmguerrero@insp.mx
Mariana Molina: molinajaimes@hotmail.com

*Corresponding author: M. Arantxa Colchero: acolchero@insp.mx
Center for Health Systems Research, Instituto Nacional de Salud Pública, Universidad No. 655 Colonia Santa María Ahuacatitlán, Cerrada Los Pinos y Caminera C.P. 62100, Cuernavaca, Mor. Mexico.
Phone: 52-777-329200

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Abstract

We assessed changes in employment in the manufacturing industry, the commercial sector and national unemployment rates, associated with the fiscal policies implemented in 2014 in Mexico: a 1 peso per liter excise tax to sugar-sweetened beverages (SSB) and an 8% tax on nonessential energy-dense food. We used data from three nationally representative surveys. Controlling for contextual variables, we used interrupted time series analyses to model changes in number of employees in the SSB and nonessential energy-dense food industry, in commercial establishments selling beverages and food and changes in national unemployment rates. Our results show that there were no significant changes in employment associated with the taxes in the manufacturing industries (for beverages and nonessential energy-dense food). We found a very small increasing trend in the post-tax period for employment in commercial stores and a decreasing trend in the unemployment rate. However, these changes are negligible and unlikely to be caused by the implementation of the taxes. In conclusion, there were no employment reductions associated with the fiscal policies implemented in Mexico in 2014 on SSB and nonessential energy-dense food.

Introduction

The prevalence of overweight and obesity in Mexico is very high. It is estimated that children aged 5-11 years old face a 34.4% prevalence of overweight and obesity; whereas 35% of adolescents (12-19 years old) and 7 out of 10 adults face the same problem [1,2]. Overweight and obesity are caused by multiple factors; however, there is evidence that the consumption of sugar-sweetened beverages (SSB) and high-energy-dense diets are associated with weight gain[3-8]. In Mexico, the consumption of SSB represents 9.8% of total energy intake and the consumption of food high in sugar and/or high in saturated fat contributes 16% of total energy intake [9].

The World Health Organization suggests implementing fiscal measures to increase the price of unhealthy food and beverages to discourage consumption and collect additional fiscal revenues that can be used to correct market failures associated with their consumption[10]. Examples of countries/cities that have proposed or implemented taxes to unhealthy food or beverages are France, Denmark, Hungary, Egypt, Finland, Colombia, South Africa, the United Kingdom as well as some cities in the US. More recently, Mexico implemented an excise tax of 1 Mexican peso per liter (USD $0.075) to all non-alcoholic beverages with added sugar starting in January 2014 [11], updated when accumulated inflation exceeds 10% [12]. In addition, an *ad valorem excise* tax of 8% was implemented to nonessential energy-dense food with energy density of at least 275 kilocalories per 100 grams (see Supplemental Material Table S1 for a list of taxable food groups) [11].

The SSB tax has been associated with an increase in prices of SSB of nearly 11% [13]. A recent study documented a decline in SSB purchases of around 6% in 2014 associated with the implementation of the SSB tax [14] and a decrease of 7.3% in per capita sales of SSBs in 2014 and 2015 compared to the period of 2007-2013 [15] and there was a 5% reduction in purchases of nonessential energy dense food [16].

As in the case of other taxes, *e.g.* tobacco and alcohol, concerns that a reduction in the demand can lead to job losses may emerge [17], as opponents to the tax have expressed in paid and earned media [18], despite the modest taxes implemented in Mexico.

The objective of this paper was to assess changes in employment associated with the implementation of the SSB and nonessential energy-dense food taxes. We analyzed changes in employment in the non-alcoholic beverage manufacturing industry and industry that produces nonessential energy-dense food, in the commercial sector that sells food and beverages and we estimated changes in national unemployment rates.

Methods

Sources of information and variables

Monthly Surveys of the Manufacturing Industry

We used data from the Monthly Surveys of the Manufacturing Industry (EMIM, for its acronym in Spanish) from January 2007 to December 2016 [19]. In this survey, the unit of observation is the manufacturing establishment, defined as an economic unit that has a fixed location and combines resources to transform or modify inputs into new products, through mechanical, physical, or chemical processes, including maquiladoras, parts assembling, machinery reconstruction, among others [19]. The EMIM has a deterministic sampling design: firms are ordered from largest to smallest according to the economic census and then selected until the sample size has a number of firms that equals the expected coverage for each economic activity. For food and beverages, coverage is defined as 80% of total revenue and 80% of employees.

The EMIM classifies firms into 240 categories, according to the North American Industrial Classification System (NAICS) [20]. We used the monthly time series of total employment for class 312111, *i.e.* Soft Drink Manufacturing, according to NAICS. This class includes companies primarily engaged in manufacturing carbonated, non-carbonated drinks and other non-alcoholic beverages such as bottled water produced by the beverage industry. Thus cola, soda, plain water, hydrating or energetic beverages and juices are included in this class; so we will call this class the non-alcoholic beverage manufacturing industry.

We also identified the economic classes that produce nonessential energy-dense food. We included snack food (NAICS code 311910), chocolate and chocolate confectionery (NAICS codes 311320 and 311330), non-chocolate confectionery (NAICS code 311340), breakfast cereals (NAICS code 311230) and retail bakery (NAICS code 311811). We excluded classes that produce ice creams, jellies, puddings and other sweet desserts because although these items belong to the list of taxable foods, most of them fail to meet the cut-off point for taxable foods of at least 275 calories/100grams.

We gathered 120 monthly observations from January 2007 to December 2016. All data in the EMIM are aggregated at the national level. The outcome of interest was the number of employees in these manufacturing industries. We modeled employment in the SSB and taxed foods separately and combined.

Monthly Surveys of the Commercial Establishments

To estimate changes in employment in commercial stores associated with the implementation of the taxes, we used the Monthly Surveys of the Commercial Establishments (EMEC, in Spanish) over the available period of January 2011 to December 2015 [21]. The unit of observation is the commercial establishment. The survey is applied monthly and the respondents are the store owners. The survey collects data on net sales, expenses, wages, number of workers and days worked. The sampling frame is constituted by the commercial establishments captured by the 2009 Mexican Economic Census. The EMEC represents the retail sector in the country. The design of the survey is probabilistic for retail trade stores (99% of the EMEC sample) and for wholesale stores the design is deterministic. Wholesale establishments are included until 80% of the total income of the category is reached (1% of the sample) [21].

The EMEC is a panel of establishments classified into 40 categories and 142 subcategories according to the NAICS. The EMEC is nationally representative and by category. In this study, we used establishments from 14 subcategories: establishments selling food and/or beverages (excluding those that exclusively selling fruits, vegetables or meat): wholesale and retail of groceries, snacks, beer, confectionery, bread & cakes, beverages & ice, and supermarkets.

The outcome of interest for this analysis was monthly number of employees at the national level. The EMEC provides monthly specific information at the store level but we aggregated the data to set up the time series for the empirical analysis described below. We stratified the analyses by store size using the classification used by the National Institute of Geography and Statistics [22]: micro: 10 or less employees, small: between 11 and 30, medium: between 31 and 100 and large: more than 100 employees

Although stores may have shifted sizes over time, particularly those in the upper or lower limit, when comparing the distribution of stores by size between January and July 2011 and 2014, only 1% of stores shifted sizes. To account for these small changes in sizes, the size of the stores was defined based on the size the stores had for 31 months or more during the 60 months available.

National Occupation and Employment Survey

We analyzed changes in unemployment rates to test whether the taxes had any impact on the entire economy using the National Occupation and Employment Survey (ENOE in Spanish) [23]. The ENOE is a nationally representative survey collected quarterly since 2005 that provides estimates of national unemployment rates, among other labor statistics. Unemployment rate is defined as the proportion of unemployed population (individuals that did not have employment during the week of the survey and that looked for employment during the previous month) aged 15 years or older in the economically active population in the same age group. We gathered 48 quarterly observations from 2007 to the last quarter of 2016.

Empirical estimation

To assess changes in the outcomes of interest, we performed Interrupted Time Series Analyses (ITSA)[24]. We used a linear regression, as all our outcomes are continuous variables. The ITSA model divides the data in two segments: before and after the intervention. The model tests for statistical differences in pre-intervention trends, changes in the intercept (level of the outcome immediately after the intervention was implemented) and changes in the post-intervention trend. The ITSA model is particularly adequate in the absence of an experimental design in which units of observations are randomly assigned to an intervention or control group [25], such as the fiscal policies that were implemented in the entire country in 2014 without a control group. The ITSA model has been used to evaluate changes in health outcomes associated with the implementation of interventions or associated to economic events in the absence of an experimental design [26,27]. We selected a model that would test if there was a change in the level (after the tax was implemented) and in the trend. We did not expect to have temporary changes in employment, as the tax was not modified during the period. The segmented regression model was defined as follows:

$$\boldsymbol{y_t = \beta_0 + \beta_1 T + \beta_2 X_t + \beta_3 T X_t + \beta_k Z_{kt}}$$

where $\boldsymbol{\beta_0}$ represents the baseline level at $\boldsymbol{T}$=0 ($\boldsymbol{T}$ represents the time since the start of the study), $\boldsymbol{\beta_1}$ is the pre-tax trend (before 2014, since $\boldsymbol{X_t}$ is an indicator variable representing the intervention –pre tax period 0, otherwise 1-), $\boldsymbol{\beta_2}$ is change in the level of the outcome in the period immediately after the implementation of the tax (2014), $\boldsymbol{\beta_3}$ indicates the slope change after the tax, and $\boldsymbol{\beta_k}$ are the parameters associated with other explanatory variables $\boldsymbol{Z}$ included in the models measured in $\boldsymbol{t}$ periods.

In time series analysis, the assumption that observations are independent can be violated, since it is possible that current values are influenced by past observations. This is known as autocorrelation or serial correlation. For instance, the probability of an increase in current number of employees is higher if past employment has been rising. With autocorrelation the coefficients are unbiased but the standard errors are incorrect. We tested for autocorrelation using the Cumby-Huizinga test under the null hypothesis that the disturbance is a moving average process up to order q (actest or actest robust if conditional heteroskedasticity in Stata 13). We tested for 12 lags of autocorrelation. Based on the results of these tests, we included lags of the dependent variable to correct for autocorrelation. We chose the models that corrected for autocorrelation. We present in sensitivity analysis models with up to four lags where we were not able to correct for autocorrelation to see how coefficients change and the robustness of the results.

We modeled the logarithm of the dependent variables (number of employees for the EMIM, thousands of employees for the EMEC and unemployment rate for the ENOE) to interpret the coefficients of interest as percentage (relative change in the outcomes) and because the dependent variables do not have a normal distribution. We included a dummy variable that equals 1 during the post-tax period (from January 2014 onwards) and zero otherwise. For the EMIM analyses, we adjusted the models for variables that change over time and are associated with employment: we included total monthly population projected [28] as a proxy variable for the demand for beverages and taxed food, seasonality (monthly dummies), and the global indicator of the economic activity –a short-term proxy for Gross Domestic Product that incorporates weighted information on production from primary, secondary and tertiary sectors that reaches 93% of the gross value added- [29]. The same variables were used to estimate changes in employment in the commercial sector using the EMEC. In the estimation of changes in unemployment rates using the ENOE we controlled for quarter, and quarterly average global indicator of the economic activity. Since unemployment rates are measured quarterly, we averaged the monthly data for the global indicator of the economic activity over each quarter.

For each survey, we graphically display the unadjusted dependent variable as well as the predicted values in levels from the ITSA models.

In sensitivity analysis we tested if the results were different when using number of hours worked as the outcome of interest compared to number of employees for the EMIM and EMEC data.

In addition to the ITSA model, for the analysis using the ENOE, since we have 48 observations and the ITSA models require between 50 and 100 observations, we also ran a Joinpoint regression to test whether there were statistically significant splines [30]. We were particularly interested in the possibility that the joinpoint regression would capture a spline after the taxes were implemented. The joinpoint regression tests whether there are statistically significant joinpoints (*i.e.* changes in trend). The tests of significance use a Monte Carlo permutation method. This regression requires at least seven observations to test for a joinpoint and 4 data points between joinpoints so 48 observations are adequate to run the model as we specified a maximum of 8 joinpoints.

Results

Employment in the manufacturing industries (non-alcoholic beverages and nonessential energy-dense food)

Monthly number of employees in the non-alcoholic beverages and the nonessential energy-dense food manufacturing industries between 2007 and 2016 are shown in Figure 1 (1A and 1B). The vertical line represents the time when the taxes were implemented. The graph shows a decreasing trend in the number of employees for SSB that stabilized in 2014. For the nonessential energy-dense food there is no apparent trend before or after the tax were implemented.

Table 1 presents the results of the ITSA models to predict employment changes in the manufacturing industries. For the non-alcoholic beverages manufacturing industry, results show a non-statistically significant trend in the pre-tax period, a small and non-significant change in the intercept after the tax was implemented and a small statistically significant positive change in the post-tax period (monthly average increase of 0.09%). The models included one lag of the dependent variable to address the autocorrelation.

The nonessential energy-dense manufacturing industry did not show any significant changes in the pre-tax trend, changes in the intercept or the post-tax trend. The autocorrelation was corrected by including one lag of the dependent variable. Similarly, for the combined industries (beverages and nonessential energy-dense food) the models show no significant changes in employment.

As shown in supplemental Table S4 the results using number of hours worked are very similar compared to number of employees in the EMIM.

Figure 1. Thousands of employees in the non-alcoholic beverages and nonessential energy-dense food manufacturing industries. Mexico, EMIM 2007-2016

Figure 1A- Sugar-sweetened beverages industy

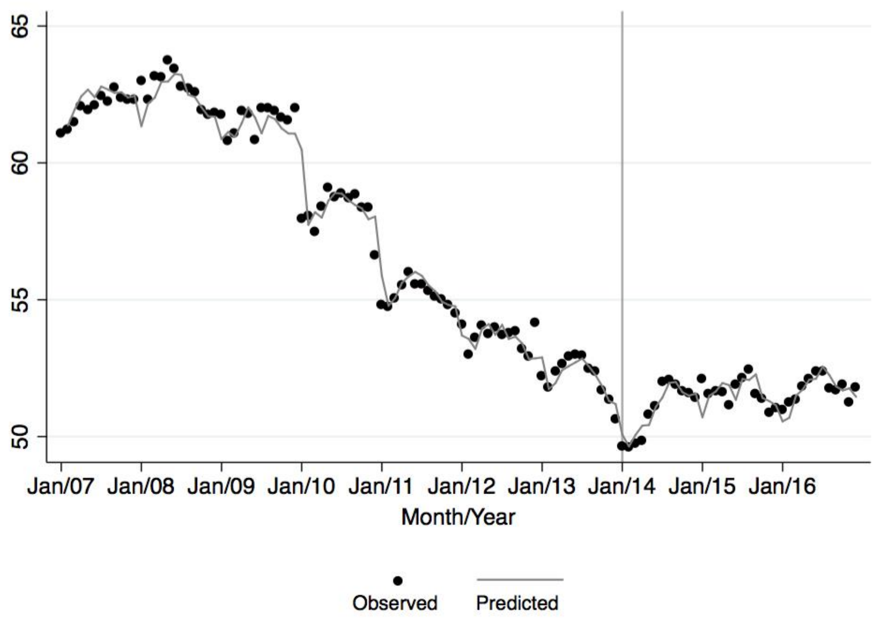


Figure 1B- Nonessential energy-dense food industry

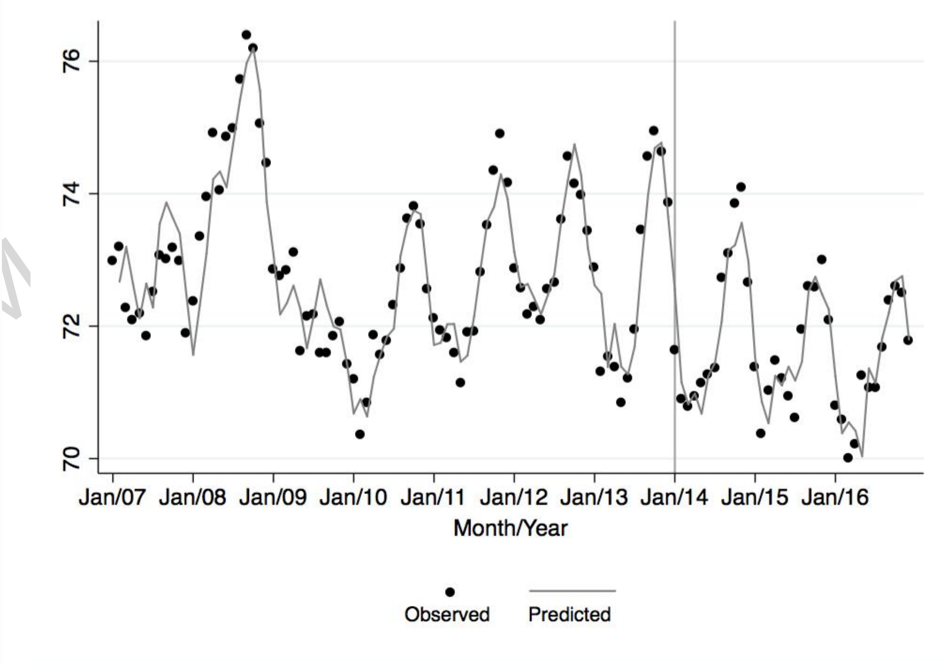


Table 1. Changes in employment in the non-alcoholic beverages and nonessential energy-dense food manufacturing industries in Mexico before and after the taxes were implemented.

	Manufacturing industry					
	Non-Alcoholic beverages		Nonessential energy-dense food		Sugar-sweetened beverages and nonessential energy-dense food	
Dependent variable: logarithm of number of employees	**Coefficient (95% CI)**	**p-value**	**Coefficient (95% CI)**	**p-value**	**Coefficient (95% CI)**	**p-value**
Pre-tax trend	-0.0008 (-0.0027, 0.0010)	0.365	-0.0006 (-0.0016, 0.005)	0.303	-0.0006 (-0.009, -0.0002)	0.005
Intercept change	0.0044 (-0.0005, 0.0092)	0.076	-0.0042 (-0.0097, 0.0013)	0.131	0.00002 (-0.0039, 0.0038)	0.993
Post-tax trend change	0.0009 (0.003, 0.0015)	0.002	0.00002 (-0.001, 0.0002)	0.808	0.0003 (0.00004, 0.0005)	0.006

Source: authors' estimations using the Monthly Surveys of the Manufacturing Industry (EMIM 2007-2016). Models were adjusted for population, the global indicator of the economic activity, monthly dummies and one lag of the dependent variable.. ^Cumby-Huizinga test shows autocorrelation persisted (actest or actest robust for conditional heteroskedasticity in Stata 13).

Employment in the commercial stores

Figure 2 displays the number of employees in establishments selling food and beverages between 2011 and 2015. The graph shows an increasing trend in employment since 2011.

Figure 2. Thousands of employees in commercial establishments. Mexico, EMEC, 2011-2015

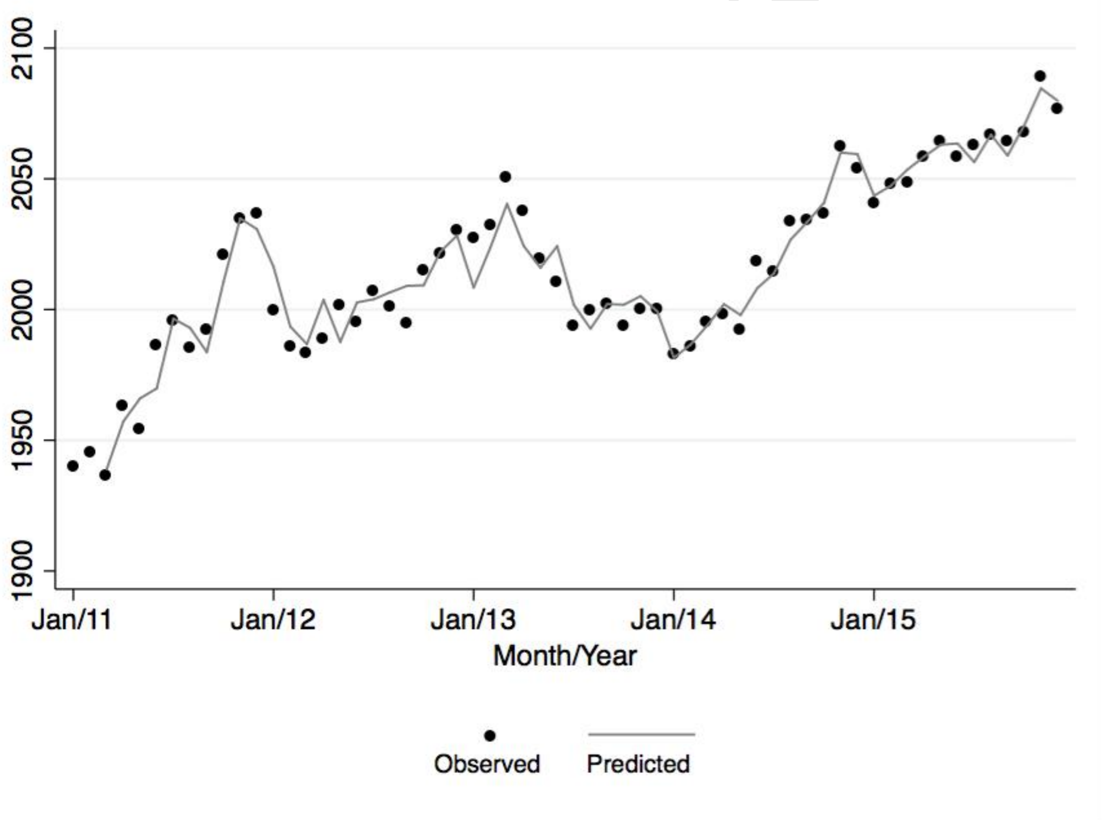


Table 2 shows the results of the models for the commercial establishments overall and by store size. For all stores, we see a statistically significant negative pre-tax trend (monthly average reduction of 5.5%), a non-statistically significant change in the intercept after the tax was implemented and a small statistically significantly positive post-tax trend of (monthly average increase of 0.3%). The model was corrected for autocorrelation. The results by store size are similar to the results for the complete sample: a decreasing pre-tax trend (not significant for small stores), a non-significant change after the tax was implemented and a small increasing trend in the post-tax period. For small, medium and large store models, the autocorrelation persisted. In Supplemental Material Table S2 we present results including up to 1, 3 and 4 lags. All specifications show very similar results so the conclusions do not change, although the autocorrelation was not corrected.

As shown in supplemental Table S5 the results using number of hours worked are very similar compared to number of employees in the EMEC.

Table 2. Changes in employment in commercial stores selling food and beverages in Mexico before and after the taxes were implemented.

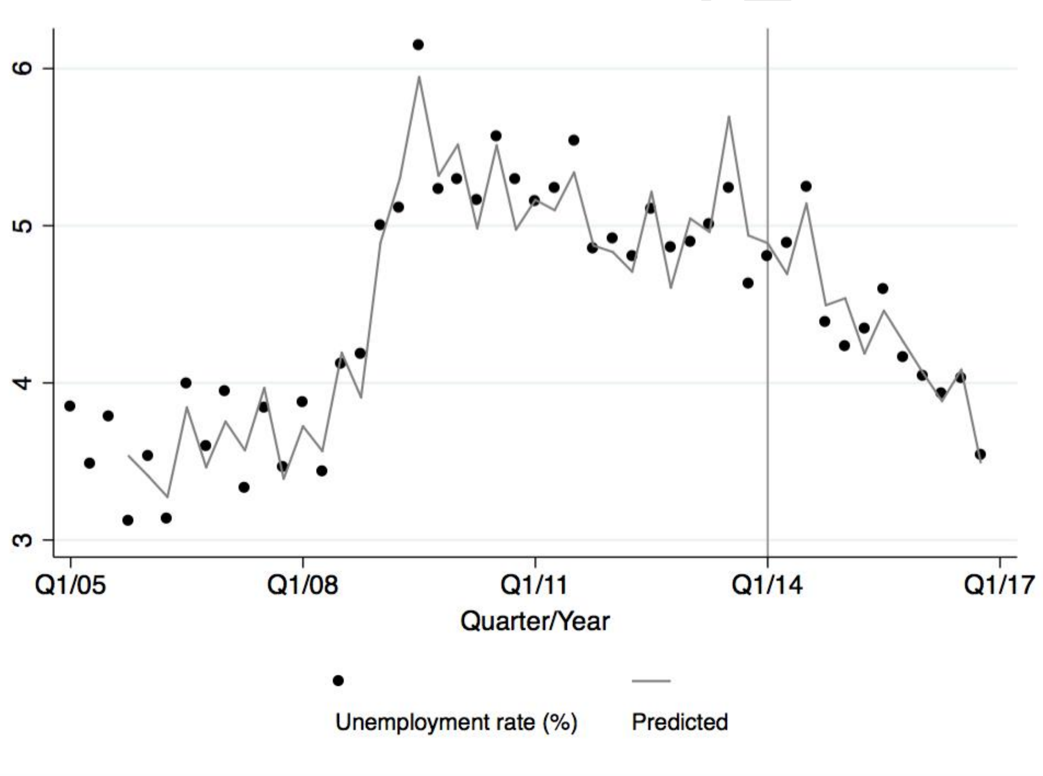
	All		Micro		Small		Medium		Large	
Dependent variable: logarithm of number of employees	**Coefficient (95% CI)**	**p-value**	**Coefficient (95% CI)**	**p-value**	**Coefficient (95% CI)**	**p-value**	**Coefficient (95% CI)**	**p-value**	**Coefficient (95% CI)**	**p-value**
Pre-tax trend	-0.055 (-0.086, -0.023)	0.001	-0.05 (-0.09, -0.01)	0.009	-0.047^ (-0.14, 0.05)	0.294	-0.099^ (-0.163, -0.035)	0.003	-0.075^ (-0.108, -0.042)	0
Intercept change	0.002 (-0.005, 0.008)	0.53	-0.002 (-0.01, 0.007)	0.672	-0.014^ (-0.042, 0.014)	0.321	-0.012^ (-0.03, 0.006)	0.199	0.01^ (0.0003, 0.02)	0.043
Post-tax trend change	0.003 (0.001, 0.005)	0.001	0.004 (0.001, 0.006)	0.002	0.005^ (-0.000,0.01)	0.064	0.005^ (0.001, 0.009)	0.004	0.002^ (0.001, 0.004)	0

Source: authors' estimations using the Monthly Surveys of the Commercial Establishments (EMEC 2011-2015). Models were adjusted for population, the global indicator of the economic activity, monthly dummies and two lags of the dependent variable. ^ Cumby-Huizinga test shows autocorrelation persisted (actest or actest robust for conditional heteroskedasticity in Stata 13)

National unemployment rates

As shown in Figure 3, the national unemployment rate was steady from 2005 to early 2008. In 2008 and 2009 it grew at its maximum reaching over 6% in the first quarter of 2009 due to the global economic crisis that affected Mexico. This was followed by a constant decline since then.

Figure 3. National unemployment rate. Mexico, ENOE 2005-2016.



For national unemployment rates (Table 3), results from the models show a small positive increasing trend in the pre-tax period, a non-statistically significant change after the tax was implemented and a small decreasing trend in the post-tax period (average monthly reduction in the unemployment rate of 2%). The autocorrelation was not corrected in the models, however, we present in Supplemental Material Table S3 models including 1, 2 and 4 lags that show very similar results.

Results from the joinpoint regression show two splines for the unemployment rate time series (see Figure S1 in the Supplemental Material). One is located at observation 14 (second quarter of 2008) which is related to the economic crisis in the country. A second joinpoint is located in observation 19 (third quarter of 2009), which is the beginning of a period of reduction in the unemployment rate that extends to the end of our period of analysis.

Table 3. Changes in national unemployment rates in Mexico before and after the taxes were implemented.

	Unemployment rate	
Dependent variable: logarithm of unemployment rate	**Coefficient (95% CI)**	**p-value**
Pre-tax trend	0.01973^ (0.0104, 0.0290)	0.000
Intercept change	-0.04055^ (-0.1018, 0.0207)	0.188
Post-tax trend change	-0.0201^ -0.0292, -0.0111)	0.000

Source: author´s estimations using the National Occupation and Employment Survey (ENOE 2005-2016). Models were adjusted for quarterly average global indicator of the economic activity, quarter dummies and three lags of the dependent variable.. ^ Cumby-Huizinga test shows autocorrelation persisted (actest or actest robust for conditional heteroskedasticity in Stata 13).

Discussion

We estimated changes in employment in the non-alcoholic beverages and nonessential energy-dense food manufacturing industries, in commercial establishments that sell food and beverages and changes in national unemployment rates using interrupted time series analyses. Our results show that there were no significant changes in employment associated with the taxes in the manufacturing industries (for non-alcoholic beverages and nonessential energy-dense food). We found a very small increasing trend in the post-tax period for employment in commercial stores and a decreasing trend in the unemployment rate. However, these changes are negligible and unlikely to be caused by the implementation of the taxes.

For the ENOE, the additional analysis using joinpoint regression, supports the hypothesis and results from the ITSA model that there were no changes in the unemployment rate related to the implementation of the taxes."

We simulated the power for our parameters of interest (change in the intercept and change in post-tax trend) for the all sectors analyzed in this study (results not shown). The power to detect changes in the intercept was always greater than 90%. For changes in the post-tax period, we have the power to detect changes in post-tax trends greater than 10%. Since all ITSA models show that employment has not changed after the taxes were implemented –i.e. we do not reject the null hypothesis-, the power is not as relevant as if we had concluded that there was a significant change in employment. Since confidence intervals include zero, we are confident that there was no change in employment/unemployment.

Our results are similar to studies in other countries. International experiences on tobacco taxes show similar findings. Whilst industry-funded studies argue that the reduction in the demand for tobacco associated with the taxes lead to job losses, the vast majority of independent studies have found that a reduced demand of taxed and harmful products increases household budgets to spend in other goods, which in turn implies employment replacements for jobs lost in the taxed industries [31,32]. Our results differed from the study conducted by Powell *et al*. that modeled the impact of SSB taxes on net employment in Illinois and California in the United States [33]. Although both studies conclude that the taxes do not have a negative impact on employment, they found that the SSB tax was associated to a net gain in employment, since declines in the number of employees in the beverage industry were offset by new employment created in the non-beverage industry and government. The difference may be related to the methods used (we used data on employment while their study is based on a modeling approach; they assumed a higher tax (20%), a complete pass though prices for all beverages and a higher reduction in SSB consumption (24%).

The implementation of the SSB tax has led to a price increase and a subsequent reduction of approximately 6% in sales of these products in 2014 and 8.7% in 2015 [14,15]. Although a reduction in sales could lead to reductions in employment, our results show that there were no significant changes after the implementation of the taxes. One hypothetical reason for this is potential substitutions within the non-alcoholic beverages industry. For instance, we have documented that there was an increase in sales of bottled water manufactured partially by the same industry that produces SSB[15] and other studies have shown that after the taxes were implemented there were increase in untaxed beverages [14,34]. This increase could have offset the potential negative effect on employment associated with the reduction in sales of taxed beverages. Similarly, as commercial establishments sell taxed and untaxed food and beverages, if they are offering more bottled water or other untaxed food or beverages, there is no reason to expect reductions in employment in this sector. Furthermore, it is unexpected that a potential reduction in employment in the manufacturing industries would have an impact on unemployment rates in the country as these industries account only for 1.7% (SSB) and 2.2% (nonessential energy-dense food) of all employees in the manufacturing industry.

This study has some limitations. We acknowledge that we were not able to estimate changes in employment in all economic units that produce energy-dense food since we excluded some classes of industries that produced untaxed foods. In addition, some of the classes included may produce untaxed foods although the majority of the products listed are taxed due to a high energy density.

Data on the entire private or public sectors is unavailable. However, changes in national unemployment rates would capture changes in employment in all sectors of the economy.

We recognize that for the EMEC data, 3 subcategories (wholesale of snacks and stores selling beer) out of 14 subcategories of establishments maybe not representative at national level. However, we are not stratifying at the subcategory level since we aggregated the data at the national level to run the time series models

Another limitation is that the study lacks a comparison group since the taxes were implemented nationally. We tried to find a control group using the synthetic controls methodology developed by Abadie *et al* [35]. However, none of the classes included had a similar pre-tax trend compared to the sectors studied in our paper, which is the basic assumption needed to run a difference in difference model. To partly address this limitation, the models adjusted for variables that change with time such as the global indicator of the economic activity. We also recognize that because of the lack of an experimental design, causality cannot be claimed. We are unable to adjust for other interventions implemented during the post-tax period or any time varying confounder not included in the analysis. As for the public sector, if investments in water fountains or other government programs that used the revenues collected from the taxes increased jobs in the public sector – although this information is not available because taxes in Mexico are not earmarked-, this would be captured in the analysis of changes in national unemployment rates. However, our methodological approach meets Siegel's criteria [36]. First, we relied on objective data, *i.e.* official employment statistics or surveys designed to measure employment and other related outcomes. Second, we included all available data points before and after the implementation of the taxes. Lastly, we performed adequate econometric methods in order to control for secular trends, random data variability and we included information on general economic trends.

Finally, population or the global indicator of the economic activity could be endogenous due to reverse causality. Employment opportunities could have an impact on population by reducing fertility rates as well as increasing the economic activity. To address this potential bias, we ran the models using one lag of these two variables (same month or quarter from the previous year) and concluded that the results did not change (results not shown).

This paper illustrates that the implementation of the taxes in Mexico was not associated with job losses in the manufacturing industries, the commercial sector or the economy as a whole. Future research should be conducted to model potential long-term effects of the tax on employment including money transfers to other sectors and from the government.

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Highlights

- No decrease in employment associated with the taxes in the manufacturing sector
- Employment in commercial stores selling food and beverages did not change after the two taxes
- National unemployment rates did not increase after the taxes were implemented.