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Effects of a Tax Reform: Increase in Value-Added Tax in Ecuador as a Post-Catastrophe Economic Measure

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ABSTRACT

This study delves into the direct impact of a 2% increase in Value Added Tax (VAT) on firms' sales in Ecuador. Employing a quasi-experimental design and canton-level data (224) for the period 2014-2017, we compare the sales of localities affected by the tax reform (treatment group) with those that were not (control group). By utilizing a difference-in-differences analysis, we were able to isolate the specific effect of the VAT increase, minimizing the impact of other factors that may have influenced sales during that period. The results reveal a negative and statistically significant causal relationship between the VAT hike and firms' sales. In other words, the increase in the tax led to a contraction in the demand for goods and services, resulting in a decline in firms' revenue. These findings suggest that increases in consumption taxes can adversely affect economic activity by discouraging consumption and negatively impacting firms' competitiveness. The results of this research hold significant implications for the formulation of fiscal policy, as they highlight the need to carefully evaluate the potential side effects of changes in tax rates on consumer and firm behavior.

KEYWORDS: Fiscal policy, Taxation, Income distribution, Income policy, Ecuador.

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Efectos de una Reforma Tributaria: Aumento del Impuesto al Valor Agregado en Ecuador como medida económica posterior a una catástrofe

RESUMEN

Este estudio emprende un análisis exhaustivo del impacto directo que tuvo un aumento del 2% en el Impuesto sobre el Valor Añadido (IVA) sobre las ventas de las empresas en Ecuador. Utilizando un diseño cuasi-experimental y datos a nivel cantonal (224) para el período 2014-2017, se compararon las ventas de las localidades que experimentaron este incremento tributario (grupo de tratamiento) con aquellas que no se vieron afectadas (grupo de control). A través de un análisis de diferencias en diferencias, se logró aislar el efecto específico del aumento del IVA, minimizando el impacto de otros factores que pudieran haber influido en las ventas durante ese período. Los resultados obtenidos revelan una relación causal negativa y estadísticamente significativa entre el incremento del IVA y las ventas de las empresas. En otras palabras, el aumento del impuesto generó una contracción en la demanda de bienes y servicios, lo que se tradujo en una reducción de los ingresos para las empresas. Estos hallazgos sugieren que los aumentos en los impuestos al consumo pueden tener efectos adversos sobre la actividad económica, al desincentivar el consumo y afectar negativamente la competitividad de las empresas. Los resultados de esta investigación tienen importantes implicaciones para la formulación de políticas fiscales, pues resaltan la necesidad de evaluar cuidadosamente los potenciales efectos colaterales de los cambios en las tasas impositivas sobre el comportamiento de los consumidores y las empresas.

PALABRAS CLAVE: Política fiscal, Tributación, Distribución del ingreso, Política de ingresos, Ecuador.

Introduction

The effects of tax reforms on economic activity have been under debate for a long time, allowing for a vast amount of academic literature. Many bets on macro-econometric estimation methods have led to maintaining standard ideas. Taxes introduce massive distortions that lead to less economic development (Infantino, 2020), or fiscal policy remains the main macroeconomic policy lever to counter adverse economic shocks and possibly foster economic growth (van der Wielen, 2019).

In other studies, emphasis has been placed on the fact that the best responsible fiscal policy management should prevail. Creating a climate that encourages the private sector to

make medium- and long-term decisions with greater confidence will improve economic productivity, which is vital for long-term growth (Segura, 2015).

This article aims to extend the existing set of estimates of the effects using methods that allow evaluation of the impact of public policies. This document seeks to quantify the development of the increase of two percentage points in VAT on sales between June 2016 and May 2017.

Undoubtedly, this type of evaluation will prove the effectiveness of a specific program or public policy. Impact evaluations are necessary to inform those responsible for improving policies and taking corrective action on their intervention objectives (Gertler et al., 2017).

Taxes and their effects on the economy have relevant relationships in the market and the behavior of its main variables, such as income, GDP, consumption, investment, and revenue. Applying a new tax can generate positive or negative economic impacts, even when other factors such as public spending, social benefits, incentives, and trade policy measures are incorporated.

The classical and neoclassical position defends a position on impacts. Adam Smith, in his book "Inquiry into the Nature and Causes of the Wealth of Nations", Adam Smith laid the foundation that raising (imposing) tax rates beyond a certain level discouraged compliance, encouraged smuggling, and reduced tax revenue (Hedau, 2018). Hedau (2018) mentions that taxes should be designed to minimize taxpayer compliance and government administrative costs while discouraging tax avoidance and evasion.

The neoclassical view holds that income and wealth must first be produced and then consumed, which means that taxes on factors of production, such as capital and labor, are particularly detrimental to wealth creation. Corporate and shareholder taxes reduce the incentive to invest and build capital (McBride, 2012).

In the empirical field, a series of studies try to explain the impacts on the market. The main contributions focused on developing theories that explain the incidence of general sales taxes and taxes on certain goods. Most research has focused on the incidence theory of the tax, and the legal conclusion of much of this theoretical analysis is that consumers bear the entire burden of any sales and excise tax (Alm et al., 2009).

The main contributions were from Brown (1939), Rolph (1952), and Bishop (1968). However, with more sophisticated statistical and econometric tools, software, and

techniques, empirical evidence and impact assessments of the measures in each economic and social variable were expanding.

The results vary according to the countries, the methodologies, the fiscal variables involved, and the periods within the same country. The studies distinguish between the types of taxes, from corporate income taxes, personal income taxes, consumption taxes through Value Added Tax (VAT), and property taxes.

The studies range from a province, region, country, economic sector, and product. That is the case of Blagrave (2005), who analyzes the impact of the harmonized sales tax on provincial revenues in the Atlantic Canada area. Their methodological strategy focused on an OLS regression to predict the relationship between the forecast variable (consumption tax revenue) and explanatory variables such as provincial GDP and disposable personal income in the three participating provinces. These provinces had the highest sales tax rates in the country, and the proposal to lower those high tax rates to eight percent (along with changing the tax bases) ended up benefiting consumers (Blagrave, 2005).

Another line of research uses vector auto regression (VARs) to measure tax multipliers. The idea is to include shocks to taxes and government revenue in a VAR (Romer & Romer, 2010). According to the researchers, if they are orthogonal to the relevant information established in the VAR, then the fiscal multipliers are calculated naturally through the impulse responses to such shocks generated by the VAR (Favero & Giavazzi, 2012) in their research on the " Measuring Tax Multipliers: The VAR Method", argues that using this approach solves an apparent puzzle in measuring tax multipliers.

In their research, Romer & Romer (2010) and Barro & Redlick (2011) found substantial effects of tax changes on economic activity. The first estimate is that the impact of a 1 percent GDP tax increase is equivalent to a 3 percent reduction in output over three years. David and Christina Romer, in their research, look at the overall U.S. federal tax burden as a percentage of GDP since World War II. Analyze the record of federal tax changes, including presidential speeches and congressional reports, to identify legislated "fiscal shocks," such as attempts to reduce a budget deficit or promote long-term growth (Romer & Romer, 2010).

The most significant effect comes from tax changes to promote economic growth, and the main channel is investment. These results are robust for several specifications,

including controlling for the state of the economy, monetary policy, and public spending behavior (McBride, 2012).

Moreover, Barro and Redlick point out that taxes' effect on GDP works mainly through substitution effects, with increases in average marginal tax rates considerably reducing GDP (Barro & Redlick, 2011).

Blanchard and Perotti (2002) point out that positive fiscal shocks, such as unexpected increases in total revenue, negatively affect private investment and GDP.

For William Gale (2014), in his research "Effects of changes in income tax on economic growth", the critical advantage of the approach is that it allows a distinction between anticipated and unanticipated fiscal shocks based on temporary assumptions. In addition, and at least partially, control for available information on future tax changes is usually ignored in standard VAR-based methods (Gale & Samwick, 2014).

The general equilibrium model with tax that includes the participation of families, companies, and the Government follows the same research path, seeking the best strategy to estimate the impact of fiscal policy shocks. The Dynamic General Equilibrium Model (Conesa et al., 2010) was applied to the Spanish economy.

For other researchers, increasing corporate taxes is the most damaging, followed by personal income, consumption, and property taxes. In the research "Tax Policy For Economic Recovery and Growth" by Arnold et al. (2011), where the behavior of tax reforms and their effects between 1971 and 2004 are analyzed in 21 OECD countries, it is pointed out that the progressivity of income taxes damages growth A 1 percent shift in tax revenue from income tax (both personal and corporate) to consumption and property taxes would increase GDP per capita by 0.25 to 1 percent over the long run term Corporate taxes, both in terms of the statutory rate and depreciation deductions, reduce investment and productivity growth Raising the top marginal rate on personal income reduces productivity growth (Arnold et al., 2011).

Van der Wielen explained that the estimates made for the EU are based on a structural identification of fiscal shocks (Burriel et al., 2010); they focus on public spending shocks (Mencinger, 2017) or measures cyclically adjusted budgets (Carnot & de Castro, 2015; Gechert et al., 2019).

Several recent contributions reveal that increasing taxes affect income and salaries. To do this, they have developed more sophisticated general equilibrium models of the long-

term incidence of corporate income taxes in an open economy, as described by Randolph (2006) and Gravelle & Thomas (2011).

Most empirical studies on taxes and their effects on the variables that promote economic growth, published in peer-reviewed academic journals, find that tax increases hurt the economy.

Moreover, in a review of twenty-six such studies since 1983, at least three found no negative effect of taxes on growth. The rest found a generation of problems in the macroeconomic variables.

For García (2011), the causal analysis based on structural equations has many criticisms and is based on deficiencies in reproducing the observed data (García, 2011). Lalonde (1986) commented that empirically, the structural models based on regressions give poor results compared to more experimental methods.

For this reason, the difference-in-difference method (DID) will be designed, in which the sales of the taxpaying companies are compared before and after the implementation of raising the VAT from 12 to 14%, which will include the provinces that received the increase. Moreover, those that remained with the same tax.

-What happened in Ecuador?

At the beginning of 2016, the Ecuadorian economy faced a reduction in its Gross Domestic Product (GDP) growth rates. According to the Central Bank of Ecuador (BCE), the first quarter of 2016 registered a decrease in GDP of 4%, and the fourth quarter of 2015 reported a decline of 2% (BCE, 2017). In this context, former President Rafael Correa presented the Organic Law for the Balance of Public Finances, which aims to boost domestic consumption and production.

The project was sent to the National Assembly as an urgent economic issue on March 30, 2016. The first debate on the bill was on April 11, and five days later, an earthquake (7.8 magnitudes) destroyed the productive sectors of the provinces of Manabí and Esmeraldas.

Official figures record 671 people dead and 8,690 people sheltered. In addition, it affected the provinces of Esmeraldas, Guayas, Los Ríos, Santa Domingo, and Santa Elena. Thus, on April 17, 2016, the President of the Republic, Rafael Correa, issued Decree 1001, declaring a State of exception for sixty days to the Esmeraldas, Manabí, Santa Elena provinces, Los Ríos, Santo Domingo, and Guayas just as it orders the Ministry of Finance to allocate the funds to meet the needs caused by the earthquake.

A few days later, the government issued decree 1002, which extended the mobilization to the entire country and provided for the requisitions for which there was room to solve the emergency.

Likewise, between April 17 and 20, former President Correa and his work team prepared another economic project called the Solidarity and Citizen Co-responsibility Law for the Reconstruction and Reactivation of the Areas Affected by the Earthquake, which will serve to finance the rehabilitation and reconstruction of the areas affected by the earthquake.

The original proposal included an increase of 2 in VAT, an additional 3% contribution from companies on profits, a 0.9% contribution from people with assets greater than 1 million dollars, the gift of one day's salary of those who earn more than 1,000 and the sale of public support.

The proposal for the Solidarity Law was sent to the National Assembly on April 20 as an urgent economic matter.

On April 26, decree 1004 was issued to create the Reconstruction and Productive Reactivation Committee in the affected areas. Its functions are to implement programs, plans, actions, and public policies to reactivate production and employment in the area. Former Vice President Jorge Glass presided over the committee, and he worked with several State Ministers in executing the Reconstruction Plan.

On that same day, the Assembly discussed the Public Finance Balance Bill and approved it in a second debate. Therefore, April 29 is issued in the Official Gazette, and its articles focus on the return of two percentage points of the Value Added Tax for using electronic means of payment when paid with electronic money and 1 point when they used debit, credit, or prepaid cards. In addition, the return of VAT paid by people with disabilities or by older adults on a taxable base of up to two unified basic salaries.

Also included is the exemption in the payment of income tax for older adults (one basic fraction exempt) and people with disabilities or their only substitute two basic fractions exempt). Moreover, the advance payment of Income Tax for micro-enterprises is reduced through a simplified calculation.

Furthermore, a taxable base for the Special Consumption Tax is established for alcoholic and non-alcoholic beverages. Moreover, a 15% special consumption tax rate has been restored for companies with fixed and mobile telephones, excluding internet and data

services. An additional 50% IR deduction is also established for Excise Tax (ICE) payments generated in telephone services for centralized call management offices (call centers).

The first debate of the Solidarity Law was held on May 3, 2016, and its second debate was approved on May 12. Furthermore, it was published in the Official Gazette for execution on May 20. However, it was not until June 10 that Decree 1073 approved the Regulations of the Solidarity Law.

The Solidarity Law, in Article 1, indicated that its objective is the collection of solidarity contributions to allow the planning, construction, and reconstruction of public and private infrastructure and productive reactivation. Article 2 maintained that the following solidarity contributions are created only once: on remunerations, heritage, profits, and real estate and capital rights in Ecuador owned by companies resident in tax havens or other foreign jurisdictions.

In addition, it includes the contribution to real estate and rights representing capital existing in Ecuador and a 0.9% contribution on the inheritance of natural persons equal to or greater than one million dollars. Moreover, finally, one day of their remuneration of natural persons in a relationship of dependency who receive more than 1000 dollars per month and the temporary increase of 12% of VAT for one year.

Furthermore, the first Transitory Provision provides for an increase from 12 to 14% for one year. In addition, it provides that natural persons who are final consumers and purchase goods or services in the provinces of Manabí and Esmeraldas will receive from the State a discount equivalent to the increase of two percentage points of the VAT paid on their consumption. That is, the tax will not be increased in those localities.

On May 25, 2016, Decree 1044 was issued, which provides for the exemption from the payment of 100% of the advance value of Income Tax for the 2016 fiscal period to all economic sectors of the cantons of Manabí such as Bolívar, Chone, El Carmen, Flavio Alfaro, Jama, Jaramijó, Junín, Manta, Montecristi, Pedernales, Pichincha, Portoviejo, Rocafuerte, San Vicente, Santa Ana, Sucre, and Tosagua. In addition, it is located in the Muisne canton of the province of Esmeraldas.

On May 31, 2016, representatives of ECLAC, the United Nations, and Secretaria Nacional de Planificación y Desarrollo (SENPLADES) presented the reconstruction costs of the provinces of Manabí and Esmeraldas, which were affected by the earthquake. According to the Reconstruction Costs Evaluation report, the total cost for the reconstruction of the

affected areas amounts to 3,343.8 million dollars, of which 2,252.3 million (67%) would come from the public sector and 1,091.5 million (33%) from the private sector (SENPLADES, 2016).

1. Materials and Methods

The empirical analysis of this article is based on the sales collections by cantons obtained on the Internal Revenue Service (SRI) website in the multidimensional statistics section, which is responsible for providing information on form 104 (https://declaraciones.sri.gob.ec/saiku-ui/). There, the declarations of the commercialized goods' taxes with VAT 0% and VAT 12% by province and cantons are registered. The same ones will be selected from the period 2014 to May 2017. There are 224 cantons distributed in 24 regions of Ecuador that report the amounts sold are counted. The population of each canton will also be used to build a per capita sales indicator for each city.

May 2016 is used to analyze the treatment period, while the pre-treatment period goes from January 2014 to April 2016. The post-treatment period goes from June 2016 to May 2017. Therefore, each analysis period has 28 and 12 months.

It must be remembered that the information does not come from a random assignment when evaluating the impact. Work is done on existing databases and can be considered quasi-experimental. In addition, we use the information by canton where the affected areas are classified (the cantons of Esmeraldas and Manabí), in which the VAT increase measures from 12 to 14% are not applied and which will be considered control groups. The rest of the cities will make up the treatment group.

It is important to remember that in May 2016, the Solidarity Law was approved, which increases VAT from 12 to 14% in 22 of the 24 provinces. The tax for necessities throughout the country has remained the same. Sales that do not have VAT (0%) and are applied throughout the country will also be used, especially for necessities that are part of the basic basket.

The supporting data and forms, such as revenue behavior, collections, tax payments, and more details about economic activity and geographic location, are all publicly available.

1.1. Empirical Model

Understanding and outlining the mechanisms by which the VAT increase can affect sales is necessary to estimate the causal relationship between fiscal policy and the demand for goods.

The difference-in-differences technique will be used to estimate the impact of the two-percentage-point increase in VAT on sales. This quasi-experimental design uses longitudinal data from the treatment and control groups to obtain an appropriate counterfactual for estimating a causal effect (Imbens & Wooldridge, 2009).

This method was used in many economic and social evaluation studies. One of the best-known was to estimate the impact of the New Jersey minimum wage increase on employment in fast food restaurants in New Jersey and Pennsylvania (Card & Krueger, 1994; Vergara-Romero et al., 2022). Another study investigated how the evolution of a tax subsidy to employer-provided health insurance affects employer-provided health insurance coverage (Finkelstein, 2002). The difference-in-difference methodology is also used to assess the effect of the terrorist conflict on the economic evolution of the Basque Country using Spanish regions not affected by the conflict as a synthetic control group (Abadie & Gardeazabal, 2003). These studies show that the DID method can control for effects due to general time trends, regional differences, and other confounding factors. However, this method has yet to be used in any analysis of tax reforms.

However, one of the criticisms of this method is the issue of parallel trends where evidence is required to confirm that assumption. Moreover, you must know that similar groups only sometimes exhibit truly parallel trends. Moreover, this can be generated because the control group is not very good or because the functional form of the counterfactual is incorrect. Using a fictitious or falsified trend test, researchers must test the assumption of parallel trends whenever the data allows (Kahn-Lang & Lang, 2019).

The basic proposal is that observations are collected for two groups during two periods. One of the groups is the treatment group that is exposed to the treatment in one period. The other group, the control group, receives no treatment during both periods. If the same units are observed within a group at each period, the average gain in the unexposed (control) group is subtracted from the gain over time in the exposed (treatment) group. This double differentiation, also called the "difference-in-difference" method, seeks to eliminate biases in the second-period comparison between treatment and control groups that could be the result of permanent differences between those groups, as well as

comparison biases in time in the treatment group, which could be the result of non-treatment related time trends (Li et al., 2012).

This technique estimates the effect of a specific public policy or treatment by comparing changes in outcomes over time between a measure applied to a group of study units (the intervention group) and a group of study units that it is not, called a control group.

This difference-in-difference design (DID) will seek to compare sales before and after the implementation of raising VAT from 12% to 14% for the cantons unaffected by the earthquake, regardless of the number of inhabitants since other factors that change over time can affect sales and confuse a simple before and after policy comparison. The spurious effect due to secular trends will be removed using a DID model (Donald & Lang, 2007). The DID method is based on identifying a control group that (1) does not have a VAT increase and (2) experiences the same or parallel secular trends in sales of products with and without VAT (see Figure 1).

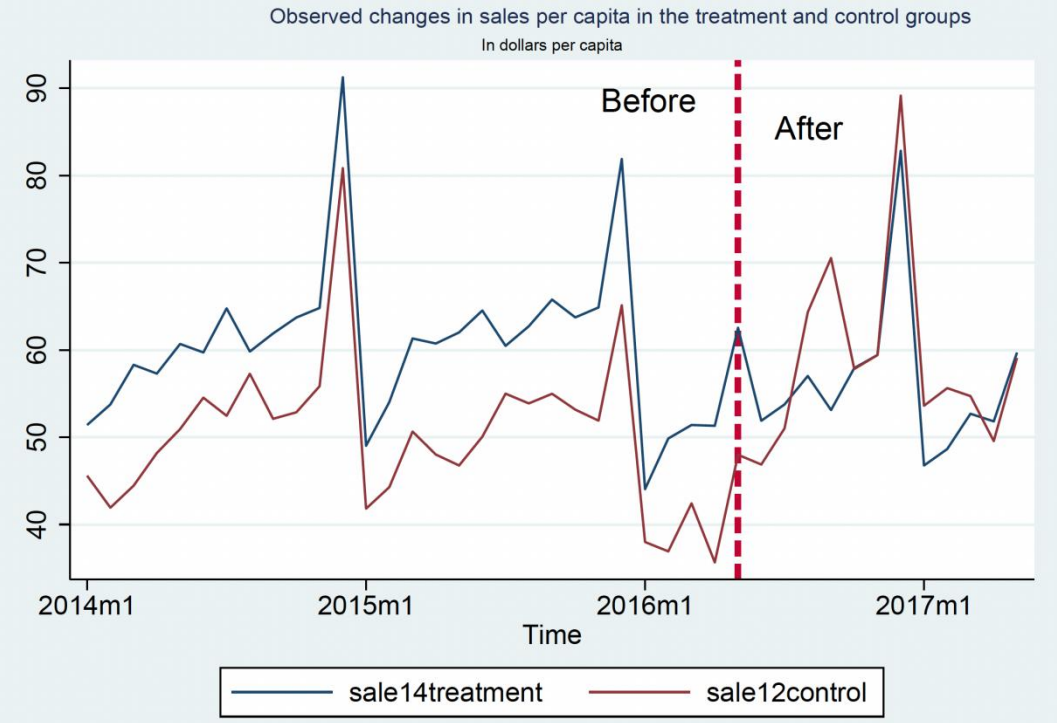

Figure 1. The trends of sales of treatment (VAT 14%) and control (VAT 12%).

The effect of VAT on sales was estimated as the difference between the change in income before and after the introduction of the tax increase in the treatment group (i.e., the actual

effect of VAT) and the change in income before and after VAT with no increase in the control group (i.e., only secular trends in outcome).

The DID estimate is unbiased when trends in canton sales due to unobserved factors in the control group are the same as they would have been in the treatment-eligible group if the eligible group had not been exposed. to politics (Angrist & Pischke, 2009). The control group should ideally be like the qualified group, except for the eligibility characteristics. The parallel prior trends test arises naturally in the potential treatment approach to DiD, which assumes we can write possible outcomes for a group (Macas-Acosta et al., 2022).

To correct this, a DD could be estimated for the affected group (sales with VAT) and a DD for the non-affected group (sales without VAT). The triple difference estimator (DDD) is then calculated as the difference in the DD estimators comprising the interaction of the multiplication of the dummy variables (iva*after*tax). With this situation, the assumption of identification changes since now the difference in the change in the time between the treated and control groups that correspond to the sales that pay VAT is a good counterfactual of the difference in the change in the time between the group treaty and rule that fits sales that do NOT pay VAT (see figure 2).

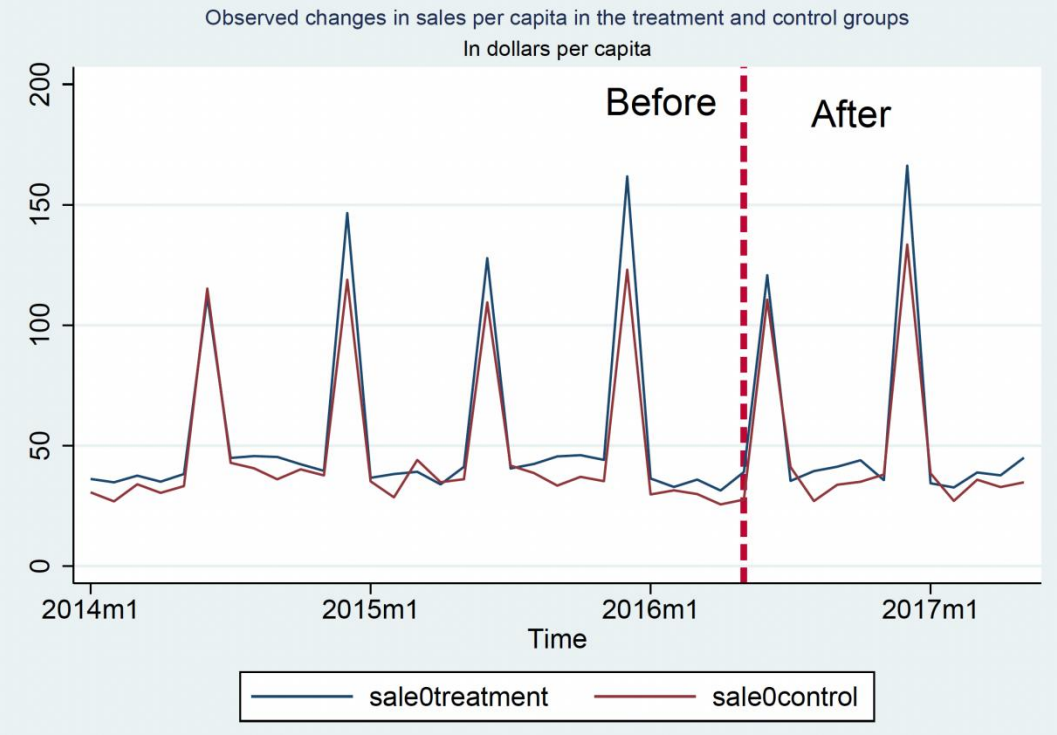

Figure 2. The trends of sales of treatment (VAT 0%) and control (VAT 0%).

This way, possible results could be found, and various specifications could be applied as double differences but with control variables such as time, province, trend, and then triple difference. In addition, there is a double contrast between goods that pay and do not pay VAT only in cantons outside of Esmeraldas and Manabí. Thus, it is also determined its robustness to these specifications.

1.2. Variables

The event is the VAT increase from 12 to 14% that was applied in May 2016, but only to the cantons of the provinces unaffected by the earthquake, which became the treatment. The cantons of the two regions affected by the quake will not increase so that they will be under control.

Sales without VAT remain the same in all country cantons since they are essential products. The study focuses on a single period (cross-section).

The following variables are identified in the investigation:

Per capita sales in dollars that are made with the Value Added Tax (VAT) of 12%

Per capita sales in dollars that are made with the Value Added Tax (VAT) of 14%

The per capita sales in dollars made without the Value Added Tax (VAT) is 0%.

A dummy variable to identify the event of the application of the VAT increase from 12 to 14%

Generate a temporary variable for the panel: gen month_year = ym(year, month)

Generate a variable ID Panel: gen canton_prov = province*1000+canton

Generate a post VAT increase: gen after = month_year>tm(2016may)

Generate a binary variable: 1 if VAT increased in a non-affected province and 0 only for Esmeraldas and Manabí: gen tax = 1

Generate a logarithm of sales per capita: lsales = log(sales)

In addition, create an Interaction between the generated variables:

gen ddd = vat*after*tax

gene d1 = after*tax

gen d2 = vat*after

gen d3 = vat*tax

Generate a leading indicator of taxes (leading indicators - tax)

gen month1 = month_year17*tax

gen month2 = month_year16*tax

Generate a leading indicator of VAT (leading indicators - VAT)

gen month1 = month_year17*vat

gen month2 = month_year16*vat

Generate a trend variable by province: tab province, gen(prov)

The potential problems that can be identified could be generated if people who live in nearby cantons and who have the VAT increase can move to a city that does not have the measure.

1.3. Empirical Model

This section explains the methodology used to verify the hypothesis that the VAT increase impacts sales. In the first instance, three equations were structured, each with four models that will allow for the best strategy to determine the most efficient and consistent coefficients. The first equation tries to analyze a difference between the control (Manabí and Esmeraldas) vs. the treatment (rest of the country) on the VAT increase but in different models starting with effects of time, province, and trend with the province. The objective is to obtain the coefficient d1.

$$lsales_{it} = \alpha + \beta_1 after_{it} + \beta_2 tax_{it} + \beta_3 d_1 + \mu_{it} \quad (1)$$

The second equation tries to analyze a difference between the control (Manabí and Esmeraldas) and the treatment (rest of the country) on those who pay the VAT and those who pay 0% of the tax but in different models starting with time effects, province, and trend with the province. The objective is to obtain the coefficient d2. Equation 3 is then carried out to get the global development of the impact of tax measures globally.

$$lsales_{it} = \alpha + \beta_1 VAT_{it} + \beta_2 after_{it} + \beta_3 d_2 + \mu_{it} \quad (2)$$

$$lsales_{it} = \alpha + \beta_1 VAT_{it} + \beta_2 after_{it} + \beta_3 tax_{it} + \beta_4 d_1 + \beta_5 d_2 + \beta_6 d_3 + \beta_7 ddd + \mu_{it} \quad (3)$$

Then, models are made to verify that the trends are parallel before the fiscal measure. The idea is to demonstrate no effect on products that do not pay the VAT with the three additional specifications: time effects, province effects, and effects in conjunction with trend and province.

$$lsales_{it} = \alpha + \beta_1 after_{it} + \beta_2 tax_{it} + \beta_3 d_1 + \mu_{it} \qquad if\ VAT == 0 \qquad (4)$$

$$lsales_{it} = \alpha + \beta_1 VAT_{it} + \beta_2 after_{it} + \beta_3 d_2 + \mu_{it} \qquad if\ VAT == 0 \qquad (5)$$

This strategy is critical because it may happen that the control group is not very good or because the functional form of the counterfactual is incorrect. Therefore, whenever the data allows, researchers must test the assumption of parallel trends using a "dummy trend" test (Kahn-Lang & Lang, 2019).

Angrist and Pischke (2010) argued that the more effective differences-in-differences method reports the results of treatment and control observations over a period long enough to show underlying trends, with attention focused on how deviations of the direction are related to changes in policy (Angrist & Pischke, 2010; Romero-Subia et al., 2022).

2. Results

With the defined variables and the transformed data, it was possible to carry out the first regression (equation 1), but with different control variables where its results are demonstrated in four models. The purpose was to determine the coefficients of the variable d1, which is the interaction of the variables after tax. That is, obtain the first difference between the effect when the VAT increase was generated between the treatment and control groups. The best result was the fourth model since it has all the control variables, and its coefficient was negative, -0.2544, and significant (See Table 1).

The second equation has the same structure as the previous one, but now the variables VAT, after, and d2 are included. Seeing the difference between those who pay the new VAT and those who remain with the 0% VAT is a matter of seeing it. Likewise, four models were carried out; the last one generated a negative coefficient of -0.1315, which is also significant. The difference with the rest of the models is similar since the first obtained -0.1383 but without the corresponding effects.

With the two equations measuring the difference at different times, the third equation can now be executed. Its main objective is to obtain the coefficient of the third difference (D), which quantifies the impact of the VAT increase in the 12 months that the measure lasted.

Table 2 shows that the coefficient of the id variable is the same and highly significant in the four models. This implies that the increase of two percentage points caused a reduction in the average per capita sales transformed into logarithms of approximately 22.3% in that period.

Table 1. Primary Outcomes VAT 0%, 12%, and 14%.

VAT 12% vs. VAT 14%	MODEL 1	MODEL 2	MODEL 3	MODEL 4
After	0.1637***	0.3198***	0.3224***	0.3257***
	(0.0268)	(0.0282)	(0.0279)	(0.0286)
Tax	1.3635**	1.3638**	1.3638**	1.4192**
	(0.6572)	(0.6581)	(0.6572)	(0.5860)
d1	-0.2460***	-0.2463***	-0.2492***	-0.2544***
	(0.0294)	(0.0294)	(0.0291)	(0.0293)
Time effect	NO	YES	YES	YES
Province effect	NO	NO	YES	YES
Trend and province	NO	NO	NO	YES
VAT 14% vs. VAT 0%	**MODEL 1**	**MODEL 2**	**MODEL 3**	**MODEL 4**
VAT	0.7067***	0.7067***	0.6998***	0.6998***
	(0.1761)	(0.1762)	(0.1765)	(0.1766)
After	0.0560***	0.2066***	0.2032***	0.2021***
	(0.0201)	(0.0237)	(0.0236)	(0.0231)
d2	-0.1383***	-0.1383***	-0.1315***	-0.1315***
	(0.0141)	(0.0141)	(0.0142)	(0.0142)
Time effect	NO	YES	YES	YES
Province effect	NO	NO	YES	YES
Trend and province	NO	NO	NO	YES

Source: Authors' Compilation.

This reduction was generated only for taxpayers in the cantons that suffered the measure. In certain cities, the values were higher because there was more movement, and their inhabitants could not access the same goods they used to consume.

Superficial differences certainly provide an unbiased estimate of treatment effects. However, for these coefficients to be potentially robust, they must be verified using a falsification test. Different models will be applied to demonstrate no impact on products that do not pay the VAT with all the controls, both for the selected group as treatment and management.

Table 3 shows that after May 2016, sales of products with zero tax (staple foods) increased by 24.38 in the cities considered as treatment. Furthermore, if the control cities are also analyzed, they also had increases in sales of 29.9%; both coefficients came out significant in the regression that all possible controls were used.

Table 2. Secondary Outcomes Difference in Difference.

	MODEL 1	MODEL 2	MODEL 3	MODEL 4
VAT	0.1526	0.1526	0.1451	0.1451
	(0.1562)	(0.1563)	(0.1564)	(0.1563)
After	0.0790**	0.2391***	0.2359***	0.2387***
	(0.0255)	(0.0264)	(0.0261)	(0.0264)
Tax	0.8094	0.8997	0.8103	0.8167
	(0.4870)	(0.4873)	(0.4869)	(0.5722)
d1	-0.0238	-0.0232	-0.0238	0.0279
	(0.0268)	(0.0325)	(0.0319)	(0.0314)
d2	0.0846**	0.0846**	0.0921**	0.0921**
	(0.0315)	(0.0315)	(0.0316)	(0.0316)
d3	0.5541**	0.5541**	0.5541**	0.5541**
	(0.0294)	(0.2355)	(0.2355)	(0.2357)
ddd	**-0.2230*** **	**-0.2230*** **	**-0.2230*** **	**-0.2230*** **
	(0.0345)	(0.0345)	(0.0346)	(0.0346)
Time effect	NO	YES	YES	YES
Province effect	NO	NO	YES	YES
Trend and province	NO	NO	NO	YES

Source: Authors' Compilation.

Table 3. 0% VAT in Treatment Provinces

VAT 0% (Rest of the country)	MODEL 1	MODEL 2	MODEL 3	MODEL 4
After	0.0790**	0.2431***	0.2416***	0.2438***
	(0.0255)	(0.0305)	(0.0305)	(0.0308)
Tax	0.8094	0.8097	0.8079	0.7584
	(0.4870)	(0.4876)	(0.4863)	(0.5802)
d1	-0.0229	-0.0231	-0.0214	-0.0245
	(0.0325)	(0.0325)	(0.0320)	(0.0315)
Time effect	NO	YES	YES	YES
Province effect	NO	NO	YES	YES
Trend and province	NO	NO	NO	YES
VAT 0% (Esmeraldas & Manabí)	**MODEL 1**	**MODEL 2**	**MODEL 3**	**MODEL 4**
VAT	0.1526	0.1526	0.141	0.141
	(0.1586)	(0.1594)	(0.1594)	(0.1594)
After	0.0790**	0.3040***	0.2982***	0.2990***
	(0.0259)	(0.0270)	(0.0267)	(0.0269)
d2	0.0846**	0.0846**	0.0962**	0.0962**
	(0.0320)	(0.0321)	(0.0328)	(0.0328)
Time effect	NO	YES	YES	YES
Province effect	NO	NO	YES	YES
Trend and province	NO	NO	NO	YES

Source: Authors' Compilation.

Conclusions

Most governments frequently use tax reforms to access liquidity and finance their current expenses, social programs, or reconstruction. In this sense, it is essential to quantify its effects. A better understanding of these effects can benefit public policymakers and academics interested in studying fiscal policy empirically. This research contributes to the literature by applying a method that allows estimating the causal relationship effect of a specific tax policy on commercial transactions on their sales income.

This research studies the impact of the value-added tax (VAT) increase from 12 to 14% imposed by the Ecuadorian government in May 2016 and last year to finance the damage caused by the earthquake in April 2016. The analysis was focused on the sales of products

taxed with VAT and those that do not have a tax (0% VAT). We use a differences-in-differences approach to obtain an unbiased estimate, which creates an appropriate control by combining product sales information in two provinces unaffected by the policy change.

The results indicate that the two-percentage point increase produced a statistically significant reduction in sales in 22 provinces of 22.3%. Interestingly, this estimate is very similar to a before and after assessment. It can be seen as evidence that the policy shock under investigation did not co-occur with other relevant but unobserved (by the researcher) or that it is exogenous. The exogeneity and the apparent stationarity of the series imply that a before and after comparison provides a reasonable estimate of the treatment effect.

In this sense, this research's main contribution is methodological. The differences-in-differences method can be used as a robustness check for more formal specifications and as an indirect test for the homogeneity of policy shocks. Furthermore, if the policy under study coincides with, and is therefore confounded with, other changes observed nationally or internationally, other methods could be combined to estimate the causal effect of interest.

Finally, the estimation method used has the potential to assess the impact of particular policies or programs on outcome variables other than business sales, such as taxes collected, investment flows, assistance programs, and job creation, among others.

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Conflicto de interés

Los autores de este manuscrito declaran no tener ningún conflicto de interés.

Declaración ética

Los autores declaran que el proceso de investigación que dio lugar al presente manuscrito se desarrolló siguiendo criterios éticos, por lo que fueron empleadas en forma racional y profesional las herramientas tecnológicas asociadas a la generación del conocimiento.

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