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Colegio de Administración y Economía

Beyond TFP Estimation: Productivity in Ecuador in the Aftermath of the Oil Boom

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RESUMEN

Realizo una estimación de la productividad total de los factores en Ecuador para los sectores transables y no transables, para los años 2015, 2016 y 2017. Utilizo un estimador de Arellano Bond para una función de producción de Cobb Douglas para corregir problemas de endogeneidad. Encuentro que las estimaciones de trabajo y capital para bienes transables son 0.52 y 0.42; mientras que para los no transables son 0.25 y 0.44. Cuando calculo la PTF, encuentro que las industrias más productivas son la construcción para el sector transable y la información y comunicación para el sector no transable. Los grupos económicos y las grandes corporaciones son los más productivos en ambos sectores. Respecto a la distribución geográfica de la productividad, encuentro que para el sector transable Orellana, Manabí y Cañar son los más productivos y para el sector no transable es Carchi.

Palabras clave: Productividad total de los factores, función de producción, transables y no transables, industrias.

ABSTRACT

I perform an estimate of total factor productivity for Ecuador for the tradable and non-tradable sectors, for the years 2015, 2016 and 2017. I use an Arellano Bond estimator for a Cobb Douglas production function in order to correct endogeneity issues. I find the estimates of labor and capital for tradable goods are 0.52 and 0.42; while for the non-tradable are 0.25 and 0.44. When calculating TFP I find that the most productive industries are construction for tradable and information and communication for non-tradable. Economic groups and big corporations are the most productive in both sectors. Regarding the geographic distribution of productivity I find that for the tradable sector Orellana, Manabí and Cañar are the most productive and for the non-tradable sector is Carchi.

Keywords: Total factor productivity, production function, tradable and non-tradable, industries.

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1. Introduction

Due to the increase of the price of the WTI prices in 2014, Ecuador's economy seemed to enroll in a rapid growth spurt. However, in the aftermath of the oil boom, Ecuador's economy became stagnated. Some of the most significant impacts were that people were laid off and imports and exports were reduced. In the light of this, what happened to productivity during the economic downturn in Ecuador?

To answer this question I estimate productivity from a Cobb Douglas production function using data at the firm level for 26,048 firms for the period 2014 to 2017 for tradable and non-tradable sectors. The methodology used was an Arellano-Bond estimator in order to reduce endogeneity problems and bias in the total factor productivity estimates. The use of this estimator takes the lags of each year for each firm as an instrumental variable, thus losing one year. Therefore I present results for years 2015, 2016 and 2017.

I find that for tradable goods, the construction industry remains the most productive during the period studied. On the other hand, within the non-tradable sector, the information and communication industry takes this place. Regarding the geographic distribution of productivity, in spite of Pichincha and Guayas being the largest provinces in the country since they concentrate around 43% of the country's population (INEC, 2010) and most of the firms are based there, I find that for tradable goods the provinces that show the most productivity were Orellana, Manabí and Cañar; while in the non-tradable goods were Carchi for two years in a row and Pichincha.

This study contributes to the literature that estimates TFP for Ecuador. In particular, it provides a precise measure of TFP based on the Arellano-Bond estimator, solving many of the

endogeneity issues that are present in this type of empirical exercises. Moreover, this paper presents estimations for heterogeneous groups including tradable and non-tradable sectors, by geographic location, and by type of firm (locals, open to international trade, import-competing, economic groups), which allows it to present a detailed taxonomy of productivity in Ecuador.

In this regard, Wong (2008) estimates Ecuador's productivity only for manufacturing industries. She calculates productivity based on a Cobb Douglas production function and she controls the regression with variables on plant efficiency and plant-invariant effects that represent economic events that had an impact on the economy, such as dollarization in 2000. In order to correct the endogeneity problem she uses an instrumental variable with the technique of one-time labor as an instrument for itself. The problem with this strategy is that while it may correct for labor, the rest of the covariates are still endogenous. Then, Wong adds the productivity estimate obtained with plant efficiency to obtain a plant-specific productivity (Wong, 2008). This results in unobservable productivity which presents correlation problems, causing the estimates not to be the most accurate to represent TFP.

In the same line, Camino, Armijos & Cornejo, (2018) calculate total factor productivity for the manufacturing industry at the firm level. The authors estimate TFP based on a GMM system estimator. It takes capital as its exogenous variable, while labor and raw materials are endogenous. The instruments used are the lagged variables for labor and consumption of raw materials. They add variables to control for the economic shocks that occurred during the period studied.

The rest of the paper is organized as follows. In section 2 the estimation method is explained as well as how endogeneity problems are corrected. Section 3 focuses on data and

summary statistics. In section 4 I present the results, while in section 5, I make the final remarks.

2. Methodology

This study draws from the literature of TFP calculation for Ecuador. The purpose is to design an empirical strategy to obtain TFP estimates for Ecuador for tradable and non-tradable sectors that are precise and free of endogeneity issues that normally arise in this type of estimations. For this, it uses a Cobb-Douglas production function as the central equation in order to calculate TFP. Total factor productivity is defined as "the portion of output not explained by the amount of inputs used in production… it is determined by how efficiently and intensely the inputs are utilized in production". (Comin, 2006).

Using the International Standard Industrial Classification (ISIC) goods are classified into tradable and non-tradable. The tradable sector includes ISIC codes A, C, F and G which are agriculture forestry and fishing, manufacturing, construction, wholesale and retail trade with repair of motor vehicles and motorcycles respectively. The non-tradable includes ISIC codes J which is information and communication and K is financial and insurance activities.

Firms are also classified by their trade status. These categories are importers, importer-exporters, exporters and local firms. Firms are classified as:

> "Importer-exporter when the ratios of imports-sales and exports-sales both exceed 15%. A firm is only an importer when it is not an importer-exporter but its imports-sales ratio exceeds 15%, and a firm is an exporter when the ratio exports-sales exceeds this threshold. Otherwise, we classify a firm as local. We can further combine the import-competing

> and the trade status classifications to arrive to a more detailed firm classification that identifies import-competing firms within each trade status category." (Grijalva et al., 2019).

From the production function, equation 1 is estimated twice, once with the sample for tradable goods where total production is measured as Value Added, and then for non-tradable goods where production corresponds to total sales. In particular, I want to estimate the following equation,

$$logY = \alpha_0 + \alpha_L \log(L) + \alpha_k \log(K) + \delta_{1_{2015}} + \delta_{2_{2016}} + \delta_{3_{2017}} + \delta_4 bigcorp + \delta_5 econgroup + \delta_6 econcorp + u_{jt} \quad [1], \qquad (1)$$

for firm j at time t where Y is value added (total production less raw materials), L is labor, K is capital, $\delta_{1_{2015}}$, $\delta_{2_{2016}}$, $\delta_{3_{2017}}$, are dummy variables for years 2015, 2016 and 2017 respectively. $\delta econgroup$ is a dummy variable that identifies firms that are part of economic groups and the same goes with $\delta bigcorp$ which is for big corporations. Then there is $\delta econcorp$ which is an interaction variable between $\delta econgroup$ and $\delta bigcorp$. Finally there is the productivity term (TFP) which is interpreted through the error component (u_{jt}).

The empirical exercise begins with an ordinary least squares (OLS) estimation for equation 1. Since I do not have data on these, OLS estimates will be inconsistent and biased, leading to an upward bias in large samples, which is our case (Wong, 2008). Also in the OLS estimation the capital coefficient will be biased due to the attrition endogeneity which occurs in large panel data. Another problem that arises when running the OLS estimation is that there

[1] The equation is based on the general neoclassical form of the production function shown in Diewert (1967).

can be biased results because of a difference in production technologies used by firms (Camino, 2018).

Another possibility is to exploit the panel structure of the data. For this, the fixed effects estimator helps to correct part of the issues of the OLS estimation by controlling for the fixed unobservable portion of the error term, producing a cleaner estimate of TFP. For being able to recover the random effects estimator, fixed effects are modeled with a parametric form (Hoderlein, 2009), where means across time for all the controls are included.

Although the random effects estimator combined with the parametric model for the fixed effects reduces the correlation between observables and the error term, it does not solve the endogeneity present in the explanatory variables. To correct this, the Arellano-Bond estimator is used. The advantage of this method is that the instruments for the endogenous variables can be recovered within the same dataset from lags of the data. The idea is that lags would affect the explain variable (production in my case), only through its effect on the current value of the covariates, but are not correlated to the current error term, thus satisfying the exclusion restrictions for instrumental variables. This estimator is designed for dynamic panels that include a very large cross-section for a small time frame. This characteristic prevents the estimator from dealing with autocorrelation problems in the error term and it helps explain the dependent variable (Arellano, 1991).

There are 2 different Arellano-Bond estimators, one-step and two-step, both are calculated in this study. I use the two-step estimates since they are computed by using the residuals from the one step-estimates. Therefore the productivity estimate interpreted in the

results section is the one obtained from the two-step estimator since this is the more robust (Roodman, 2003)[2].

Finally, this study takes the measure of productivity obtained from the two-step Arellano Bond estimation to take advantage of the fact that I am able to recover TFP for each firm in our sample, so I can study the distribution of productivity among different groups of firms. Thus, productivity is shown by province, economic group, big corporation, economic groups, big corporations, International Standard Industrial Classification (ISIC), and trade status only for tradable goods.

3. Data

The data used in this study comes from Grijalva et al., (2019). Data was originally obtained from the *Superintendencia de Compañías (Supercias)* for the period 2014 to 2017. This dataset contains detailed information on the general balances of all companies registered with the Internal Revenue Service, so it constitutes the universe of formal firms. In table 1 and 2 I present summary statistics for the sample that I use in the estimations. For non-tradable goods I include the sales as a proxy for production, while for tradable goods I include value added. Both tables include the number of workers, and the main to the rest of covariates used to estimate the model proposed in the previous section.

[2] Roodman mentions that in order to compensate the use of two step Arellano-Bond "makes available a finite-sample correction to the two-step covariance matrix derived be Windmeijer" (2003).

Table 1: Summary statistics non-tradable goods using sales

	Variable	Obs	Mean	Std. Dev.	Min	Max
year = 2015	Sales	234	18.22	111.07	0	1520.23
	Capital	234	103.51	702.10	0	8928.28
	Workers	234	0.14	0.54	0	6.16
	Economic Groups	234	0.06	0.24	0	1
	Economic Groups and Big Corporations	234	0.06	0.24	0	1
year = 2016	Sales	237	16.37	103.49	0	1430.66
	Capital	237	105.25	778.51	0	10116.06
	Workers	237	0.13	0.49	0	5.60
	Economic Groups	237	0.11	0.31	0	1
	Economic Groups and Big Corporations	237	0.10	0.30	0	1
year = 2017	Sales	235	17.38	97.44	0	1305.44
	Capital	235	119.68	825.79	0	10615.39
	Workers	235	0.13	0.51	0	5.48
	Economic Groups	235	0.12	0.32	0	1
	Economic Groups and Big Corporations	235	0.10	0.30	0	1

Table 2: Summary statistics tradable goods using value added

	Variable	Obs	Mean	Std. Dev.	Min	Max
year = 2015	Value Added	8,593	2.93	14.55	0	521.07
	Capital	8,593	6.04	29.49	0	1342.99
	Workers	8,593	0.07	0.28	0	8.69
	Economic Groups	8,593	0.06	0.24	0	1
	Economic Groups and Big Corporations	8,593	0.04	0.21	0	1
year = 2016	Value Added	8,577	2.74	13.52	0	455.97
	Capital	8,577	6.12	30.22	0	1440.14
	Workers	8,577	0.06	0.27	0	8.33
	Economic Groups	8,577	0.08	0.27	0	1
	Economic Groups and Big Corporations	8,577	0.06	0.23	0	1
year = 2017	Value Added	8,172	3.07	14.50	0	470.91
	Capital	8,172	6.71	32.26	0	1564.00
	Workers	8,172	0.06	0.28	0	8.43
	Economic Groups	8,172	0.08	0.27	0	1
	Economic Groups and Big Corporations	8,172	0.06	0.23	0	1

4. Results

In this section I present the estimates for equation 1. First, table 3 presents the results for tradable goods, using OLS, fixed effects, and one step and two step Arellano Bond models. In what follows, I always refer to the two step Arellano Bond estimator because this is the more robust.

The coefficients obtained for labor and capital, are 0.52 and 0.42 respectively showing that the assumption of constant returns to scale is plausible for the case of tradable goods. Under this assumption, a coefficient of 0.42 for the capital input implies that, in the Ecuadorian tradable sector, 42% of production is paid to capital. This level is significantly higher than estimates for developed countries (for the US this coefficient is close to 36%), a finding that is in line with the fact that the stock of capital is lower in developing countries, so its marginal productivity tends to be higher.

To avoid the possibility of omitted variable bias, I include additional controls that can be correlated to the level of production of firms. The first is a dummy variable that identifies economic groups which are defined as the "set of parties, made up of individuals and companies, both national and international, foreign countries, where one or more of them directly or indirectly own 40% or more of the shareholding in other companies". Reglamento para la Aplicación de la Ley de Régimen Tributario Interno. (2015). Economic groups might be important not only because of their access to capital and labor, but also because of their abilities to form production networks, which can be thought of as an important input to increase production.

Also, I control the regression by a dummy that identifies big corporations. These are defined as firms "with sales above the industry average sales at the ISIC 3-digits level". (Grijalva et al., 2019). This covariate is important because its production scheme is completely different compared to non-big corporations. For example, while a big corporation might have access to more state-of-the-art technology, smaller firms might use more artisan techniques.

Table 3: Production function estimates obtained for tradable with value added

	OLS	Fixed Effects	One Step Arellano Bond	Two Step Arellano Bond
Log Labor	0.294***	0.546***	0.522***	0.522***
	(0.009)	(0.012)	(0.035)	(0.035)
Log Capital	0.268***	0.469***	0.429***	0.423***
	(0.01)	(0.01)	(0.049)	(0.048)
2015	-0.054***	0.051***		
	(0.010)	(0.007)		
2016	-0.130***	-0.043***	-0.098***	-0.094***
	(0.011)	(0.007)	(0.007)	(0.006)
2017	0	0	-0.063***	-0.064***
	(.)	(.)	(0.009)	(0.009)
Economic Group	0.132***	0.075	0.068	0.067
	(0.039)	(0.053)	(0.057)	(0.057)
Big Corporations	0.310***	0.397***	0.400***	0.398***
	(0.013)	(0.020)	(0.027)	(0.027)
Economic Groups and Big Corporations	0.111***	-0.084	-0.093	-0.091
	(0.040)	(0.057)	(0.057)	(0.057)
L.log Yva	0.402***	-0.086***	-0.039	-0.040
	(0.013)	(0.006)	(0.026)	(0.026)
Constant	3.305***	6.114***	6.180***	6.278***
	(0.109)	(0.145)	(0.622)	(0.590)
Observations	25342	25342	15486	15486

Standard errors in parentheses
* p<0.1, ** p<0.05, *** p<0.01

In table 4, I show the averages of the TFP estimates obtained for tradable goods using value added. Since I am able to estimate TFP for every firm, I group them by heterogeneous groups. Results indicate that the most productive industry is construction for the years studied. This industry includes activities such as general construction, specialized in buildings and civil

engineer works. During this time frame, construction represents, on average, 18.44% of total GDP, this may be due to the increase in public investment. Highways, hydroelectric plants and infrastructure for education, were among the largest investments the government carried out.

Table 4: Total factor productivity estimates obtained for tradable goods using value added

Total Factor Productivity Tradable Value Added	**2015**	**2016**	**2017**
CIUU			
A - Agriculture Forestry and Fishing	1.14	1.34	1.42
C – Manufacturing	1.25	1.29	1.35
F – Construction	1.25	1.39	1.50
G - Wholesale and retail trade, repair of motor vehicles and motorcycles	1.23	1.28	1.35
Economic Groups			
0 - Non Economic Groups	1.22	1.27	1.34
1 - Economic Groups	1.36	1.50	1.58
Big Corporations			
0 - Non Big Corporations	1.16	1.22	1.31
1 - Big Corporations	1.35	1.43	1.46
Economic Groups and Big Corporations			
0 - Non Economic Groups nor Big Corporations	1.22	1.27	1.34
1 - Economic Groups and Big Corporations	1.49	1.69	1.75
Trade Status			
Local, no import-competing	1.23	1.49	
Local, import-competing	0.72	0.35	
Exporter, no import-competing	1.84	1.79	2.08
Exporter, import-competing	0.99	1.15	1.13
Importer-exporter	1.47	1.58	1.58
Importer	1.14	1.19	1.26
Importer, import-competing	1.20	1.28	1.34

TFP estimates are consistent with what I expected. Economic groups are more productive than their counterparts, as well as big corporations. In the same line, the most productive group of firms according to their trade status are the exporter's non-import competing. This implies that, in terms of productivity, in Ecuador the firm's size does matter, but also their ability to build networks (economic groups) and their exposure to international trade (exporters non-import competing).

Table 5: Total factor productivity estimates by province obtained for tradable goods using value added

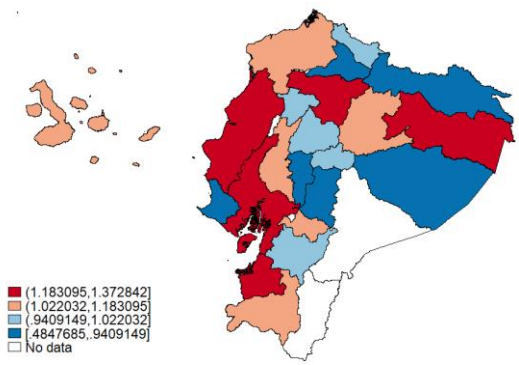
Total Factor Productivity Tradable Value Added	**2015**	**2016**	**2017**
Provinces			
Orellana	1.37	1.29	1.8
Guayas	1.26	1.34	1.42
Pichincha	1.26	1.31	1.38
El Oro	1.24	1.39	1.35
Manabí	1.21	1.43	1.32
Cañar	1.18	1.14	1.96
Galápagos	1.15	1.35	1.37
Esmeraldas	1.08	1.01	1.15
Los Rios	1.07	1.15	1.35
Loja	1.06	0.93	1.04
Napo	1.04	0.74	1.48
Azuay	1.00	0.96	1.04
Cotopaxi	0.99	1.07	1.2
Tungurahua	0.97	1.04	1.12
Carchi	0.96	0.77	1.32
Santo Domingo de los Tsachilas	0.95	0.92	0.92
Imbabura	0.94	0.96	1.14
Chimborazo	0.9	1.02	1.13
Santa Elena	0.76	1.2	1.17
Bolivar	0.74	0.91	0.52
Sucumbíos	0.65	0.69	0.65
Pastaza	0.48	0.26	0.38

In table 5 and graph 1, I show productivity for tradable goods per province for years 2015, 2016 and 2017. Orellana province is the most productive in 2015 with an estimate of 1.37; in 2016 Manabí with 1.43 and 2017 Cañar with 1.96. The urbanization rate for Pichincha, Guayas and Manabí provinces are the largest in the country, therefore they are among the most productive. A closer look to Graph 1 shows decrease in productivity by provinces in 2016 form 2015, and a recovery in 2017.

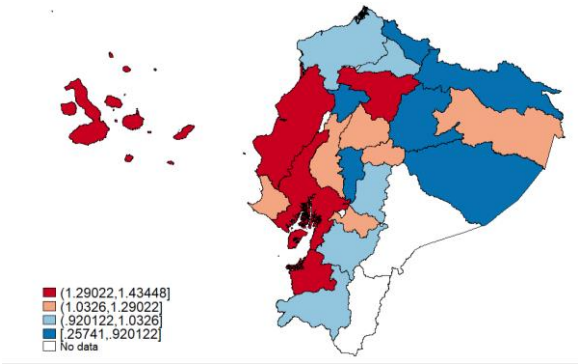
Part of the evolution of productivity in this period might be explained by public policies. For example, in March 2015 the government implemented a safeguard tariff policy that was in place until June 2017, this may lead firms to prefer to use local goods rather than import ones; therefore reducing productivity in 2016.

Due to a massive earthquake in Ecuador's coast, the government decided to increase the value added tax rate from 12% to 14%. This may have caused the final prices of goods to increase, therefore the incentives for consumption may fall, leading to less production and less productivity.

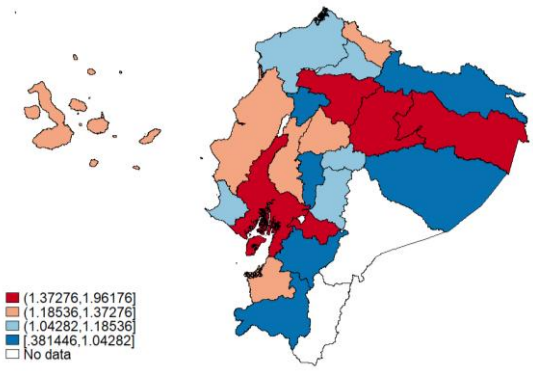
Graph 1: Total factor productivity for tradable goods by province per year 2015 – 2017



a. 2015



b. 2016



c. 2017

In table 6, I present the regression estimates obtained in the OLS, fixed effects and one step and two step Arellano Bond for non-tradable goods with sales. By using this data I am able to construct the TFP estimates for non-tradable goods. I do the same exercise of adding both estimates labor and capital in the two step Arellano Bond model. I get 0.69, which is less than 1, meaning they exhibit decreasing returns to scale. The fact that non-tradable firms have decreasing returns to scale may result as the fact that these industries do not have lots of competitors. For example in the financial industry there are a few firms that earn most of the incomes, leading to an oligopoly structure. This means they have low competition, this leads to a reduction in productivity since they are not producing at their maximum capacity. Firms may have and excessive capacity to produce goods installed and what is making then have decreasing returns to scale is that they may be producing below their capacity.

In table 7, I present TFP results obtained for non-tradable goods using sales as a proxy for total production. The results show that the most productive industry is information and communication for the years studied. This industry includes activities such as publishing activities, motion pictures, programming and telecommunications. Information and communication industry represents an average for the period I consider 5.47% of the total GPD, this may be as well due to public investment. During Rafael Correa's government, he implemented a mandatory presidential broadcast on television and radio every Saturday.

As well as in the case of tradable goods, for non-tradable goods the firms that remain the most productive are economic groups, big corporations, and the interaction of both.

Table 6: Production function estimates obtained for non-tradable goods using sales

	OLS	Fixed Effects	One Step Arellano Bond	Two Step Arellano Bond
Log Labor	0.214***	0.262***	0.228*	0.254**
	(0.043)	(0.065)	(0.129)	(0.126)
Log Capital	0.191***	0.505***	0.452***	0.443***
	(0.037)	(0.072)	(0.105)	(0.101)
2015	-0.015	0.091*		
	(0.069)	(0.053)		
2016	-0.118*	-0.007	-0.097**	-0.122***
	(0.064)	(0.051)	(0.039)	(0.0029)
2017	0	0	-0.086	-0.098
	(.)	(.)	(0.064)	(0.060)
Economic Group	0.087	0.150	0.023	-0.014
	(0.352)	(0.349)	(0.317)	(0.315)
Big Corporations	0.483***	0.764***	0.692***	0.681***
	(0.070)	(0.123)	(0.135)	(0.139)
Economic Groups and Big Corporations	-0.087	-0.422	-0.331	-0.310
	(0.356)	(0.348)	(0.272)	(0.274)
L.log Y	0.501***	-0.162***	-0.068	-0.110
	(0.057)	(0.045)	(0.125)	(0.144)
Constant	3.454***	7.953***	7.626***	8.286***
	(0.454)	(1.077)	(1.942)	(2.167)
Observations	706	706	428	428

Standard errors in parentheses
* p<0.1, ** p<0.05, *** p<0.01

Table 7: Total factor productivity estimates obtained for non-tradable goods using sales.

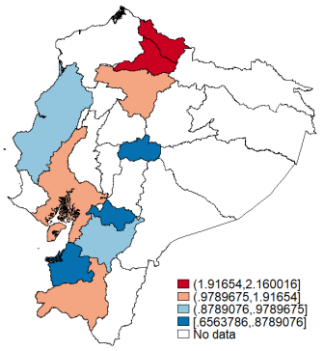
Total Factor Productivity Non-tradable Sales	**2015**	**2016**	**2017**
CIUU			
J - Information and Communication	1.72	1.81	1.90
K - Financial and Insurance Activities	1.20	1.06	1.87
Economic Groups			
0 - Non Economic Groups	1.42	1.26	1.40
1 - Economic Groups	5.67	5.87	5.58
Big Corporations			
0 - Non Big Corporations	0.94	0.90	0.95
1 - Big Corporations	2.19	2.39	2.76
Economic Groups and Big Corporations			
0 - Non Economic Groups nor Big Corporations	1.42	1.25	1.42
1 - Economic Groups and Big Corporations	5.67	6.10	6.34

Table 8: Total factor productivity estimates by province obtained for non-tradable goods using sales.

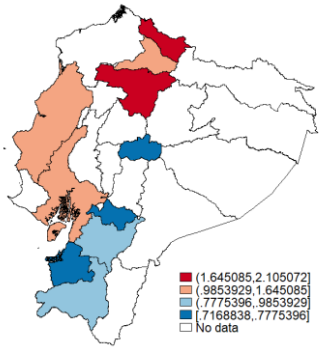
Total Factor Productivity Non-Tradable Sales	**2015**	**2016**	**2017**
Provinces			
Carchi	2.16	2.11	2.11
Imbabura	1.97	1.29	1.5
Pichincha	1.92	1.98	2.02
Guayas	1.54	1.65	1.75
Loja	1.05	0.95	0.67
Azuay	0.91	0.93	1.25
Manabí	0.88	1.02	1.08
El Oro	0.88	0.78	0.93
Tungurahua	0.66	0.72	0.68
Cañar	0.66	0.74	0.52
Napo			1.54

In table 8 and graph 2 I display productivity per province for years 2015, 2016 and 2016 respectively, for non-tradable goods. Data is not available for all provinces because only few of them produce non-tradable goods since they require higher investments and cash flow than tradable goods. These results are consistent with what I mentioned before: The provinces with highest urbanization rates (Pichincha and Guayas) remain among the most productive ones. It is interesting to see that that the province with the highest productivity for the years studied is Carchi. A possible explanation for this may be that it is the border with Colombia so people use financial institutions to take out capital resources to use them at our neighbor country.

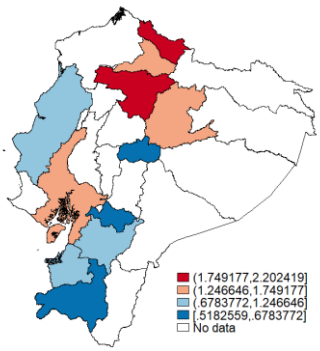
Graph 2: Total factor productivity for non-tradable goods by province per year



a. 2015



b. 2016



c. 2017

5. Conclusions

What happened to productivity during the economic downturn in Ecuador? In the aftermath of the oil boom, the Ecuadorian economy ended up with the construction industry being the most productive one within the tradable sector, while for the non-tradable was the information and communication industry. Big corporations and economic groups remain the most productive in the two sectors. For the tradable sector, the exporter, no import-competing is the most productive.

I answered this question by estimating productivity from a Cobb Douglas production function for tradable and non-tradable sectors. For this, I used the two-step Arellano-Bond

estimator to reduce endogeneity problems and reduce bias in the total factor productivity estimates.

With this study I contributed to the literature that estimates TFP for Ecuador. In particular, I provided a precise measure of TFP based on the Arellano-Bond estimator, solving many of the endogeneity issues that are present in this type of empirical exercises.

One limitation is that the time period is too short and I am not able to capture the evolution of TFP before and after the oil boom, so an avenue for further research might include to extend the time period studied. By doing this I will be able to capture the behavior of TFP in heterogeneous groups of firms during economic expansions and contractions.

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7. Appendix

Appendix 1: Production function estimates obtained for tradable goods with sales

	OLS	Fixed Effects	One Step Arellano Bond	Two Step Arellano Bond
Log Labor	0.127***	0.439***	0.429***	0.435***
	(0.007)	(0.012)	(0.032)	(0.032)
Log Capital	0.259***	0.470***	0.422***	0.405***
	(0.011)	(0.010)	(0.044)	(0.044)
2015	-0.036***	0.108***	0.115***	0.116***
	(0.010)	(0.007)	(0.009)	(0.009)
2016	-0.140***	-0.025***	-0.020***	-0.020***
	(0.011)	(0.007)	(0.008)	(0.007)
2017	0	0		
	(.)	(.)		
Economic Group	-0.155***	-0.001	0.01	0.024
	(0.041)	(0.051)	(0.088)	(0.088)
Big Corporations	0.465***	0.563***	0.567***	0.564***
	(0.014)	(0.019)	(0.029)	(0.029)
Economic Groups and Big Corporations	0.178***	0.032	0.052	0.047
	(0.043)	(0.054)	(0.104)	(0.103)
L.logY	0.514***	-0.047***	-0.011	-0.013
	(0.011)	(0.006)	(0.023)	(0.023)
Constant	2.783***	6.729***	6.899***	7.147***
	(0.094)	(0.142)	(0.553)	(0.524)
Observations	25969	25969	15935	15935

Standard errors in parentheses
* p<0.1, ** p<0.05, *** p<0.01

Appendix 2: Total factor productivity estimates obtained for tradable goods using sales

Total Factor Productivity Tradable Sales	2015	2016	2017
CIIU			
A - Agriculture Forestry and Fishing	1.05	1.18	1.42
C - Manufacturing	1.15	1.22	1.29
F - Construction	0.73	0.78	0.84
G - Wholesale and retail trade, repair of motor vehicles and motorcycles	1.51	1.58	1.66
Economic Groups			
0 - Non Economic Groups	1.34	1.40	1.49
1 - Economic Groups	1.60	1.72	1.82
Big Corporations			
0 - Non Big Corporations	1.20	1.24	1.35
1 - Big Corporations	1.65	1.78	1.83
Economic Groups and Big Corporations			
0 - Non Economic Groups nor Big Corporations	1.34	1.40	1.49
1 - Economic Groups and Big Corporations	1.78	1.96	2.07
Trade Status			
Local, no import-competing	0.93	1.20	
Local, import-competing	0.42	0.27	
Exporter, no import-competing	2.92	3.20	3.50
Exporter, import-competing	1.05	1.05	1.62
Importer-exporter	1.73	1.85	1.86
Importer	1.22	1.27	1.35
Importer, import-competing	1.11	1.18	1.26

Appendix 3: Production function estimates obtained for non-tradable goods with value added

	OLS	Fixed Effects	One Step Arellano Bond	Two Step Arellano Bond
Log Labor	0.203***	0.368***	0.227	0.194
	(0.044)	(0.069)	(-0.200)	(0.180)
Log Capital	0.181***	0.413***	0.316*	0.292*
	(0.036)	(0.081)	(0.167)	(0.171)
2015	-0.145**	-0.074		
	(0.071)	(0.057)		
2016	-0.128**	-0.079	-0.018	-0.068
	(0.062)	(0.054)	(0.072)	(0.044)
2017	0	0	0.049	0.031
	(.)	(.)	(0.072)	(0.060)
Economic Group	0.016	-0.345	-0.224	-0.157
	(0.334)	(0.370)	(0.352)	(0.341)
Big Corporations	0.332***	0.449***	0.530***	0.562***
	(0.066)	(0.133)	(0.128)	(0.126)
Economic Groups and Big Corporations	-0.010	-0.025	-0.240	-0.329
	(0.337)	(0.369)	(0.283)	(0.267)
L.logYva	0.557***	-0.182***	0.441	0.589*
	(0.060)	(0.046)	(0.346)	(0.311)
Constant	2.874***	9.114***	2.354	0.789
	(0.518)	(1.176)	(4.012)	(3.883)
Observations	689	689	415	415

Standard errors in parentheses
* p<0.1, ** p<0.05, *** p<0.01

Appendix 4: Total factor productivity estimates obtained for non-tradable goods with value added

Total Factor Productivity Non-tradable Value Added	**2015**	**2016**	**2017**
CIUU			
J - Information and Communication	1.28	1.82	1.63
K - Financial and Insurance Activities	0.66	1.39	0.93
Economic Groups			
0 - Non Economic Groups	1.24	1.88	1.62
1 - Economic Groups	0.89	0.96	1.19
Big Corporations			
0 - Non Big Corporations	1.61	2.98	2.25
1 - Big Corporations	0.94	0.87	0.93
Economic Groups and Big Corporations			
0 - Non Economic Groups nor Big Corporations	1.24	1.88	1.62
1 - Economic Groups and Big Corporations	0.89	0.98	1.12