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# Territorial Growth in Ecuador: The Role of Economic Sectors

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## Abstract

Ecuador is a developing country characterised by severe territorial disparities, reflected in a heterogeneous economic and social geography that risk to undermine a future balanced development.

The paper analyses for the first time the impact of main economic sectors on subnational growth process in the context of the "Changing Productive Matrix" policy objective, which aims to achieve productive diversification based on adding value through a deconcentration the production from the existing poles to the whole territory. The estimation is performed using new data provided by Central Bank of Ecuador for period 2007-2014 through a panel econometric technique. The results prove that, despite the strategy aimed at changing the productive matrix pushed by the government, this process is far to be completed. In particular the country is too much focussed into low productive sectors which depress economic growth and the manufacture and financial services sectors are too much concentrated in few areas, preventing their possible positive effect into the whole economy.

**Keywords:** Subnational growth, Ecuador, Spatial Econometrics, Panel Analysis, Economic Sectors.

[a] The authors are solely responsible for the content of the paper. The views expressed are purely those of the authors and may not in any circumstances be regarded as stating an official position of the European Commission.

# 1 Introduction

Ecuador, a country whose growth has been mainly favored by the high level of oil prices in recent years, has been characterized by persisting severe cantonal disparities, reflected in a heterogeneous economic and social geography, which account for cantons with asymmetric characteristics in terms of productivity and competitiveness, as well as in terms of differentiated population and social dynamics (Mendieta, 2015a; Ramón-Mendieta et al., 2013; Alvarado, 2011). CEPAL (2010) admits that these asymmetries between subnational areas can inhibit the growth of domestic production and contribute to its instability, becoming a problem of circular causation that can undermine the future development of the whole country.

In spite of the compensatory territorial policies that started in the 1990s together with policies and reforms whose aim was to increase the decentralization and the autonomy of the institutions that manage development, benefits in terms of reduction of asymmetries have been very limited (Barrera, 2007).

Since 2008, with the new constitution, the process of territorial compensation in Ecuador made another push, with a stronger role of the National Secretariat of Planning and Development (SENPLADES), which coordinates the processes of autonomy, promotes decentralization of institutions, and seeks to expand local development capacities. In this context, the Central Government has started the project called "Changing Productive Matrix" which aims to achieve "productive diversification based on adding value; promotion of the exports and their expansion in terms of products and destinations: substitution of imports, including the different actors; deconcentration of production from the existing poles to the territories, and the continuous improvement of productivity and competitiveness across all sectors of the economy" (National Plan of Good Life, PNBV, 2013-2017: 73).

This study, using a new dataset provided by the Central Bank of Ecuador, assesses the role of main economic sectors into economic growth of the 221 Ecuadorian cantons.

In our knowledge no studies on the sectoral impact on growth have been done for Ecuador. The few empirical evidences which analyse economic growth in this country refer mainly to absolute convergence using standard econometric framework. In this extent we can recall Ramón-Mendieta (2009), Valdiviezo-Ramón (2013) and Mendieta, (2015a), who use cross-section models to evaluate absolute provincial convergence of Gross Value Added (GVA) per capita. Ramón-Mendieta et al. (2013) use a provincial panel and Mendieta (2015b) a cantonal cross-section estimation. More sophisticated techniques are adopted by Mendieta and Pontarollo (2016) who identify club-convergence patterns using spatial econometrics techniques and by Mendieta and Szeles-Raileanu (2016) who find, through parametric and non-parametric analysis, that the regional GVA distribution remains polarized and it seems that the group of rich provinces advances faster than the majorities' one.

The paper is organised as follows. In the second section a brief overview of the economic structure of Ecuador is given. The third section describes the empirical model and the estimation technique, while in fourth we illustrate the results of our analysis. In last part, finally, we discuss the conclusions and policy implications.

# 2 Subnational Ecuadorian economic structure

The PNBV, in force from 2008, implemented various strategies in order to smooth territorial gaps. The first one relies on an unprecedented level of public investment deployed throughout the country, especially on roads, hydroelectric projects and in various areas among which health, education and safety, which was made possible from the significant government revenues derived mainly from high oil prices and a more efficient tax collection.
[1] The second strategy consists into reshaping the productive structure of the country through the individuation of geografical macroareas that, according with the central government, might specialise into some specific sectors. This strategy of sectoral relocation is part of the changeover process that aims to go beyond the productive specialization that actually characterizes the country. According with the PNBV, it would be obtained through the evaluation of the endogenous capabilities and the phisical characteristics of each territory. This would lead to know the specific functional economic specialization of each area, building Zonal Agendas, which would permit to define a territorial governance model that aims to push the transformation of each "local" productive matrix. The total number of Zonal Agendas is nine and in each one various functional economic specialization have been identified. According to Article 238 of the Constitution, one of the responsabilities of the Autonomous Decentralized Governments [2] (GADs), which have political, administrative and financial autonomy, is to promote the productive activities in the framework of the "Changing Productive Matrix" strategy.
According with Martín (2012) the results of these policies have been quite positive in terms of economic growth, but also of poverty reduction (Mideros, 2012). World Bank data confirm this trend between 2006 and 2011, with a 16.9 per cent reduction of the rate of extreme poverty.
But were these apparent positive results distributed equally within the country? Is it possible to speak of balanced effects? Are these performances accompanied by a process of homogeneous territorial growth? These questions implicitly imply to evaluate how national and local productive matrix has evolved in order to determine if the process of improvement in well-being is sustainable over time.
Ecuador, in fact, is characterised by a relatively strong share of non-financial services and agriculture, while it is widely differentiated in terms of manufactory, with some cantons and provinces in which the latter is rather concentrated.
This is shown in appendix B, where the average sectoral weight by province grouped into ten sectors in 2007 and 2014 is reported.[3] The data on GVA show that minimal changes in provincial production structure are observed. Manufacturing sector, that accounts for around 16 per cent of domestic Value Added, is very concentrated in few areas. These belong to Guayaquil and Quito, in provinces of Pichincha and Guayas, respectively, that create around 60 per cent of the manufacturing Value. The weight of the agricultural sector is important in some provinces with low levels of development like Los Rios, Esmeraldas, Cotopaxi, Carchi y Bolivar. According to the last public spending policy, the public administration sector, plus the education and health services, are important for creation of economic value especially in poor provinces like Morona Santiago, Napo, Bolivar, Pastaza, Zamora Chinchipe and Orellana. In connection with this, as a

[1] Since the seventies, the oil extraction is the most important activity for Ecuadorian economy. In 1974, oil represented 42.51 per cent of public sector revenues, 62.01 per cent of exports and 13.15 per cent of national value added. By 2014, these proportions were 18.47 per cent, 51.70 per cent and 10.41 per cent respectively (Central Bank of Ecuador, 2015).

[2] Autonomous Decentralized Government are composed by different levels of government, such as 1228 rural parish boards, 221 municipal councils, and 24 provincial councils.

[3] Following the indications of the Central Bank of Ecuador, in this paper we excluded the Gross Value Added related to oil production because it does not create wealth in the cantons where it is produced (Mendieta, 2015a; Ramón-Mendieta et al., 2013). The data on GVA provided by the Central Bank of Ecuador and expressed in USD is constant prices with base year 2007 Central Bank of Ecuador does not produce annual cantonal data on Gross Domestic Product. Anyway, GVA per head is one of the headline indicators used, for example, in UK regional policy (Dunnell, 2009). According to BIS (2010: 3), in fact, "Gross Value Added per head is typically used for considering performance levels within a country. Although there are some criticisms of this metric it has the advantage that it provides a full picture of performance implicitly including both productivity and employment effects". In addition, GVA, which measures the contribution to the economy of each individual producer, industry or sector is used in the estimation of Gross Domestic Product (GDP) when using the production or income approaches. In this extent, GVA can be used as a proxy of GDP.

result of public investment in infrastructure and housing, the construction sector shows an increasing weight between 2007 and 2014 in all provinces.
Theseresults can be seen more clearly in table 1, where the Gini index based on the sectoral GVA share for each sector is reported.[4] The Gini index varies between 0 and 1, where zero expresses perfect equality, while a coefficient of one corresponds to the maximal inequality among values. The table confirms that productive structure has changed only slighlty and that some sectors are characterized by very high concentration. These sectors are, as conceivable, mining and hydroelectric, because they depend from the availability of natural resources, but also manufacturing and financial sector, which are concentred in the provincial capitals and whose concentration only slowly diminished between 2007 and 2014. Other important sectors for Ecuatorian economy which tend to be more concentrated in 2014 are agriculture, basic services and construction. Sectors more related to public intervention like teaching and health are more stable over time, while public administration is 7% less concentrated in 2014 than in 2007 probably because of NPBV policies.

**Table 1: Gini index**

| Year | GVA/pop growth | GVA/pop | Agricult. | Mines | Manuf. | Hydro-electric | Const. | Basic serv. | Fin. serv | Pub. adm. | Teaching | Health |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2007 | | 0.333 | 0.359 | 0.977 | 0.743 | 0.943 | 0.292 | 0.209 | 0.611 | 0.409 | 0.250 | 0.600 |
| 2008 | 0.720 | 0.355 | 0.392 | 0.975 | 0.748 | 0.949 | 0.336 | 0.233 | 0.599 | 0.380 | 0.288 | 0.607 |
| 2009 | 0.494 | 0.326 | 0.370 | 0.965 | 0.755 | 0.954 | 0.374 | 0.234 | 0.610 | 0.374 | 0.278 | 0.615 |
| 2010 | 0.579 | 0.318 | 0.394 | 0.960 | 0.745 | 0.939 | 0.382 | 0.239 | 0.573 | 0.353 | 0.281 | 0.615 |
| 2011 | 0.739 | 0.307 | 0.402 | 0.958 | 0.436 | 0.436 | 0.381 | 0.255 | 0.564 | 0.357 | 0.279 | 0.599 |
| 2012 | 0.703 | 0.311 | 0.417 | 0.965 | 0.700 | 0.429 | 0.389 | 0.260 | 0.556 | 0.334 | 0.273 | 0.602 |
| 2013 | 0.729 | 0.321 | 0.422 | 0.961 | 0.706 | 0.444 | 0.386 | 0.272 | 0.571 | 0.335 | 0.270 | 0.605 |
| 2014 | 0.729 | 0.331 | 0.415 | 0.969 | 0.705 | 0.446 | 0.399 | 0.281 | 0.584 | 0.340 | 0.269 | 0.603 |

GVA/pop growth is intended between two consecutive years. The first cell means between 2007 and 2008, the second between 2008 and 2009, and so on. The Gini index for GVA/pop growth, as there are various negative values, is based on Raffinetti et al. (2015).

The results reported in the previous table do not tell anything about spatial patterns. In the perspective of this study the last point is quite important because, if high Gini coefficient goes together with spatial concentration, this guarantees quite homogeneous territorial context that might facilitate spatial diffusion. This position contrasts with various studies especially on European regional development (see Ertur, et al. 2006) because we start from a different departure point. In Europe, in which the territorial context is more homogeneous in terms of infrastructure, education and socio-economic conditions, spatial inhomogeneities are traslated into a core-periphery pattern in which regions phisically located in the pheriphery of each country and/or of the continent are tipically the poorest. In Ecuador the situation is completely different: there is not a well defined territorial context, and richest cantons, typically the main cities, i.e. the provincial capitals, create the vast majority of wealth and the highest percentage of value added. In this extent, a clear territorial pattern in presence of a so high territorial inequality would mean that richest cantons are not "isolated islands" surrounded by poorest cantons, but tend to form well-defined clusters.
To check this point Moran's I is used. This statistic provides a single summary measure that describes the degree of clustering in spatial data, and it is defined as:

$$MI = \frac{n}{\sum_{i=1}^{n}\sum_{j=1}^{n} w_{i,j}} \frac{\sum_{i=1}^{n}\sum_{j=1}^{n} w_{i,j}(y_i-\bar{y}_i)(y_j-\bar{y}_j)}{\sum_{i=1}^{n}(y_i-\bar{y}_i)} \quad (1)$$

[4] The Gini index has been calculated for each economic sector individually and measures the distribution of GVA between cantons.

where *i* and *j* refer to different spatial units of which there are *n*, *y* is the data value in each and $w_{i,j}$ the element of the line *i* and row *j* of the row standardized spatial weights matrix **W** of $n \times n$ size. The calculated Moran's I varies between minus one and one. A positive coefficient corresponds to a value of Moran's I that is larger than its theoretical mean of $-1/n$-1, or, equivalently, a positive z-value, and points to positive spatial autocorrelation, that is similar values cluster together in a map. The reverse represents regimes of negative association, that is, dissimilar values cluster together in a map.

Following Dall'Erba and Le Gallo (2007 and 2008) and Ertur et al. (2006), we constructed the spatial weights matrix **W** considering the shortest distance by car in kilometres of road between the capital of canton *i* and *j*.[5] Precisely, only the cantons belonging to the lower quantile of the kilometres of road distance are accounted, and they are weighted by the inverse of the squared distance, in order to reflect a gravity function. Cantons whose distance is greater than the first quantile distance have value zero. This choice guarantees every single canton is connected to at least another canton. The matrix, then, as customary, is standardised by row.

The estimated results are in table 2. In the majority of sectors, despite the significant Moran's I, its value is very low, while in mining, hydroelectic and health sectors it is not significant. This is due to the fact that mining and hydroelectric sectors are located in very few and specific cantons, while health sector is widespreaded in space. The other sectors need to be analyzed wit a bit more detail. In fact, comparing the results of table 1 and 2 we can get some interesting insights regarding the concentration and the spatial patterns of the variables. Manufactory and financial services sectors are strongly polarised in few areas (see Appendix A an table 1), and have a low Moran's I. This means that they do not form clusters within the provinces in which they are, and neither among areas belonging to different provinces, showig what is called spatial heterogeneity, i.e. a clumpy distribution of processes across a space. Agriculture and construction sectors, at the reverse, are not so strongly concentred according to the Gini index, and their Moran's I, although higher than the two previous sectors, are pretty low. This points to a patchy territorial pattern with small groups of quite homogeneous cantons. Another interesting case is public administration, that has the highest relative Moran's I and quite low Gini index highlighting that this sector, in comparson with the others, is much more homogeneous within each cluster. Finally, the level of GVA per capita is randomly distributes, and GVA growth per capita has a Gini index between 0.5 and 0.7, but a not significant Moran's I, showing that the growth of cantons does not depend from the growth of the neighbour ones.

**Table 2: Moran's I of sectoral GVA share**

| Year | GVA/ pop growth | GVA/pop | Agricult. | Mines | Manuf. | Hydro-electric | Const. | Basic serv. | Fin. serv | Pub. adm. | Teaching | Health |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2007 | | 0.122*** | -0.019 | -0.016 | 0.141*** | -0.013 | 0.144*** | -0.049 | 0.053 | 0.169*** | 0.177*** | 0.005 |
| 2008 | -0.088 | 0.034 | 0.051 | -0.013 | 0.168*** | -0.012 | 0.087*** | -0.035 | 0.061* | 0.161*** | 0.243*** | -0.007 |
| 2009 | 0.034 | 0.082** | 0.050 | -0.021 | 0.107*** | -0.016 | 0.048*** | -0.02 | 0.076** | 0.219*** | 0.238*** | -0.011 |
| 2010 | -0.045 | 0.095** | 0.094** | -0.012 | 0.121*** | -0.018 | 0.073*** | -0.007 | 0.114*** | 0.210*** | 0.217*** | -0.010 |
| 2011 | 0.012 | 0.065* | 0.113*** | -0.012 | 0.144*** | -0.012 | 0.107*** | 0.054 | 0.108*** | 0.229*** | 0.196*** | -0.024 |
| 2012 | 0.053 | 0.053 | 0.152*** | 0.016 | 0.082*** | 0.004 | 0.149*** | 0.067* | 0.104** | 0.219*** | 0.188*** | -0.029 |
| 2013 | -0.095 | 0.048 | 0.157*** | 0.032 | 0.102*** | 0.012 | 0.197*** | 0.098** | 0.150*** | 0.172*** | 0.162*** | -0.017 |
| 2014 | 0.055 | 0.037 | 0.155*** | 0.030 | 0.150*** | 0.013 | 0.187*** | 0.127*** | 0.203*** | 0.134*** | 0.141*** | -0.017 |

*Significant at 1 per cent, ** significant at 5 per cent, *** significant at 10 per cent.
GVA/pop growth is intended between two consecutive years. The first cell means between 2007 and 2008, the second between 2008 and 2009, and so on.

This findings address the problem that, in principle, the widespread differences among neighbour locations might be an obstacle to the application of general policies because their effects may be confined to a very limited spatial dimension.

[5] The distance has been computed using the command R function `mapdist` of the library `ggmap` Kahle and Wickham (2013).

Furthermore, in accordance with the rising central government spending, sectors like public administration, education and health have increased their relative weight in the recent years, but were not able to foster a more productive and balanced productive structure. On the contrary, in particular in provinces with the lowest GVA per head, they were responsible of a large part of Gross Value Added both in 2007 and 2014. This eventuality risks to undermine the long-run development perspectives and the balanced territorial development. Thus, if, from a side, the effects of public sector and of connected activities can be hampered by unfavorable socio-economic conditions, on the other hand, the potential positive impact is connected to the capacity of local policy makers, namely the GADs, to tailor policies related to the specificity of each territory (Barca et al., 2012).
On the bases of this first analysis, in the next section we delve over the Ecuadorian subnational growth and the roles of sectoral structure.

# 3 Empirical model

The sectoral pattern described above can have, inevitably, an impact on growth. In particular the concentration of more productive sectors in few areas can be an obstacle for a balanced territorial development and can amplify, or at least maintain unchanged the territorial inequality levels. In addition, as shown in table 1, the effectiveness of "Changing Productive Matrix" policy objective is put in question. In particular the deconcentration of production from the existing poles to the territories is not reached. In order to analyse the sectoral effects on growth, following Mallik and Carayannis (1994), we specify the following equation:

$$gr_{i,t} = \alpha + \beta log\left(y_{i,t-1}\right) + \delta \boldsymbol{sectors}_{i,t-1} + \mu_i + \eta_t + \varepsilon_{it} \quad (2)$$

Where the dependent variable $gr_{i,t}$ represents the cantonal annual growth rate of per capita Gross Value Added between *t-1* and *t*; $\alpha$ is a constant term; $\mu_i$ and $\eta_t$ are, respectively, dummies specific to canton *i* which control for unvarying factors determining differences in the steady states across cantons and time dummies that account for yearly specific effects; $y_{i,t-1}$ is the per capita GVA in canton *i*, of which there are 221, over period 2007-2014;[6] $\beta$, if significantly different from zero and negative, is the coefficient related to the annual rate at which an economy converges to the long-run steady state. The vector of additional variables $\boldsymbol{sectors}_{t-1}$ represent the relative weight of the GVA produced by the different economic sectors, which assume an important role in light of the "Changing of Productive Matrix" plan. The considered sectors are: agriculture, mines, manufactory, hydro-electric, construction, basic services, financial services, public administration, teaching and health.
When dealing with territorial data, as in this case, equation (2) can be extended to include spatial effects. These can be modelled in different ways and are related to the possibility that in the empirical estimation, the presence of significant spatial autocorrelation in the explanatory and/or dependent variables might lead to biased and/or inconsistent results using classical OLS estimation techniques (Anselin, 1988; Lesage and Pace, 2009). The simplest spatial models can include the spatial lag as autoregressive term (SAR), as an error term (SEM), or as additional regressors (spatial lag of x model, SLX). Further specification, as a mix of previous ones are possible: spatial Durbin, with both the spatial autoregressive and spatial lag of independent variables (SDM), and spatial error model with spatial error term and the spatial lag of the regressors (SDEM). The choice of the model has direct consequences in the interpretation of the partial derivatives: while in case of spatial error there are no differences from OLS, in the other cases we have implications in terms of spatial effects and spatial spillovers. According with Elhorst (2014) and Le Sage and Pace (2014), spillovers can be of two types: local for SLX and SDEM and global for SAR model and SDM. Among the firsts McMillen (2003) and more recently, Gibbons and Overman (2012) and Corrado and Fingleton (2012), argued that the use of a spatial autoregressive term may reflect some identification problems that, using standard spatial

[6] In literature, Henley (2005) uses GVA per head to measure growth of UK regions.

econometric approaches, could not be correctly accounted for. These authors, as well as Halleck Vega and Elhorst (2015), suggest to put more attention on SLX, taking it as baseline model because more flexible and computationally simpler.
In this study we consider these issues testing the mentioned spatial models and comparing them with the standard OLS.

# 4 Estimation results

Following the logic of the previous section, the estimation in table 3 has been performed with both standard and spatial panel techniques following Elhorst (2009 and 2014). The comparison of the models based on the AIC leads to exclude spatial models. The spatial lag of the dependent variable and the autoregressive error term are not significant and their introduction does not substantially increase the explanatory power of the model.
The signs related to the significant sectors are negative and robust unegarding from the specification. Spatial effects accounted by the spatial lag of the independent variables are very weak both in SLX, Durbin and error Durbin models. In the last two cases, furthermore, the autoregressive terms continue to be not significant. These results, combined with the spatial exploratory analysis of the previous paragraph, confirm a certain degree of permeability of Ecuatorian territories with regard to spatial spillovers. The permeability is basically related to the heterogeneity of Ecuadorian reality, which is an obstacle for spatial diffusion of the effects of economic growth. This is, at least partially, due to an historical heritage in which the development of the country has been focussed almost exclusively into the two main cities, Quito and Guayaquil, that took a reciprocal benefit that pushed their growth trajectories with the construction of the railways that connected them in 1908, and that excluded various territories and provincial capital cities (Deler et al. 1983). This generated an axis between the capital and the main port that reinforced these cities reciprocally, at the price of leaving aside the other areas of the country. The mentioned heterogeneity, although it has been originated more than a century ago, nowaday is still an obstacle for a balanced territorial development. This is because there are deep differences not only in terms of territorial distribution of sectors, but also in infrastructure, phisical and human capital endowments and public amenities. Furthermore, more densely populated cantons, which generally correspond to provincial capitals, benefit from a cohesive business tissue, able to better exploit the competitive advantages and mechanisms that promote production (Guevara et al., 2015; Mendieta, 2015a). According to the theory of urban systems (Eaton and Eckstein, 1997 and Black and Henderson, 1999) larger urban areas are related with an industrial variety which leads to better local conditions and hence to an increase of productivity. In this extent, Guevara et al. (2015) find that only 63 cantons out of 221 in Ecuador have more than 50% of urbanization. The territorial dishomogeneity makes that spillovers, and in particular Schumpeterian ones, do not find fertile ground to generate a spatial multiplier effects. The problem of Ecuador, in fact, is that, as it has isolated production systems, they are not, by definition, enough structured and integrated to be able to fully exploit their potentials, with the result of a limited or negative effects with respect to economic growth. This is shown by agriculture, construction, basic services and administration sectors, which are typically characterized by a low productivity. Unfortunately there are no data on employment at cantonal level but, at national level, only around 11% of employment is in manufactory sector, while around 25% in agriculture. This means that, despite manufactory is more important than agriculture in producing GVA (see tables in appendix), a large part of the population is not directly involved in this process. In this extent, the negative impact on economic growth might be explained by the fact that the less productive sectors are the ones that hold the highest share of employment and this structure has not changed over the years (Guzmán-Espinoza, 2011). The results of table 3, beside giving information regarding the (lack of) spatial spillovers, allow us to examine the effects of each single sector. Water procurement, together with construction, has a negative effect on growth, which is probably related to the fact that these sectors are well developed only in some cantons, which are located mainly in the province of Zamora and in cantons where mining and big public infrastructures, as hydroelectric, are been build. Financial sector, as well as manufactory, which could make the difference into fostering growth, is too

much clustered in few central locations, and the result is that their impact on cantonal growth is null. The outcomes go together with the lack of sectoral deconcentration and the unchanged productive matrix. This processes is too slow and not able to generate a real change that can have an impact on growth. The reason might be found in the lack of empowerment of GADs that, often, are not enough efficient to permit an effective disarticulation of central governmant policies at local level. Additionally, the distribution of state agencies, as well as public services and productive infrastructureshas traditionally been unequal in the territory, and did not change in the considered time span, which might led to deepening territorial inequalities .

A further motivation of our findings could be due to the fact that less productive sectors, such as agriculture, which employes the higher share of employment, are typically subsistence, and manufaturing and services are only complementary activities in the majority of cantons. A further cause of the results could be that the policy of the central government is based on a wrong geographic scale. Zonal Areas are based on regions defined according to criteria of territorial contiguity, interregional balance, political-administrative divisions and management of watersheds, but without accounting for the productive structure and functionality of the territories (Tandazo and Gasca, 2014).

Thus, this "regionalization" do not account for aspects such as geographic market integration, organizational and geographic fragmentation of production, and distribution and spatial relationship of economic activities in the territory.

Finally, as a robustness check, we computed the same estimates of table 3 using the approach described in paragraph 2 but with different thresholds. In particular, to account for the possible existence of small clusters, we considered as cut-off the percentile from the fifth to the fifteenth. The results do not vary and spatial models are excluded to be the best choice for our data. The still negligible spatial dependence leads us to confirm that the standard OLS is still the best choice.

**Table 3: Estimation results**

| | OLS | | Sp. Lag | | Sp. Error | | SLX | | Sp. Durbin | | Sp. Durbin Error | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GVA/pop | -0.3939 | *** | -0.3941 | *** | -0.3946 | *** | -0.3946 | *** | -0.395 | *** | -0.3952 | *** |
| | (-15.6931) | | (-14.557) | | (-14.6417) | | (-15.4009) | | (-14.3573) | | (-14.3666) | |
| Agricult. | -0.4386 | *** | -0.4412 | *** | -0.44 | *** | -0.4382 | *** | -0.4405 | *** | -0.4413 | *** |
| | (-3.824) | | (-3.5676) | | (-3.5745) | | (-3.7749) | | (-3.5327) | | (-3.5384) | |
| Mines | -0.1011 | | -0.1042 | | -0.1002 | | -0.0467 | | -0.0472 | | -0.0494 | |
| | (-0.6242) | | (-0.5967) | | (-0.5754) | | (-0.2837) | | (-0.2668) | | (-0.2799) | |
| Manuf | -0.0237 | | -0.0258 | | -0.0265 | | -0.0188 | | -0.0204 | | -0.0198 | |
| | (-0.3342) | | (-0.3375) | | (-0.349) | | (-0.2639) | | (-0.267) | | (-0.2585) | |
| Hydroelectr. | -0.396 | ** | -0.4005 | * | -0.4027 | * | -0.3948 | ** | -0.398 | * | -0.3957 | * |
| | (-2.051) | | (-1.9237) | | (-1.9416) | | (-2.0341) | | (-1.9093) | | (-1.8998) | |
| Construct | -0.3846 | *** | -0.3903 | *** | -0.3964 | *** | -0.325 | ** | -0.329 | ** | -0.3238 | ** |
| | (-2.8426) | | (-2.6749) | | (-2.7365) | | (-2.3469) | | (-2.2116) | | (-2.1724) | |
| Basic serv. | -0.2525 | ** | -0.2566 | ** | -0.2563 | ** | -0.2372 | ** | -0.2393 | ** | -0.2377 | ** |
| | (-2.274) | | (-2.1432) | | (-2.1536) | | (-2.1047) | | (-1.9768) | | (-1.9624) | |
| Fin. serv | 0.0027 | | -0.0017 | | -0.045 | | 0.2421 | | 0.224 | | 0.2451 | |
| | (0.0044) | | (-0.0026) | | (-0.068) | | (0.3789) | | (0.3263) | | (0.3566) | |
| Pub. adm. | -0.394 | ** | -0.3985 | ** | -0.3913 | ** | -0.3511 | ** | -0.3512 | * | -0.3531 | * |
| | (-2.3551) | | (-2.2084) | | (-2.178) | | (-2.0703) | | (-1.9277) | | (-1.9395) | |
| Teaching | -0.3055 | | -0.3066 | | -0.3069 | | -0.3567 | * | -0.3626 | * | -0.368 | * |
| | (-1.5887) | | (-1.4784) | | (-1.4894) | | (-1.8148) | | (-1.718) | | (-1.741) | |
| Health | -0.4938 | * | -0.497 | | -0.4987 | * | -0.3785 | | -0.3817 | | -0.3816 | |
| | (-1.7619) | | (-1.6447) | | (-1.654) | | (-1.3307) | | (-1.2497) | | (-1.2527) | |
| **W**×GVA/pop | | | | | | | -0.0138 | | -0.0275 | | -0.0132 | |
| | | | | | | | (-0.3312) | | (-0.5884) | | (-0.2993) | |
| **W**×Agricult. | | | | | | | 0.1178 | | 0.0809 | | 0.0839 | |
| | | | | | | | (0.4581) | | (0.2922) | | (0.3075) | |
| **W**×Mines | | | | | | | 0.2017 | | 0.197 | | 0.2377 | |
| | | | | | | | (0.4198) | | (0.3817) | | (0.4704) | |
| **W**×Manuf | | | | | | | -0.257 | * | -0.2824 | * | -0.2658 | * |
| | | | | | | | (-0.339) | | (-0.3394) | | (-0.3441) | |
| **W**×Hydroelectr. | | | | | | | -0.257 | | -0.2824 | | -0.2658 | |
| | | | | | | | (-0.5294) | | (-0.5412) | | (-0.5158) | |
| **W**×Construct | | | | | | | -0.2755 | | -0.3053 | | -0.3019 | |
| | | | | | | | (-1.0031) | | (-1.0338) | | (-1.0383) | |
| **W**×Basic serv. | | | | | | | -0.0234 | | -0.0575 | | -0.0631 | |
| | | | | | | | (-0.0913) | | (-0.2091) | | (-0.2328) | |
| **W**×Fin. serv | | | | | | | -1.836 | | -1.8771 | | -1.8997 | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | | (-1.4599) | (-1.3897) | (-1.4273) |
| **W**×Pub. adm. | | | | 0.3575 | 0.3236 | 0.3215 |
| | | | | (1.0833) | (0.9124) | (0.9188) |
| **W**×Teaching | | | | 0.1907 | 0.183 | 0.206 |
| | | | | (0.5327) | (0.4758) | (0.5419) |
| **W**×Health | | | | 0.2734 | 0.2344 | 0.2476 |
| | | | | (0.3817) | (0.3046) | (0.3261) |
| ρ | | -0.0258 | | | -0.0367 | |
| | | (-0.7861) | | | (-1.0527) | |
| λ | | | -0.044 | | | -0.047 |
| | | | (-1.2565) | | | (-1.3423) |
| Time dummies | yes | yes | yes | yes | yes | yes |
| Cantonal dummies | yes | yes | yes | yes | yes | yes |
| Observations | 1547 | 1547 | 1547 | 1547 | 1547 | 1547 |
| R-sq. | 0.322 | 0.4456 | 0.4452 | 0.2179 | 0.4504 | 0.4495 |
| Rbar-sq. | 0.2174 | 0.2223 | 0.2224 | 0.0139 | 0.2284 | 0.2285 |
| sigma | 0.0139 | 0.0161 | 0.016 | 0.0139 | 0.016 | 0.0159 |
| logliksfe | 1119.9 | 1120.481 | 1120.78 | 1126 | 1126.953 | 1127.121 |

*Significant at 1 per cent, ** significant at 5 per cent, *** significant at 10 per cent. t-stat in brackets.

# 5 Conclusion

The paper explores the spatial disributions of seven economic sectors in Ecuador and their impact on cantonal growth using a panel approach.
The results support the importance of considering (lack of) spatial relationships in analyzing subnational development in Ecuador, which appears asymmetrically distributed in space, with some circumscribed areas in which the majority of productive sectors are concentrated. Despite the Central Government's project to change productive matrix and to deconcentrate development, the weight of non-financial and agricultural sector is still too strong and accounts for almost 40 per cent of Gross Value Added. Recent government's investment policies boosted construction and public sectors but failed to generate a positive impact in most productive sectors like manufactory and high level services. This might be due to various reasons, among which the mentioned territorial heterogeneity, the lack of urban agglomerations, but also the lack of efficiency of the public sector and of coordination between public actors and local stakeholders.
The outcomes of the analysis have some important policy implications and opens various problems for the future of the PNBV. The first is that sectoral government policies need to be reshaped accounting for territorial specificities because these are conceived as a fundamental sources of growth if properly valued (Barca et al., 2012). These policies must have multiple directions. The first one is decentralizing manufactory sector and/or creating incentives related to the creation of collateral services. This requires an in-deep analysis of the actual situation with the involvement of institutional actors and territorial stakeholders. The second point is to reinforce the local networks investing in both 'harder' (for example routes) and 'softer' infrastructure (human capital and research capacity). The third point is to add an explicit spatial dimension to the actual policy objectives. In addition to the reduction of existing disparities, the aim has to be avoiding territorial imbalances making both sectoral policies which have a spatial impact and subnational policy more coherent through an improved territorial integration and cooperation.
With the actual economic deceleration due to the low oil price and the cut in the government spending, new forms of partnerships between public and private have to be found. This means a new strategical planning based on real and concrete needs, and a more efficient public sector, able to quickly and effectively involve local stakeholders. Due to the fragmented economic and territorial tissue of Ecuador, new sectoral policies need to be anchored to territorial realities, and policy makers cannot leave aside the local factor that can make the difference in the long-run development of the country.

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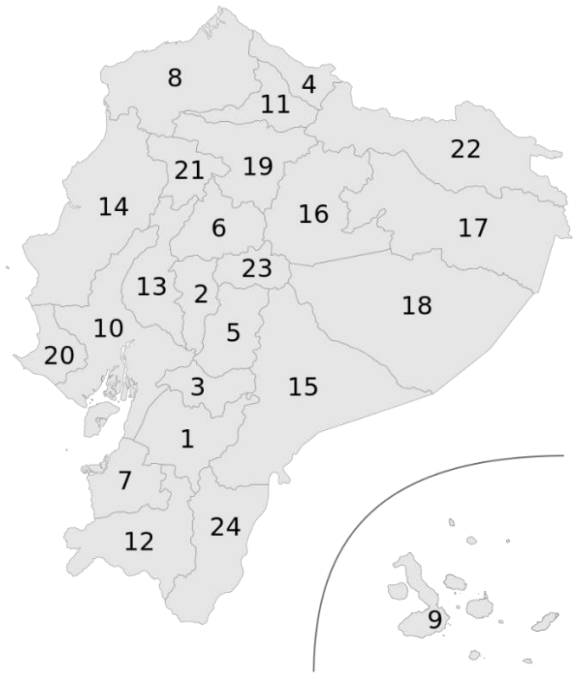
# Appendix A: map of Ecuador

**Figure A: Provinces of Ecuador**




| ID | Province | Area (km$^2$) |
|---|---|---|
| 1 | Azuay | 8,639 |
| 2 | Bolívar | 3,254 |
| 3 | Cañar | 3,908 |
| 4 | Carchi | 3,699 |
| 5 | Chimborazo | 6,479 |
| 6 | Cotopaxi | 6,569 |
| 7 | El Oro | 5,988 |
| 8 | Esmeraldas | 14,893 |
| 9 | Galápagos | 8,010 |
| 10 | Guayas | 17,139 |
| 11 | Imbabura | 4,599 |
| 12 | Loja | 11,027 |
| 13 | Los Ríos | 6,254 |
| 14 | Manabí | 18,400 |
| 15 | Morona | 25,690 |
| 16 | Napo | 13,271 |
| 17 | Orellana | 20,773 |
| 18 | Pastaza | 29,520 |
| 19 | Pichincha | 9,494 |
| 20 | Santa Elena | 3,763 |
| 21 | Santo Domingo | 4,80 |
| 22 | Sucumbíos | 18,612 |
| 23 | Tungurahua | 3,334 |
| 24 | Zamora | 10,556 |

Source: authors' elaboration on the basis of INEC.

# Appendix B: sectoral composition by province

Tables B1 and B2 show, for years 2007 and 2014, respectively, the relative sectoral weight in the production of Value Added for each province. The sum by row is one and the number in bold highlights the sector with the highest relative weight.

**Table B1: Percentage of contribution by sector to total provincial Value Added 2007**

| Province | Agricult. | Mines | Manuf. | Hydroe. | Constr. | Basic serv. | Fin. Serv. | Pub. adm. | Teach. | Health | GVA/pop |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Azuay | 5.50 | 0.90 | 14.80 | 11.70 | 10.40 | **34.60** | 4.80 | 7.00 | 5.50 | 3.50 | 3635.2 |
| Bolivar | **34.00** | 0.00 | 1.70 | 0.00 | 10.30 | 21.50 | 1.40 | 13.90 | 12.20 | 3.40 | 1568.1 |
| Cañar | 20.70 | 0.30 | 8.50 | 0.00 | 15.60 | **31.70** | 2.90 | 7.10 | 9.00 | 3.40 | 2232.6 |
| Carchi | 21.00 | 0.10 | 5.10 | 0.50 | 11.10 | **35.50** | 1.70 | 13.70 | 7.90 | 2.80 | 2070.5 |
| Cotopaxi | 26.90 | 0.00 | 7.00 | 0.90 | 13.40 | **29.90** | 1.50 | 7.10 | 8.90 | 3.20 | 2130.3 |
| Chimborazo | 13.40 | 0.10 | 8.20 | 0.70 | 15.90 | **33.70** | 2.40 | 10.70 | 10.00 | 3.80 | 1852.6 |
| El Oro | 25.40 | 2.30 | 4.30 | 0.20 | 11.00 | **34.20** | 1.70 | 7.50 | 7.40 | 3.40 | 2662.4 |
| Esmeraldas | 20.30 | 0.00 | **39.20** | 0.00 | 7.60 | 17.10 | 0.50 | 6.20 | 6.50 | 1.80 | 3236.1 |
| Guayas | 7.80 | 0.40 | 19.30 | 0.80 | 8.50 | **45.60** | 2.30 | 4.40 | 5.60 | 2.70 | 3528.4 |
| Imbabura | 9.60 | 0.10 | 7.20 | 0.20 | 16.60 | **41.70** | 3.10 | 8.70 | 9.10 | 2.60 | 2218.0 |
| Loja | 16.00 | 0.10 | 4.00 | 0.10 | 16.70 | **33.50** | 3.80 | 14.20 | 6.70 | 4.50 | 2051.1 |
| Los Rios | **38.60** | 0.00 | 3.60 | 0.30 | 7.20 | 26.80 | 0.90 | 6.60 | 9.50 | 5.20 | 2113.9 |
| Manabi | 21.10 | 0.10 | 15.60 | 0.10 | 11.30 | **29.70** | 1.40 | 7.80 | 9.00 | 3.00 | 2056.0 |
| Morona Santiago | 17.70 | 0.00 | 1.70 | 5.90 | 11.30 | **23.80** | 1.70 | 21.70 | 10.90 | 4.00 | 1401.6 |
| Napo | 13.80 | 0.00 | 1.50 | 1.40 | 16.10 | **27.80** | 0.90 | 21.80 | 10.30 | 5.30 | 1558.2 |
| Pastaza | 7.50 | 0.00 | 4.80 | 0.00 | 14.40 | **37.80** | 2.00 | 19.80 | 8.40 | 4.40 | 2124.3 |
| Pichincha | 5.10 | 0.20 | 18.70 | 0.40 | 7.70 | **45.50** | 4.90 | 5.60 | 4.40 | 2.80 | 4585.4 |
| Tungurahua | 6.80 | 0.10 | 11.80 | 7.90 | 12.60 | **38.50** | 3.30 | 6.30 | 6.60 | 4.80 | 2821.3 |
| Zamora Chinchipe | 15.50 | 3.40 | 1.70 | 0.70 | 12.20 | **24.10** | 1.20 | 24.10 | 11.90 | 4.80 | 1558.3 |
| Galapagos | 17.90 | 0.00 | 0.80 | 0.00 | 9.30 | **50.20** | 0.90 | 15.50 | 1.50 | 0.90 | 7115.9 |
| Sucumbios | 12.50 | 0.00 | **33.40** | 0.00 | 8.00 | 23.30 | 0.90 | 10.30 | 8.40 | 2.20 | 2385.7 |
| Orellana | 19.30 | 0.00 | 18.80 | 0.00 | 5.40 | **22.30** | 1.10 | 19.50 | 10.10 | 2.40 | 1881.3 |
| Santo Domingo | | | | | | | | | | | |
| Santa Elena | | | | | | | | | | | |
| Total | 11.18 | 0.37 | 16.41 | 1.37 | 9.41 | 39.81 | 3.05 | 6.52 | 6.16 | 3.05 | 3138.6 |

In bold the main sector. Provinces of Santa Elena and Santo Domingo were created after 2007 from the provinces of Guayas and Pichincha respectively and then they were included only in 2013.

### Table B2: Percentage of contribution by sector to total provincial Value Added 2014

| Province | Agricult. | Mines | Manuf. | Hydroe. | Constr. | Basic serv. | Fin. Serv. | Pub. adm. | Teach. | Health | GVA/pop |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Azuay | 3.55 | 1.40 | 18.82 | 4.24 | 18.05 | **32.84** | 5.44 | 5.75 | 5.79 | 4.35 | 3917.6 |
| Bolivar | 21.15 | 0.00 | 2.26 | 1.08 | 12.61 | **26.32** | 3.01 | 14.30 | 12.95 | 4.41 | 1759.5 |
| Cañar | 12.05 | 0.26 | 5.35 | 1.23 | 20.66 | **33.98** | 4.29 | 8.34 | 8.31 | 5.16 | 2613.7 |
| Carchi | 24.10 | 0.05 | 3.08 | 1.20 | 12.08 | **32.19** | 2.47 | 10.40 | 8.48 | 4.64 | 2349.8 |
| Cotopaxi | 24.94 | 0.07 | 5.22 | 1.26 | 13.02 | **32.81** | 2.17 | 7.50 | 8.45 | 3.56 | 2421.5 |
| Chimborazo | 12.35 | 0.05 | 11.12 | 1.58 | 18.39 | **28.98** | 2.71 | 9.01 | 9.65 | 5.20 | 2304.0 |
| El Oro | 28.23 | 5.82 | 4.96 | 1.14 | 12.98 | **31.21** | 2.12 | 6.72 | 6.17 | 4.23 | 3488.1 |
| Esmeraldas | **33.09** | 0.03 | 14.93 | 1.24 | 10.13 | 22.02 | 0.54 | 5.84 | 8.50 | 2.78 | 2741.1 |
| Guayas | 8.65 | 0.46 | 23.07 | 1.35 | 12.04 | **37.01** | 2.75 | 4.14 | 5.14 | 3.51 | 4233.0 |
| Imbabura | 6.88 | 0.13 | 10.88 | 1.72 | 18.43 | **39.77** | 2.63 | 6.66 | 7.62 | 4.26 | 2969.4 |
| Loja | 9.48 | 0.05 | 3.21 | 1.43 | 18.21 | **38.20** | 3.78 | 10.57 | 8.62 | 5.67 | 2456.5 |
| Los Rios | **38.50** | 0.00 | 3.46 | 0.97 | 10.29 | 26.70 | 0.81 | 6.86 | 7.79 | 3.55 | 2682.9 |
| Manabi | 12.39 | 0.11 | 16.30 | 1.29 | 16.04 | **31.85** | 1.36 | 7.49 | 8.09 | 4.13 | 2666.1 |
| Morona Santiago | 6.99 | 0.01 | 2.76 | 2.46 | 14.17 | **30.32** | 2.53 | 15.04 | 15.98 | 8.65 | 1682.3 |
| Napo | 10.40 | 0.00 | 1.64 | 1.39 | 13.51 | **32.39** | 1.33 | 16.43 | 14.24 | 7.44 | 2039.2 |
| Pastaza | 7.67 | 0.00 | 5.01 | 1.52 | 15.22 | **32.57** | 3.22 | 15.41 | 11.94 | 6.20 | 2378.4 |
| Pichincha | 3.67 | 0.46 | 17.86 | 1.01 | 11.80 | **40.67** | 4.73 | 10.31 | 3.43 | 2.58 | 5964.2 |
| Tungurahua | 5.96 | 0.05 | 15.91 | 2.19 | 12.19 | **42.69** | 4.90 | 4.37 | 6.28 | 4.27 | 3194.2 |
| Zamora Chinchipe | 6.28 | 2.35 | 1.69 | 1.79 | 16.38 | **31.06** | 0.99 | 21.05 | 14.16 | 6.09 | 1738.3 |
| Galapagos | 7.56 | 0.00 | 1.16 | 0.90 | 9.29 | **58.61** | 0.83 | 12.57 | 4.09 | 1.88 | 5095.1 |
| Sucumbios | 12.20 | 0.00 | 12.62 | 0.74 | 13.91 | **35.65** | 0.95 | 8.21 | 10.43 | 3.69 | 2460.5 |
| Orellana | 16.76 | 0.00 | 2.60 | 2.79 | 6.71 | **31.22** | 1.40 | 17.78 | 14.74 | 4.25 | 1861.7 |
| Santo Domingo | 10.46 | 0.02 | 11.75 | 1.33 | 13.91 | **36.80** | 1.66 | 8.49 | 8.51 | 6.11 | 2658.4 |
| Santa Elena | 7.52 | 13.75 | 14.86 | 1.14 | 23.69 | **33.50** | 0.68 | 6.17 | 9.58 | 1.90 | 2259.5 |
| Total | 10.34 | 0.78 | 16.40 | 1.41 | 13.19 | 36.25 | 3.22 | 7.42 | 5.87 | 3.57 | 3704.9 |

In bold the main sector.

## List of abbreviations and definitions

Agricult. – agriculture
Basic serv. – basic services
Constr. – construction
Fin. Serv. – financial services
GADs – Local Atonumous Governments
GVA – Gross Value Added
GVA/pop – Gross Value Added per person Hydroe. – hydroelectric
INEC – Instituto Nacional de Estadística y Censos – Ecuador
Manuf. – manufactury
PNBV – National Plan of Good Life
Pub. adm. – public administration
SENPLADES –National Secretariat of Planning and Development
Teach. – teaching

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