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RESEARCH ARTICLE

Fiscal Decentralization and the Allocation of Public Spending of Subnational Governments: The Case of Ecuador

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Abstract

This article analyzes the relationship between fiscal decentralization and the growth rate of per capita public spending by subnational governments in Ecuador. An empirical strategy supported in a theoretical model is proposed. Data at provincial level over the period 2001–2015 are used. The estimation results show that financial autonomy is positively correlated with growth rates of per capita public investment and per capita current spending, while mixed and weaker results are found for tax autonomy. When using disaggregated data on provincial and local governments, financial autonomy is positively correlated with the growth rate of per capita public investment of both layers of government. However, for the growth rate of per capita current spending, a positive correlation with financial autonomy is found only for local governments. Moreover, hypothesis testing shows that the correlation between financial autonomy and the growth rate of per capita current spending (public investment) is (not) different across layers of governments. Finally, the empirical evidence shown in this article suggests that there should be plenty of room for Ecuador to go further in the decentralization process.

Keywords: Subnational governments; Decentralization; Public spending; Ecuador
JEL codes: H53; H77; C23

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1. Introduction

In the last three decades, Ecuador, like many other countries around the world, has been involved in a decentralization process whereby the subnational governments have been granted more administrative and fiscal responsibilities.[1] In line with the early theory of federalism, the objective of such a policy is to become more efficient in the provision of public goods and services (Tiebout (1956); Musgrave (1969); Oates (1972)) with a view to boosting economic growth and reducing the inequality gap across provinces (SENPLADES, 2012).

This article analyzes the allocation of public spending by the Ecuadorian subnational governments during the period 2001–2015. Recently, Aray and Pacheco-Delgado (2020) tested the criteria for public investment allocation of Ecuador's central government across provinces. However, this article differs largely from Aray and Pacheco-Delgado (2020) in mainly three ways. First, we focus on subnational governments at both the provincial and the municipal levels. Second, we study the relationship between fiscal decentralization and the growth rate of per capita public expenditures by the subnational governments. Two variables are proposed to capture fiscal decentralization: financial autonomy and tax autonomy. The former measures the share of subnational governments' own revenues to total revenues (own revenues plus transfers from the general state budget and the rest of the public sector). The latter is measured as the share of the tax collected by the subnational governments on the total taxes collected in the provinces, regardless of the tax collection body. Third, we are interested, not only in the allocation of public investment, but also in current public spending. Public investment aims to increase public capital, while it is assumed that current spending aims to increase human capital (Diamond (1990); Baldacci, Clements, Gupta, and Cui (2008), among others).

A very important strand of the literature analyzes the relationship between decentralization and economic performance. In this line, the relationship between fiscal decentralization and economic growth has been the most studied (Martinez-Vazquez and McNab (2003); Baskaran, Feld, and Schnellenbach (2016); and Martínez-Vázquez, Lago-Peñas, and Sacchi (2017))

The relationship between fiscal decentralization and public spending allocation has been much less studied as confirmed in the literature review of Martínez-Vázquez et al. (2017). For the case of Latin American countries, De Mello (2010) provided evidence for a panel of Latin American countries and suggested that fiscal decentralization was negatively correlated with the investment-to-GDP ratio of subnational governments. Regarding single-country studies, Faguet (2004) found for Bolivia that fiscal decentralization was positively correlated with the public investment provision of subnational governments.

Therefore, the contribution of this article is to provide evidence on this little studied topic in Latin America. Precisely, the Inter-American Development Bank (IADB), in a series of articles collected by Fretes Cibils et al. (2015), suggested that more local autonomy to generate and manage tax revenues could promote more local development and efficiency. This is especially interesting because Latin American subnational governments rely heavily on transfers from the general state budgets to finance their spending.

The case of Ecuador is particularly interesting, as the country has undergone high political instability and fragmentation since returning to democracy in 1979, which has hindered governability and the achievement of stable political agreements, such as administrative and fiscal decentralization. It is worth mentioning that Ecuador has reformed its constitution twice in a span of ten years (1998 and 2008). The Constitution of 2008 is the country's twentieth Magna Carta since Ecuador became an independent nation in 1830, which could be seen as a further symptom of political instability (Negretto, 2009, 2015).

Although the beginning of the decentralization process in Ecuador dates to the 1970s with the ad-

[1] See Faust and Harbers (2011)

ministrative decentralization, it was not until the late 1990s that this process began to emerge. The Constitution of 1998 made progress in the administrative and fiscal decentralization (Tello-Toral and Lucio-Vásquez, 2019)) and the Constitution of 2008 is supposed to have given an important boost to the decentralization process, as it provided a model of territorial and administrative division to achieve greater accountability in the allocation of public resources. For example, the decentralized autonomous governments (*Gobiernos Autónomos y Decentralizados*, GADs, in Spanish) were created, which are the subnational governments and public institutions that shape, along with the central government, the administrative organization of the country's territory. The Constitution of 2008 also establishes tax responsibilities by layers of government and clearly defines the main taxes, fees and special contributions assigned to the GADs. However, data show that despite Constitution of 2008, Ecuador exhibits a modest degree of decentralization.

To provide empirical evidence on the relationship between fiscal decentralization and public spending in Ecuador, we propose an equation to capture the catching up of per capita public spending towards its optimal level. In addition, it is assumed that political factors could affect this catching up. The optimal level of per capita public spending is obtained by means of a theoretical model in which the subnational (provincial/local) planner chooses the level of public spending that maximizes a regional collective welfare function subject to the production technology of the regional economy and the laws of motion of public and human capital stocks. The model allows obtaining equations for the growth rates of per capita public investment and per capita current public expenditure. The equations capture the traditional criteria for public spending allocation: the equity-efficiency trade-off, special needs and political factors. Moreover, introducing fiscal variables allows us to test whether the growth rates of per capita of public investment and current expenditure are correlated with fiscal decentralization.

In the empirical implementation, a panel data of 22 provinces[2] for the period 2001–2015 is used in the analysis. In general, the results show that fiscal decentralization is positively correlated with the growth rate of per capita public spending made by the subnational governments. Results seem to be stronger for public investment and for local governments.

This paper is organized as follows. Section 2 provides an overview of the Ecuadorian administrative system. Section 3 shows the evolution of the GADs' revenues and expenditures during the sample period, as well as the evolution of the fiscal decentralization measures used in the estimation. The empirical strategy is explained in Section 4 and the estimation results are discussed in Section 5. Robustness checks are performed in section 6, while the main conclusions are presented in section 7.

2. The Ecuadorian administrative system

2.1. The central government

The president is the highest authority and is responsible for the control and administration of the central government and national public companies. The president is elected by popular vote and holds office for a four-year term. As the person in charge of the executive branch, the president is also responsible for appointing the secretaries of state, regional governors and other public servants. The president holds exclusive competencies over national security, national planning, and the preparation and administration of the general state budget, as well as economic and social policies, among other competencies that cannot be transferred to the subnational governments.

[2] Although Ecuador was divided into 24 provinces in 2008, to take advantage of the information available since 2001, we use the previous administrative division, that is, 22 provinces.

2.2. The decentralized autonomous governments (GADs)

According to the Constitution of 2008, these public institutions enjoy political, administrative and financial autonomy and assume specific competencies such as the planning and management of their territory, as well as to ensure the proper functioning of public services and physical infrastructure. There are four levels of GADs: regional, provincial, cantonal and rural parishes. As the figure of regional governments has not yet been fully implemented, they do not have a budget or established authority.

Provincial governments

The provincial governments are considered the first level of territorial and administrative division and organization. Their competencies correspond to those not covered at the local and national level and include the planning, construction and maintenance of the provincial road systems excluding urban areas, irrigation systems and other public services and infrastructure to promote the productive development of the province. In addition, provincial governments are responsible for the provincial environmental management and must promote provincial productive activities, especially in the agricultural sector. The provincial prefect is the highest authority and is elected by popular vote. There are currently 24 provinces in Ecuador.

Cantonal: Municipal and metropolitan district governments

The municipalities or cantons are the second level of administrative division and the local level of territorial organization; therefore, the municipal governments have greater proximity to the citizens. Their main competencies include control over land use and occupation, the planning, construction, provision and maintenance of urban roads, drinking water, sanitary sewers and the physical health and education infrastructure, as well as solid waste management, environmental sanitation activities, the regulation and control of transit and public transport and the preservation and dissemination of the architectural, cultural and natural heritage of the canton. The mayor is the highest authority and is elected by popular vote. There are currently 221 cantons in Ecuador.

Rural parish government

The rural parishes are part of a canton's territory. However, for geographical reasons they are decentralized governments with exclusive competencies and budget management duties. In most cases, rural parishes are very far from the urban centers where the cantonal authorities are located. The rural parishes are governed by a parish council composed of members elected by popular vote. Currently, there are 790 rural parishes.

3. Evolution of the revenues and expenditures of the GADs during the period 2001-2015

3.1. Revenues

The subnational governments of Ecuador finance their current and capital expenditures in three ways: i) by collecting their own taxes and fees ii) through transfers and iii) loans and donations.

The Constitution of 2008 (Article 271) establishes that GADs shall participate in at least 15% of the permanent revenues[3] and no less than 5% of the non-permanent revenues[4] of the general state budget. In 2010 these percentages were modified by the Organic Code for Territorial Organization, Autonomy and

[3]Permanent revenues include: taxes, fees and contributions, sale of goods and services, investment returns, fines, current transferences and donations, and other revenues.

[4]Non-permanent revenues include sale of non-financial assets and transfers and donations of capital and investment.

Decentralization (COOTAD in Spanish),[5] which established that subnational governments shall receive at least 21% of the permanent revenues and 10% of the non-permanent revenues of the general budget. These percentages are to be distributed among the subnational governments as follows: 27% for the provincial councils, 67% for municipalities and metropolitan districts and 6% for rural parish councils. Therefore, like in most Latin American countries, transfers from the general state budget and the rest of the public sector are the most prominent source of revenues for subnational governments.

The solid line in Figure 1 shows the share of public transfers to GADs (subnational governments) on the GADs' total revenues. Although this share has decreased over time, it is still close to 70%. Thus, subnational governments are highly dependent on transfers. The additional dashed lines show the ratios of the subnational governments' total revenues on the central government's total revenues, which is about 20% on average. When excluding transfers, it is below 10%.

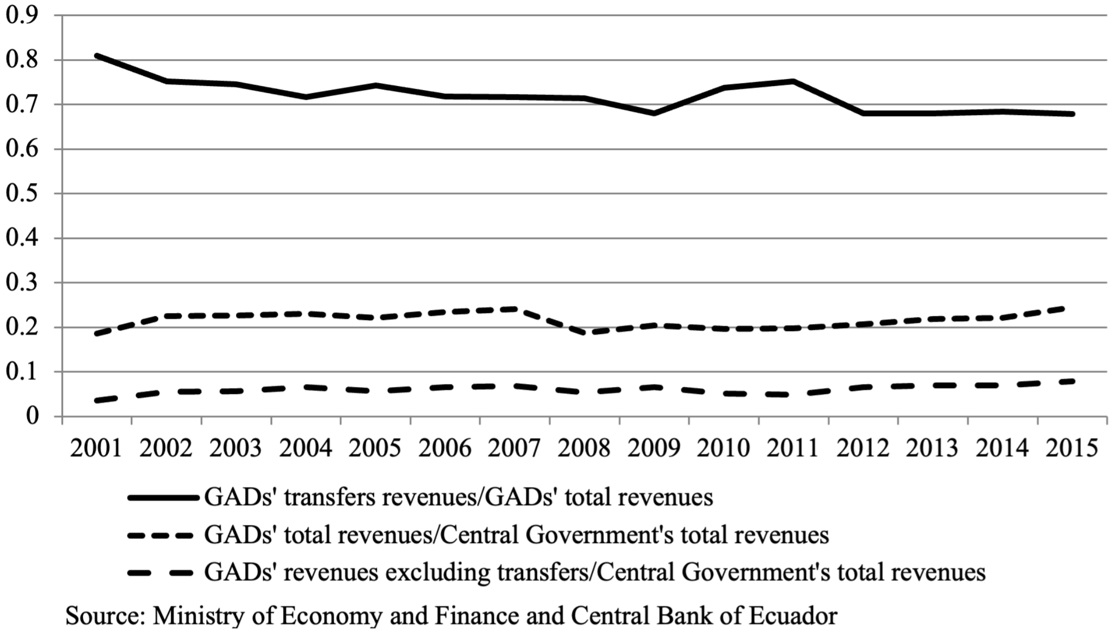
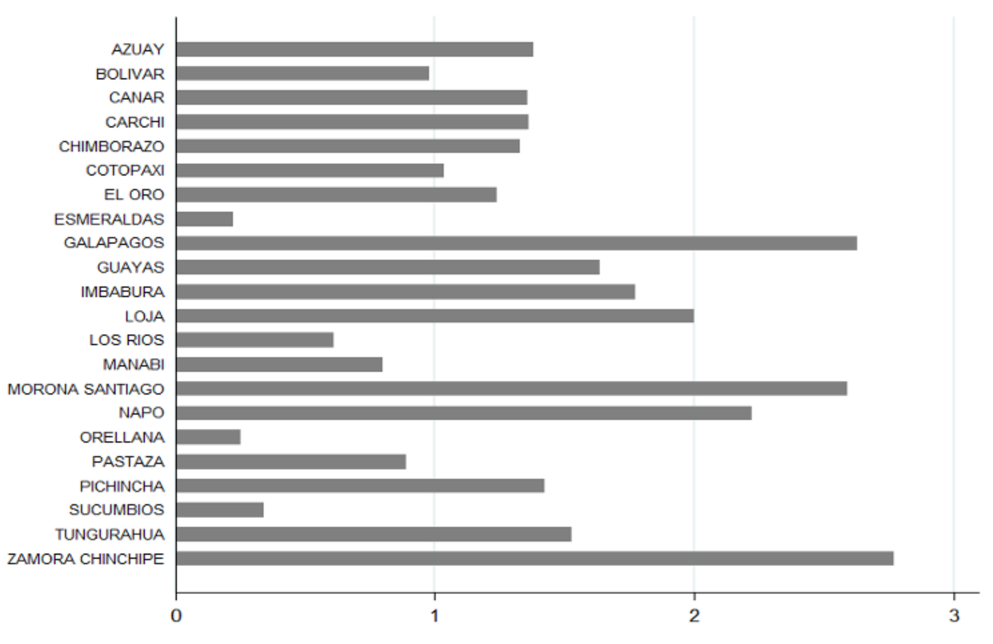


Figure 1: *GADs' revenues: shares and ratios*

Regarding the economic importance of subnational governments' own revenues, Figure 2 shows detailed information across provinces of own revenues generated by the subnational governments as a percentage of the provinces' gross value added (GVA) for the period 2001–2015.

[5] The COOTAD serves as the legal framework for the territorial organization and operation of the GADs. It has been in force since October 2010.



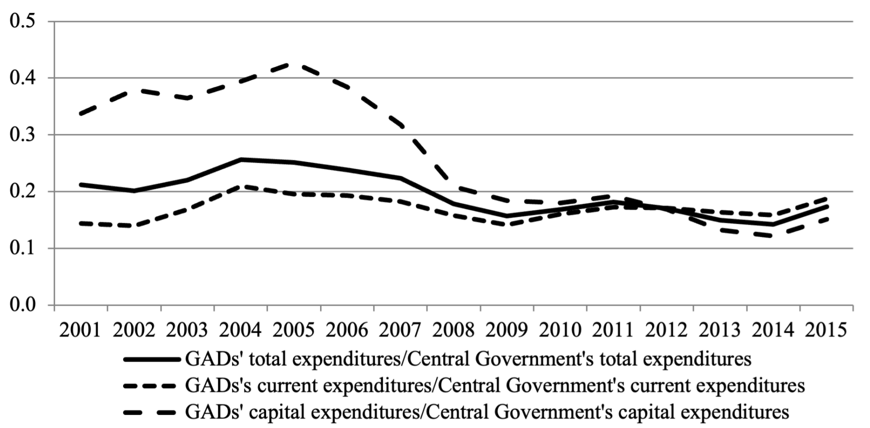
Source: Ministry of Economy and Finance and Central Bank of Ecuador.

Figure 2: *Average subnational governments' own revenues as a share of the GVA. 2001–2015*

Figures 1 and 2 provide a picture of the low weight of subnational governments in the country and the importance of transfers for funding GADs' expenditures despite the Constitution of 2008 has established a clear framework for subnational governments' taxation and other funding sources.

3.2. Expenditures

Figure 3 shows the ratio of the subnational government's expenditures to the central government's expenditures. As can be noticed, subnational governments have lost weight with respect to the central government since the mid-2000s and is more dramatic in the case of the capital expenditures.



Source: Ministry of Economy and Finance and Central Bank of Ecuador

Figure 3: *GADs' expenditures as a ratio of the central government's expenditures*

This picture is shocking, provides the Constitution of 2008 is believed to have fostered the decentralization process in Ecuador.

Table 1 includes basic statistics of per capita public investment and per capita current spending[6] by provinces. Means are ordered decreasingly taken the value of the aggregated subnational governments as the reference levels. As can be noticed, the per capita public expenditures vary greatly across provinces for both layers of governments (provincial and local) being more noticeable in the case of public investment per capita. Moreover, GADs spend more on public investment than on current expenditures and local governments have much larger per capita expenditures than provincial governments.

Table 1: *Descriptive statistics for public spending across provinces*

	Public investment					Public current spending			
Province		Subnational	Provincial	Local	Province		Subnational	Provincial	Local
Galapagos	Mean	378.02	85.78	292.24	Galapagos	Mean	217.29	48.47	168.82
	SD	197.67	124.73	165.18		SD	67.4	43.57	31.60
Pastaza	Mean	350.10	180.74	169.36	Orellana	Mean	97.98	29.37	68.61
	SD	107.96	60.18	62.64		SD	36.62	19.07	20.32
Orellana	Mean	348.26	140.93	207.33	Zamora Chinchipe	Mean	95.79	20.94	74.86
	SD	199.15	108.46	109.03		SD	21.81	8.58	19.50
Zamora Chinchipe	Mean	321.83	10800	213.83	Morona Santiago	Mean	93.3	25.64	67.65
	SD	105.55	50.36	70.33		SD	31.79	16.49	17.07
Napo	Mean	29624	106.24	190.01	Pastaza	Mean	88.71	33	55.71
	SD	98.87	41.55	65.87		SD	19.03	7.34	14.82
Morona Santiago	Mean	279.17	82.48	196.69	Napo	Mean	82.25	27.62	54.63
	SD	96.00	31.09	66.14		SD	39.25	18.74	21.62
Sucumbios	Mean	275.23	88.13	187.1	Sucumbios	Mean	76.9	18.74	58.16
	SD	125.05	50.29	80.5		SD	19.2	8.5	14.21
Carchi	Mean	126.17	40.89	85.27	Loja	Mean	57.61	8.14	49.47
	SD	56.71	25.3	33.91		SD	10.78	5.39	8.59
Azuay	Mean	108.27	21.49	86.78	Imbabura	Mean	49.44	9.26	40.17
	SD	43.92	11.87	35.88		SD	10.82	2.8	10.47
El Oro	Mean	104.34	30.45	73.9	Tungurahua	Mean	47.25	603	41.21
	SD	41.24	16.19	28.76		SD	10.06	1.62	9.27
Loja	Mean	104.28	17.4	86.88	Carchi	Mean	4703	9.56	37.47
	SD	35.17	9.03	31.61		SD	10.45	2.78	8.04
Bolivar	Mean	101.94	36.19	65.75	Bolivar	Mean	46.28	10.52	35.75
	SD	42.15	21.9	21.47		SD	11.37	3.84	9.28
Cañar	Mean	101.3	26.77	74.52	Cañar	Mean	46.21	8.25	37.96
	SD	36.23	14.34	23.16		SD	7.77	2.64	7.10
Chimborazo	Mean	92.39	31.89	60.49	El Oro	Mean	45.29	9.72	35.57
	SD	36.07	16.83	20.62		SD	11.93	4.48	9.21
Tungurahua	Mean	91.98	30.53	61.45	Esmeraldas	Mean	43.54	10.2	33.35
	SD	34.26	11.98	23.52		SD	11.04	5.71	6.15
Imbabura	Mean	91.8	23.24	68.56	Azuay	Mean	42.22	7.77	34.45
	SD	41.27	13.65	28.84		SD	8.71	4.91	5.95
Manabi	Mean	91.68	25.96	65.71	Guayas	Mean	40.31	5.34	34.97
	SD	35.17	13.06	23.35		SD	8.31	1.75	7.07
Los Rios	Mean	88.63	30.44	58.19	Chimborazo	Mean	37.15	700	30.15
	SD	30.91	13.86	18.9		SD	6.64	1.93	4.98
Guayas	Mean	86.39	18.12	68.28	Manabi	Mean	36.76	5.49	31.27
	SD	27.8	8.18	21.77		SD	8.03	2.92	6.31
Cotopaxi	Mean	85.74	26.99	58.75	Pichincha	Mean	35.3	9.6	25.7
	SD	36.15	14.42	23.6		SD	8.17	2.59	7.08
Pichincha	Mean	80.52	20.42	60.1	Los Rios	Mean	35.24	6.62	28.61
	SD	43.26	12.21	33.12		SD	7.94	3.41	5.28
Esmeraldas	Mean	75.39	24.25	51.14	Cotopaxi	Mean	3360	6.18	27.42
	SD	34.15	11.56	23.42		SD	7.36	2.23	6.34
Ecuador	Mean	167.26	54.42	112.83	Ecuador	Mean	63.43	14.7	48.73
	SD	135.6	61.52	88.90		SD	45.38	16.27	32.38

Units are constant in dollars with base year 2007
Source: Ministry of Economy and finance-SIGEF

3.3. Fiscal decentralization

Two variables to account for the evolution of the GADs' fiscal decentralization are proposed: FA is the subnational governments' share of own revenues (own taxes, fees and other special contributions) on total revenues (own revenues plus transfers from the general state budget and the rest of the public sector) and is intended to capture financial autonomy. TA is the share of tax revenues collected by the

[6] The COOTAD establishes that current expenses must be financed by permanent revenues to avoid liquidity problems due to falls in the prices of oil and other raw materials or any other external shock.

subnational governments on the total taxes collected by all layers of governments (central, provincial and local taxes) and is intended to capture tax autonomy. Figures 4 and 5 show the evolution of the average of the GADs' FA and TA, respectively, for the period 2001–2015. The general increasing trends for FA and TA in the early 2000s turned to decreasing trends since the late 2000s, precisely after the Constitution of 2008 was in force. It is not until to 2013 that they began to recover. As can be seen, local governments have had much more fiscal autonomy than provincial governments. This is more noticeable for the case of tax autonomy, which is very low for provincial governments. It is also striking that after decreasing trends of the fiscal autonomy measures since the late 2000s, they began to recover in the last three years of the sample period. However, it is more noticeable for financial autonomy and local governments. In fact, in the case of provincial governments, both measures of fiscal autonomy still show almost flat trends until the end of the sample period.

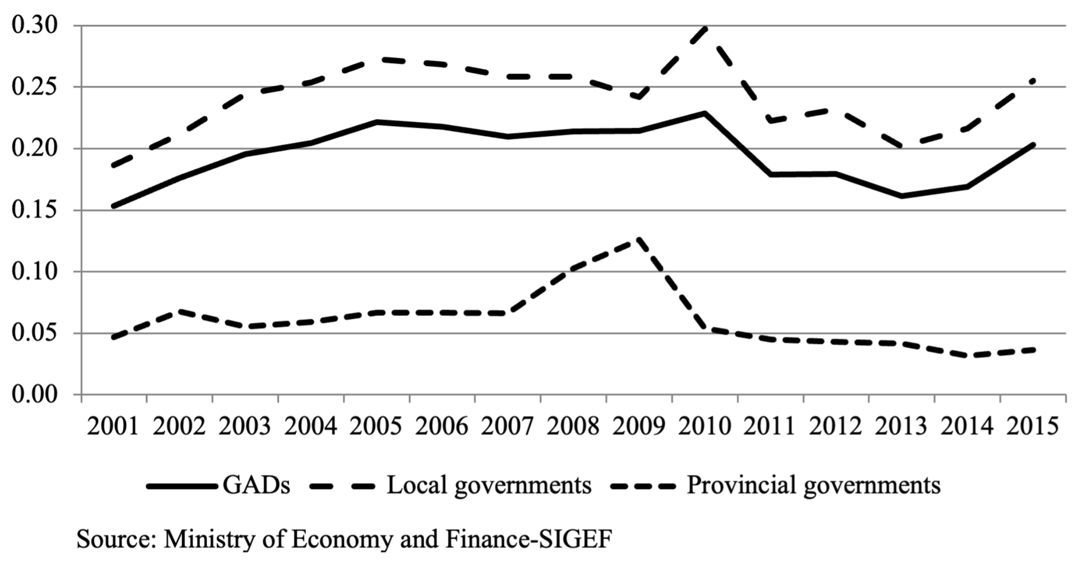


Figure 4: *GADs' financial autonomy (FA). 2001–2015*

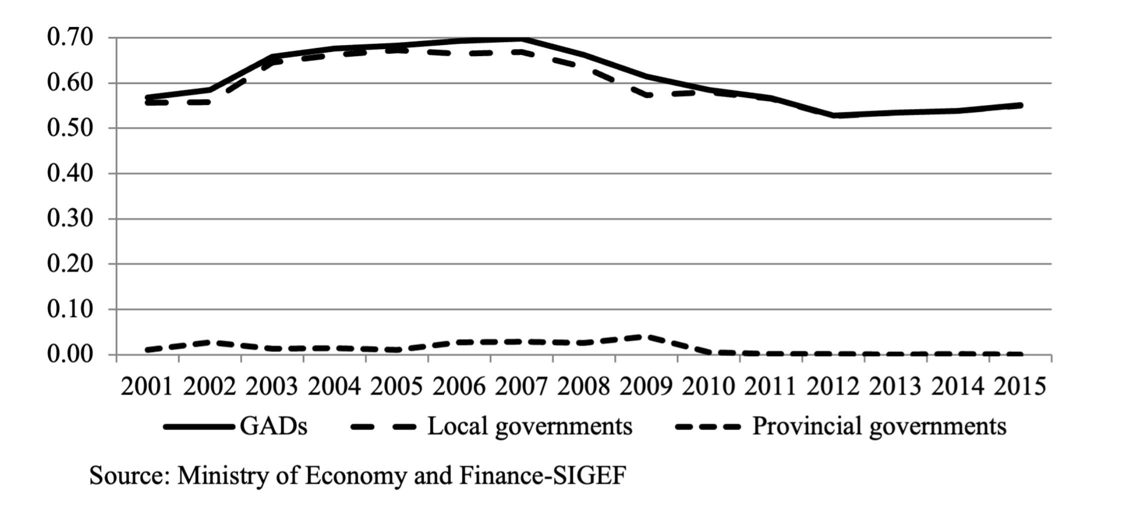


Figure 5: *GADs' tax autonomy (TA). 2001–2015*

Figures 4 and 5 along with Figures 1 and 3 show not only that Ecuador exhibits a modest degree of decentralization, but also a reversal in the decentralization process since late 2000's, which is in contrast to the belief that the Constitution of 2008 gave a great boost to the fiscal decentralization in Ecuador.

Table 2 shows the basic statistics for measures of fiscal autonomy for provinces. They are shown in decreasing order considering the total average aggregated values of the subnational governments. The average values for the aggregated GADs for FA is 0.20 while for TA is 0.61. As can be noticed, there is a great geographical variation for both measures of fiscal decentralization, ranging in the case of FA (TA) from 0.39 (0.86) in Pichincha (Orellana) to 0.09 (0.23) in Bolivar (Pichincha). Strikingly, the largest provinces, Pichincha and Guayas, have the largest financial autonomies and the lowest tax autonomies. In fact, the correlation between FA and TA is negative (-0.307). This can be explained by the fact that the central government is the responsible for collecting the income tax and VAT. Therefore, more capacity to collect such taxes is located in the most industrialized provinces. Pichincha and Guayas account for more than 50% of the Ecuador's GDP.

Table 2: *Descriptive statistics for the measures of fiscal autonomy*

	Financial autonomy					Tax autonomy			
Province		Subnational	Provincial	Local	Province		Subnational	Provincial	Local
Pichincha	Mean	0.39	0.25	0.43	Orellana	Mean	0.86	0.01	0.85
	SD	0.07	0.06	0.08		SD	0.11	0.05	0.11
Guayas	Mean	0.36	0.04	0.42	Morona Santiago	Mean	0.86	0.01	0.80
	SD	0.05	0.02	0.06		SD	0.16	0.01	0.16
Galapagos	Mean	0.30	0.19	0.33	Sucumbios	Mean	0.80	0.02	0.78
	SD	0.04	0.11	0.05		SD	0.10	0.04	0.10
Azuay	Mean	0.30	0.07	0.35	Napo	Mean	0.77	0.02	0.75
	SD	0.06	0.05	0.08		SD	0.12	0.04	0.12
Tungurahua	Mean	0.28	0.09	0.34	Pastaza	Mean	0.74	0.01	0.73
	SD	0.04	0.04	0.04		SD	0.08	0.01	0.08
Imbabura	Mean	0.28	0.06	0.34	Galapagos	Mean	0.70	0.11	0.59
	SD	0.05	0.03	0.05		SD	0.12	0.19	0.16
Loja	Mean	0.23	0.04	0.28	Los Rios	Mean	0.70	0.01	0.69
	SD	0.04	0.03	0.04		SD	0.08	0.02	0.08
El Oro	Mean	0.22	0.14	0.25	Imbabura	Mean	0.69	0.01	0.68
	SD	0.04	0.06	0.04		SD	0.09	0.02	0.08
Cañar	Mean	0.20	0.04	0.25	Cañar	Mean	0.69	0.01	0.68
	SD	0.04	0.03	0.06		SD	0.10	0.01	0.10
Cotopaxi	Mean	0.18	0.04	0.24	Loja	Mean	0.69	0.00	0.68
	SD	0.04	0.02	0.05		SD	0.08	0.01	0.07
Chimborazo	Mean	0.17	0.03	0.22	Cotopaxi	Mean	0.67	0.02	0.65
	SD	0.04	0.03	0.04		SD	0.10	0.03	0.09
Carchi	Mean	0.16	0.03	0.22	Bolivar	Mean	0.66	0.01	0.65
	SD	0.03	0.02	0.04		SD	0.10	0.03	0.10
Orellana	Mean	0.15	0.04	0.22	Zamora Chinchipe	Mean	0.66	0.00	0.65
	SD	0.05	0.06	0.08		SD	0.27	0.00	0.27
Pastaza	Mean	0.14	0.06	0.21	Chimborazo	Mean	0.64	0.01	0.63
	SD	0.06	0.05	0.08		SD	0.10	0.01	0.10
Sucumbios	Mean	0.14	0.04	0.18	Tungurahua	Mean	0.54	0.00	0.53
	SD	0.04	0.05	0.06		SD	0.11	0.01	0.11
Esmeraldas	Mean	0.13	0.01	0.17	El Oro	Mean	0.51	0.02	0.49
	SD	0.02	0.01	0.03		SD	0.11	0.02	0.12
Manabi	Mean	0.13	0.04	0.16	Esmeraldas	Mean	0.49	0.00	0.49
	SD	0.04	0.02	0.06		SD	0.26	0.00	0.26
Zamora Chinchipe	Mean	0.11	0.05	0.14	Carchi	Mean	0.48	0.02	0.46
	SD	0.05	0.04	0.09		SD	0.26	0.03	0.25
Napo	Mean	0.11	0.03	0.15	Manabi	Mean	0.44	0.00	0.44
	SD	0.03	0.03	0.05		SD	0.09	0.00	0.09
Los Rios	Mean	0.11	0.02	0.14	Azuay	Mean	0.39	0.00	0.39
	SD	0.02	0.02	0.03		SD	0.13	0.00	0.13
Morona Santiago	Mean	0.10	0.04	0.13	Guayas	Mean	0.27	0.00	0.27
	SD	0.04	0.04	0.06		SD	0.05	0.00	0.05
Bolivar	Mean	0.09	0.04	0.12	Pichincha	Mean	0.23	0.01	0.23
	SD	0.03	0.04	0.04		SD	0.05	0.00	0.05
Ecuador	Mean	0.20	0.06	0.24	Ecuador	Mean	0.61	0.01	0.6
	SD	0.10	0.07	0.11		SD	0.21	0.05	0.21

Units are constant in dollars with base year 2007
Source: Ministry of Economy and finance-SIGEF

4. Empirical strategy

Let us consider that the per capita public investment and per capita current expenditure made by the subnational government in province j in year t, ri_{jt} and rc_{jt}, adjust toward their respective optimal levels according to the following equations:

$$\frac{ri_{jt}}{ri_{jt-1}} = e^{z^i_{jt}+\epsilon^i_{jt}}\left(\frac{\widehat{ri}_{jt}}{ri_{jt-1}}\right)^{\gamma^i}, \; 0 \le \gamma^i \le 1 \quad (1)$$

$$\frac{rc_{jt}}{rc_{jt-1}} = e^{z^c_{jt}+\epsilon^c_{jt}}\left(\frac{\widehat{rc}_{jt}}{rc_{jt-1}}\right)^{\gamma^c}, \; 0 \le \gamma^c \le 1 \quad (2)$$

Where $\widehat{ri}_{jt}$ and $\widehat{rc}_{jt}$ are the optimal levels of per capita public investment and per capita current expenditure made by the subnational governments of province j in year t, respectively. Appendix 1 provides a theoretical model for obtaining $\widehat{ri}_{jt}$ and $\widehat{rc}_{jt}$. Parameters γ^i and γ^c are the adjustment coefficients toward the optimal levels of per capita public investment and per capita current expenditures, respectively. z^i_{jt} and z^c_{jt} are exogenous deterministic shocks caused by political factors, ϵ^i_{jt} and ϵ^c_{jt} are random disturbances with expected values equal to zero and e is the exponential operator. In the polar cases of $\gamma^i = 1$ and $\gamma^c = 1$, i.e., immediate catch up with the optimal levels, public spending per capita could deviate from the optimal level due to political factors and the random disturbance.

When subnational governments plan public spending, they rely on the most recent available information, which is assumed to come from just the previous period. Considering that, let us conveniently rewrite the optimal levels $\widehat{ri}_{jt}$ and $\widehat{rc}_{jt}$ obtained in Appendix 1 as follows:

$$\widehat{ri}_{jt} = \Omega^i_{jt}\Psi^{1-\rho}_{jt} y^{\rho-1}_{jt-1} y_{jt-1} \quad (3)$$

$$\widehat{rc}_{jt} = \Omega^c_{jt}\Psi^{1-\rho}_{jt} y^{\rho-1}_{jt-1} y_{jt-1} \quad (4)$$

Where y_{jt-1} is the per capita income in province j in year $t-1$. $\rho \in (0,1)$ is the parameter of a collective welfare function and Ω^i_{jt} and Ω^c_{jt} are combinations of parameters that capture unobservable provincial-specific characteristics and time-specific shocks common to all provinces.[7] Ψ_{jt} is a vector that captures the province's economic, social and demographic variables and any other relevant characteristics other than political factors and is specified in a similar way to Aray and Pacheco-Delgado (2020). However, Ψ_{jt} is extended to capture not only special needs, but also fiscal variables. Again, since subnational governments plan expenditures related to the special needs of year t and have available information for year $t-1$ the variables capturing special needs are included with one lag. However, fiscal variables are considered in their contemporaneous values because the subnational governments have available information on transfers and on most of their own revenues in year t. Thus, Ψ_{jt} is specified as follows:

$$\Psi_{jt} = DS^{\varphi1}_{jt-1} V^{\varphi2}_{jt-1} TC^{\varphi3}_{jt-1} EI^{\varphi4}_{jt-1} HI^{\varphi5}_{jt-1} SA^{\varphi6}_{jt-1} ST^{\varphi7}_{jt-1} tr^{\varphi8}_{jt} FA^{\varphi9}_{jt} TA^{\varphi10}_{jt} \quad (5)$$

Where φ_m, for $m = 1, 2, ..10$, are parameters.

The variables that control for special needs are typically intended to capture the so-called agglomeration and congestion effects. DS_{jt} is the population density that captures agglomeration, which often comes along with congestion in both hard and soft infrastructure. To capture congestion in hard infrastructure, the variable V_{jt} denotes the ratio between the number of registered vehicles and kilometers of roads built and the variable TC_{jt} denotes the number of seats available for passengers in public transport (buses) per capita. To capture congestion in soft infrastructure, we include indicators for education and health. Thus, EI_{jt} is the ratio of students enrolled in primary and secondary schools per school and HI_{jt} is the number of beds in hospitals per capita.

[7] See Appendix 1

We also consider special needs related to the sectors in which subnational governments have more competencies; for example, agriculture and tourism. Thus, the shares of GVA of agriculture, SA_{jt}, and restaurants and hotels, ST_{jt},[8] on the total provincial GVA, are included.

As regards the fiscal variables, we have to control for public transfers to the subnational governments. These transfers make up most of the subnational governments' resources and are therefore expected to affect individuals' welfare and public spending. Hence, tr_{jt} is the per capita transfer from the general state budget and the rest of the public sector to subnational governments. To capture fiscal decentralization, which is the main objective of this study, the measures proposed in the previous section are used. Thus, FA_{jt} and TA_{jt} are the financial autonomy and tax autonomy, respectively, of province j in year t.

Regarding political variables, z^i_{jt} and z^c_{jt} are specified as follows:

$$z^i_{jt} = \alpha^i_1 S_{jt} + \alpha^i_2 D^P_{jt} + \alpha^i_3 D^M_{jt} \tag{6}$$

$$z^c_{jt} = \alpha^c_1 S_{jt} + \alpha^c_2 D^P_{jt} + \alpha^c_3 D^M_{jt} \tag{7}$$

Where S_{jt} is the share of members of parliament that belongs to the same party as the president of the republic in province j in year t, D^P_{jt} is a dummy variable that takes the value of 1 if the prefect of province j in year t belongs to the same party as the president of the republic, and zero otherwise, and D^M_{jt} is a dummy variable that takes the value of 1 if the share of mayors of province j in year t belongs to the same party as the president of the republic is 50% or more, and zero otherwise.

By substituting equation (5) in equations (3) and (4), and then substituting equations (3) and (6) in equation (1) and equations (4) and (7) in equation (2), and taking logarithm, we obtain:

$$\begin{aligned}\Delta Ln(ri_{jt}) = \delta^i + \delta^i_j + \tau^i_t + \gamma^i Ln\left(\frac{y_{jt-1}}{ri_{jt-1}}\right) + \beta^i_1 Ln(y_{jt-1}) + \beta^i_2 Ln(DS_{jt-1}) + \beta^i_3 Ln(V_{jt-1})\\ +\beta^i_4 Ln(TC_{jt-1}) + \beta^i_5 Ln(EI_{jt-1}) + \beta^i_6 Ln(HI_{jt-1}) + \beta^i_7 Ln(SA_{jt-1})\\ +\beta^i_8 Ln(ST_{jt-1}) + \beta^i_9 Ln(tr_{jt}) + \beta^i_{10} Ln(FA_{jt}) + \beta^i_{11} Ln(TA_{jt})\\ +\alpha^i_1 S_{jt} + \alpha^i_2 D^P_{jt} + \alpha^i_3 D^M_{jt} + \epsilon^i_{jt}\end{aligned} \tag{8}$$

$$\begin{aligned}\Delta Ln(rc_{jt}) = \delta^c + \delta^c_j + \tau^c_t + \gamma^c Ln\left(\frac{y_{jt-1}}{rc_{jt-1}}\right) + \beta^c_1 Ln(y_{jt-1}) + \beta^c_2 Ln(DS_{jt-1}) + \beta^c_3 Ln(V_{jt-1})\\ +\beta^c_4 Ln(TC_{jt-1}) + \beta^c_5 Ln(EI_{jt-1}) + \beta^c_6 Ln(HI_{jt-1}) + \beta^c_7 Ln(SA_{jt-1})\\ +\beta^c_8 Ln(ST_{jt-1}) + \beta^c_9 Ln(tr_{jt}) + \beta^c_{10} Ln(FA_{jt}) + \beta^c_{11} Ln(TA_{jt})\\ +\alpha^c_1 S_{jt} + \alpha^c_2 D^P_{jt} + \alpha^c_3 D^M_{jt} + \epsilon^c_{jt}\end{aligned} \tag{9}$$

Where $\beta^l_1 = \gamma^l(\rho - 1)$, $\beta^l_h = \gamma^l(1 - \rho)\varphi_h$ and $\delta^l + \delta^l_j + \tau^l_t = \gamma Ln(\Omega^l_{jt})$ for $l = i, c$, and $h = 2, 3, 4, ..., 11$. δ^l, δ^l_j, and τ^l_t are the constant, the individual effects and the time effects, respectively.

As can be noticed, equations (8) and (9) include proxies for the development indicator (y_{jt}) and indicators for the productivity of public spending $(\frac{y_jt}{ri_{jt-1}}$ and $\frac{y_{jt}}{rc_{jt-1}})$, which can be related to the traditional equity-efficiency trade-off. It is expected that $0 \leq \gamma^l \leq 1$ and $\beta^l_i = \gamma^l(\rho - 1) \leq 0$. Subnational governments face a dilemma when allocating public resources, since they should invest in the most productive projects but also invest in alternative projects to compensate for a fall in income per capita to improve social welfare.

Regarding fiscal variables, it is expected that $\beta^l_9 \geq 0$. Moreover, fiscal federalism theory suggests that decentralization brings efficiency in the allocation of resources since regional and local governments

[8] We rely on a proxy for the GVA of the tourism sector due to the lack of data.

know the needs and preferences of their citizens better, which should have a positive effect on the provision of public good and services. Therefore, it is expected that β^l_{10} and $\beta^l_{11} \geq 0$.

5. Estimation results

Data have been provided by the Central Bank of Ecuador, the Ministry of Economy and Finance, the National Institute of Statistics, the Internal Revenue Service, the National Secretary of Planning and Development (SENPLADES) and the GADs, among other official information sources. Data in monetary values are calculated in constant dollars with base year 2007 using the GVA deflactor.

Table 3 shows the main statistics for the values of the variables that are used in log in the estimations. The statistics of the dependent variables, the growth rates of public investment per capita and current spending per capita, $\Delta Ln(ri_{jt})$ and $\Delta Ln(rc_{jt})$, are also reported in the Table 3. As can be noticed, the standard deviations are very high.

Table 3: *Basic statistics*

Variable	Mean	SD
ri_{jt}	167.2576	135.5962
rc_{jt}	63.42822	45.37748
$\Delta Ln(ri_{jt})$	0.0918	0.3248
$\Delta Ln(rc_{jt})$	0.0126	0.2643
$\frac{y_{jt-1}}{ri_{jt-1}}$	34.1668	31.2018
$\frac{y_{jt-1}}{rc_{jt-1}}$	74.2578	76.1589
y_{jt-1}	4161.4532	5744.8001
DS_{jt-1}	65.1929	59.7485
V_{jt-1}	24.5058	26.9871
TC_{jt-1}	0.1795	0.1311
EI_{jt-1}	117.4483	55.5103
HI_{jt-1}	0.0013	0.0004
SA_{jt-1}	0.1293	0.0842
ST_{jt-1}	0.0196	0.0153
tr_{jt}	195.7889	133.8418
FA_{jt}	0.1946	0.0962
TA_{jt}	0.6136	0.2156
SR_{jt}	0.2399	0.2824
D^P_{jt}	0.1697	0.3759
D^M_{jt}	0.1152	0.3197

Notes: Number of observations: 308.
Number of groups: 22.

Table 4 shows the correlation coefficients between the variables of the model. Focusing on the variables of interest, there is a relatively large correlation between financial autonomy and one of the measures of congestion in hard infrastructure ($Ln(V_{jt-1})$) and with one of the measures of congestion in soft infrastructure ($Ln(EI_{jt-1})$). As is known, multicollinearity reduces the accuracy of the estimated coefficients, thus making the estimates of the parameters very sensitive to small changes in the model. Therefore, estimations excluding these variables will also be provided.

Table 4: *Correlation coefficients*

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1. $\Delta Ln(ri_{jt})$	1.000																	
2. $\Delta Ln(rc_{jt})$	-0.216	1.000																
3. $Ln\left(\frac{y_{jt-1}}{ri_{jt-1}}\right)$	0.265	-0.060	1.000															
4. $Ln\left(\frac{y_{jt-1}}{rc_{jt-1}}\right)$	-0.032	0.195	0.636	1.000														
5. $Ln(y_{jt-1})$	-0.029	-0.031	0.468	0.703	1.000													
6. $Ln(DS_{jt-1})$	0.016	0.046	0.492	0.404	-0.203	1.000												
7. $Ln(V_{jt-1})$	0.012	0.016	0.461	0.538	0.162	0.736	1.000											
8.$Ln(TC_{jt-1})$	-0.020	0.038	0.214	0.463	0.071	0.645	0.750	1.000										
9. $Ln(EI_{jt-1})$	-0.036	0.053	0.368	0.457	0.235	0.596	0.682	0.560	1.000									
10. $Ln(HI_{jt-1})$	0.035	-0.008	0.143	0.132	-0.057	0.399	0.419	0.442	0.401	1.000								
11. $Ln(SA_{jt-1})$	0.025	0.027	-0.254	-0.427	-0.770	0.285	-0.109	-0.139	-0.073	-0.118	1.000							
12. $Ln(ST_{jt-1})$	0.049	-0.049	-0.270	-0.446	-0.325	-0.050	0.051	0.084	0.230	0.387	0.036	1.000						
13. $Ln(tr_{jt})$	0.005	-0.010	-0.601	-0.257	0.282	-0.852	-0.522	-0.355	-0.405	-0.295	-0.035	0.044	1.000					
14. $Ln(FA_{jt})$	0.021	0.016	0.440	0.288	0.251	0.421	0.620	0.399	0.592	0.406	-0.278	0.302	-0.400	1.000				
15. $Ln(TA_{jt})$	0.060	-0.026	-0.305	-0.293	-0.041	-0.486	-0.472	-0.411	-0.492	-0.374	0.112	-0.202	0.403	-0.307	1.000			
16. S_{jt}	-0.125	0.133	-0.238	0.168	0.021	0.200	0.303	0.401	0.501	0.167	0.028	0.133	0.069	0.057	-0.193	1.000		
17. D^P_{jt}	-0.081	0.064	-0.019	0.158	-0.045	0.350	0.399	0.427	0.347	0.354	0.001	0.199	-0.135	0.166	-0.197	0.549	1.000	
18. D^M_{jt}	-0.034	0.052	0.034	0.215	0.040	0.251	0.305	0.304	0.333	0.133	0.057	-0.021	-0.084	0.071	-0.114	0.349	0.438	1.000

Tables 5 and 6 show the estimation results of equations (8) and (9) using aggregate data of subnational (provincial and local) governments at provincial level.

Let us start with the results for the growth rate of per capita public investment in Table 5. The Hausman test (H^{FR}) shows evidence in favor of fixed effects. Control variables lagged one period avoid endogeneity problems of these variables. However, since fiscal variables are included contemporaneously, there might be a problem of endogeneity. Therefore, we perform the Hausman exogeneity test (H^E) considering fiscal variables as potentially endogenous. An instrumental variable estimation was run with the fiscal variables lagged two periods as instruments. As can be noticed, exogeneity of the fiscal variables is not rejected. The Sargan test supports the validity of the instruments.

In addition, the Green test rejected the null hypothesis of homoscedasticity and Wooldridge's test rejected the null hypothesis of serial correlation. Evidence of cross-sectional correlation (Pesaran and Friedman tests) was also found. Therefore, feasible general least square (FGLS) estimations are provided with fixed effects, accounting for correlation across panels and with a common autocorrelation structure (estimations (1) and (2)) and with a panel-specific AR(1) autocorrelation structure (estimations (3) and (4)). Estimations (1) and (3) include all the explanatory variables, while in estimations (2) and (4), the variables $Ln(V_{jt-1})$ and $Ln(EI_{jt-1})$ are removed because they are highly correlated with the variable $Ln(FA_{jt})$, as shown above.

As can be noticed, few differences can be observed between estimations (1) and (2) and between estimations (3) and (4). Therefore, let us focus on the results of estimations (1) and (3).

Striking results were obtained for the fiscal variables. On the one hand, transfers to fund public investments by subnational governments were found to have an important role. The coefficient is positive and significant at the 1% level regardless of the estimation method. On the other hand, strong evidence was also found in favor of a positive relationship between financial autonomy and the per capita public investment growth rate. The coefficient is significant at the 1% level regardless of the estimation method. However, weaker evidence is found for the coefficient of the tax autonomy, which is positive and significant at the 1% level only in estimation (3).

Table 5: *Panel data regression of equation (8): Per capita public investment growth rate of subnational governments*

	FGLS (AR1)				FGLS (PSAR1)			
	(1)		(2)		(3)		(4)	
	Coefficient	SE	Coefficient	SE	Coefficient	SE	Coefficient	SE
$Ln\left(\frac{y_{jt-1}}{ri_{jt-1}}\right)$	0.6576	0.0322***	0.6100	0.0248***	0.6837	0.0274***	0.6299	0.0304***
$Ln(y_{jt-1})$	-0.6566	0.0489***	-0.6109	0.0384***	-0.7840	0.0522***	-0.6468	0.0390***
$Ln(DS_{jt-1})$	-0.0236	0.0332	0.0242	0.0211	-0.0270	0.0248	-0.0069	0.0225
$Ln(V_{jt-1})$	-0.0111	0.0112			-0.0199	0.0117*		
$Ln(TC_{jt-1})$	0.0401	0.0280	0.0234	0.0236	0.0208	0.0169	0.0303	0.0202
$Ln(EI_{jt-1})$	0.0529	0.0468			0.1206	0.0487**		
$Ln(HI_{jt-1})$	0.0411	0.0337	0.0437	0.0256*	0.0896	0.0192***	0.0995	0.0301***
$Ln(SA_{jt-1})$	0.0163	0.0217	-0.0046	0.0154	-0.0155	0.0183	0.0130	0.0139
$Ln(ST_{jt-1})$	-0.0304	0.0220	-0.0188	0.0184	-0.0737	0.0186***	-0.0357	0.0122***
$Ln(tr_{jt})$	0.7199	0.0447***	0.7056	0.0308***	0.7639	0.0395***	0.7127	0.0398***
$Ln(FA_{jt})$	0.1329	0.0324***	0.0913	0.0283***	0.2010	0.0216***	0.1588	0.0251***
$Ln(TA_{jt})$	0.0090	0.0264	0.0255	0.0151*	0.0478	0.0135***	0.0566	0.0153***
S_{jt}	0.0479	0.0407	0.0903	0.0373**	0.0155	0.0455	0.0575	0.0452
D^P_{jt}	-0.0512	0.0250**	-0.1034	0.0168***	-0.0504	0.0276*	-0.0636	0.0182***
D^M_{jt}	-0.0305	0.0239	-0.0317	0.0221	-0.0488	0.0207**	-0.0471	0.0193*
H^{FR}	26.98 (0.0289)							
H^E	3.36 (0.3396)							
Sargan test	2.02 (0.57)							
Green test	323.28 (0.0000)							
Wooldridge SC test	35.12 (0.0000)							
Pesaran CD test	27.20 (0.0000)							
Friedman CD test	120.09 (0.0000)							
$\gamma^i = 1$	113.13 (0.0000)		247.34 (0.0000)		133.43 (0.0000)		147.81 (0.0000)	
$\rho = 0(\gamma^i = 1, \beta^i_1 = -1)$	113.15 (0.0000)		247.35 (0.0000)		190.42 (0.0000)		174.72 (0.0000)	

Notes: Number of observations: 308. Number of groups: 22. All variables in logs except for political variables. *** significant at the 1% level; ** significant at the 5% level; * significant at the 10% level.

The results support the expected belief that fiscal decentralization is positively related to public investment expenditures of the subnational governments and go in the same line as Faguet (2004) for Bolivia, Kappeler, Solé-Ollé, Stephan, and Välilä (2013) for 20 European Countries, González-Alegre (2015) and Aray (2019) for Spain.

Regarding the control variables, the estimations show the expected results, namely that the growth rate of public investment per capita is positively correlated with the indicator of public investment productivity and negatively correlated with output per capita. Both coefficients are significant at the 1% level. This can be explained by the fact that the subnational governments aim for balanced public investment, so they implement more productive projects along with projects that compensate for the evolution of income.

In relation to the variables that capture special needs criterion, it can be noticed that none has significant coefficient in estimation (1), while in estimation (3) the measures of congestion in soft infrastructure (education and health infrastructure indicators) have significant positive coefficients at the 5% and 1% levels, respectively. However, the per capita public investment growth rate is negatively correlated with one of the measures of congestion in hard infrastructure and the GVA of the restaurant and hotel sector, whose coefficients are significant at the 10% and 1% levels, respectively.

As for the political variables, puzzling evidence is found. The results show a negative coefficient for the dummy capturing the fact that the prefect of the province belongs to the same party as the president of the republic (D^P_{jt}), which is significant across the estimations (1) and (3) at the 5% and 10% levels, respectively. It is also found that the dummy for most mayors belonging to the same party as the president of the republic D^M_{jt} is negative and significant at the 5% level in estimation (3). Three possible explanations could be given to such unexpected results. First, since most of the resources for public investment of the subnational governments come from the general state budget, the central government could have taken the loyal provinces and municipalities for granted and sought to swing provinces and municipalities. Second, resources could be deviated from the target investment and misallocated more easily (corruption) if local subnational authorities are friendly with federal authorities. And third, opposition officials in subnational governments strive for differentiating themselves showing they are capable of delivering more public investment.[9]

At the bottom of Table 5, results on the convergence to optimal level of public investment per capita are shown. Recall that coefficient γ^i captures the convergence rate to the subnational governments' optimal public investment per capita. Therefore, we can test if there is an immediate convergence, that is, the hypothesis $\gamma^i = 1$, such a hypothesis is rejected at the 1% level. In addition, notice that significance of the coefficient β_1^i (rejection of hypothesis $\beta_1^i = 0$) implies the rejection of the hypothesis $\rho = 1$, which suggests that regional planners do not care only about the per capita income/output of the province, but also in the rest of the variables included in Ψ_{jt}. Alternatively, we also tested the joint hypotheses $\gamma^i = 1$ and $\beta_1^i = -1$, which suggest $\rho = 0$. Table 5 shows that the hypotheses were rejected at the 1% level. Therefore, these results suggest that $0 < \rho < 1$, as expected.

Notice that when variables highly correlated with fiscal autonomy are excluded, the results for the variables of interest remain similar, except for the stronger evidence for tax autonomy (estimations (2) and (4)).

The estimation results of the equation for the growth rate of current public spending per capita of subnational governments in Table 6 are described below.

Similar to Table 5, the Hausman test showed evidence of fixed effects and it does not reject the hypothesis of exogeneity of the fiscal variables. In addition, the Green test rejected the null hypothesis of homoscedasticity, the Wooldridge test showed evidence of serial correlation and cross-sectional correlation (Pesaran and Friedman tests) was found. Therefore, FGLS estimations are provided with fixed effects, accounting for correlation across panels and with a common autocorrelation structure (estimations (1) and (2)) and with a panel-specific AR(1) autocorrelation structure (estimations (3) and (4)). Estimations (1) and (3) include all the explanatory variables, while in estimations (2) and (4) excludes the variables $Ln(V_{jt-1})$ and $Ln(EI_{jt-1})$.

[9]Thanks to an anonymous reviewer for suggesting the second and third explanations.

Table 6: *Panel data regression of equation (9): Per capita public investment growth rate of subnational governments*

	FGLS (AR1)				FGLS (PSAR1)			
	(1)		(2)		(3)		(4)	
	Coefficient	SE	Coefficient	SE	Coefficient	SE	Coefficient	SE
$Ln\left(\frac{y_{jt-1}}{ri_{jt-1}}\right)$	0.7098	0.0424***	0.6220	0.0370***	0.6765	0.0402***	0.6115	0.0485***
$Ln(y_{jt-1})$	-0.7049	0.0555***	-0.5766	0.0347***	-0.7197	0.0596***	-0.6176	0.0600***
$Ln(DS_{jt-1})$	0.0383	0.0211*	0.0118	0.0185	0.0447	0.0255*	0.0080	0.0190
$Ln(V_{jt-1})$	-0.0363	0.0122***			-0.0395	0.0155**		
$Ln(TC_{jt-1})$	-0.0643	0.0185***	-0.0496	0.0171***	-0.0289	0.0160*	-0.0479	0.0192**
$Ln(EI_{jt-1})$	-0.2023	0.0508***			-0.0892	0.0606		
$Ln(HI_{jt-1})$	-0.0149	0.0379	-0.1098	0.0247***	-0.0490	0.0327	-0.1027	0.0251***
$Ln(SA_{jt-1})$	0.0030	0.0251	0.0198	0.0165	-0.0570	0.0260**	-0.0115	0.0240
$Ln(ST_{jt-1})$	0.0204	0.0219	0.0588	0.0103***	0.0357	0.0222	0.0385	0.0144***
$Ln(tr_{jt})$	0.4713	0.0414***	0.4777	0.0338***	0.4523	0.0350***	0.4397	0.0394***
$Ln(FA_{jt})$	0.2810	0.0201***	0.1787	0.0173***	0.2299	0.0170***	0.1873	0.0226***
$Ln(TA_{jt})$	-0.0278	0.0253	0.0204	0.0178	0.0576	0.0272**	0.0265	0.0241
S_{jt}	-0.0127	0.0413	-0.0138	0.0426	0.0187	0.0411	0.0574	0.0435
D_{jt}^{P}	-0.0435	0.0305	0.0163	0.0222	-0.0192	0.0295	-0.0303	0.0198
D_{jt}^{M}	0.0216	0.0206	-0.0232	0.0268	0.0255	0.0219	0.0081	0.0233
H^{FR}	41.84 (0.0000)							
H^{E}	4.19 (0.2413)							
Sargan test	4.56 (0.21)							
Green test	309.70 (0.0000)							
Wooldridge SC test	69.45 (0.0000))							
Pesaran CD test	23.96 (0.0000)							
Friedman CD test	116.77 (0.0000)							
$\gamma^i = 1$	46.93 (0.0000)		104.36 (0.0000)		64.67 (0.0000)		64.22 (0.0000)	
$\rho = 0(\gamma^i = 1, \beta_1^i = -1)$	48.13 (0.0000)		149.55 (0.0000)		65.83 (0.0000)		64.32 (0.0000)	

Notes: Number of observations: 308. Number of groups: 22. All variables in logs except for political variables. *** significant at the 1% level; ** significant at the 5% level; * significant at the 10% level.

Regarding fiscal variables, similar results were found to the case of the growth rate of public investment per capita. Thus, transfers per capita and financial autonomy are positively correlated with the growth rate of current public spending per capita. The coefficients are significant at the 1% level regardless of the estimation method. Weak evidence of a positive coefficient is found for tax autonomy, whose coefficient is only significant in the estimation (3).

Like the growth rate of per capita public investment, the growth rate of current per capita public spending is positively correlated with the indicator of productivity of public current spending and negatively correlated with output per capita. Both coefficients are significant at the 1% level.

In relation to the special needs criterion, density is positively and significantly correlated with the growth rate of current public spending per capita, while it is negatively and significantly correlated with the measures of congestion in hard infrastructure. Weaker evidence is also found for negative correlations between the growth rate of current public spending per capita with the education sector indicator and with the GVA of the restaurant and hotel sector. Finally, no evidence on political factors was found.

As can be checked at the bottom of Table 6, results on the issue on convergence and $0 < \beta_1^i < 1$ $(0 < \rho < 1)$ are similar to those found in Table 5.

Summarizing, we have found strong evidence of a positive relationship between fiscal decentralization and the growth rate of public expenditures per capita. The evidence is much stronger for the variable financial autonomy (FA). The results are in the same line as Faguet (2004) whose findings for Bolivia contradicted the "common claims that local government is too corrupt, institutionally weak, or prone to interest-group capture to improve upon central government's allocation of public resources". Moreover, Porto, Pineda Mannheim, and Eguino (2018) suggested that granting more autonomy to subnational governments in Latin America, so they can manage their own resources (taxes), could boost efficiency and development at regional and country level.

6. Robustness Check

6.1. Seemingly Unrelated Regression Equations (SURE)

In the previous section, equations (8) and (9) were estimated separately. However, it is natural to suspect that both equations are related and therefore form a SURE model.

Table 7 shows the estimations of the SURE model with robust standard errors. As can be noticed, regarding the financial autonomy, the estimation results are very similar to tables 5 and 6. No evidence is found for tax autonomy in the case of the growth rate of public investment per capita. However, a negative correlation is found between the growth rate of per capita current spending and tax autonomy.[10]

The SURE model allows us to test hypotheses across the equations' coefficients. Thus, we test for the equality of coefficients across fiscal variables, specifically the hypotheses $\beta_9^i = \beta_9^c$, $\beta_{10}^i = \beta_{10}^c$ and $\beta_{11}^i = \beta_{11}^c$. The first two hypotheses are not rejected at any conventional level, which might suggest that the growth rates of public investment per capita and current spending per capital are equally correlated with transfers per capita and financial autonomy. However, hypothesis $\beta_{11}^i = \beta_{11}^c$ is rejected at 10% level.

In addition, we tested the sequential hypotheses $\gamma^i = \gamma^c$ and $\gamma^i = \gamma^c = 1$. The first tests the equality of coefficients across type of spending, while the second tests the joint hypothesis of both coefficients equal to 1, that is, immediate convergence to the optimal levels. The hypothesis $\gamma^i = \gamma^c$ is only rejected at 10% level, suggesting, somehow that both, public investment and current spending, could converge similarly to their optimal levels. However, the joint hypothesis of immediate convergence to the optimal levels, $\gamma^i = \gamma^c = 1$, is rejected at any conventional level. Moreover, the hypothesis $\beta_1^i = \beta_1^c$ is tested and is not rejected, which leads us to suspect that the development criterion might not differ across types of public spending.

[10] Results were similar when the variables highly correlated with financial autonomy were excluded. Available upon request.

Table 7: *Seemingly unrelated regression equations (SURE): Growth rates of per capita public investment and current spending of subnational governments*

	Public Investment		Current Spending	
	Coefficients	SE	Coefficients	SE
$Ln\left(\frac{y_{jt-1}}{ri_{jt-1}}\right)$	0.8842	0.0622***		
$Ln\left(\frac{y_{jt-1}}{rc_{jt-1}}\right)$			0.7446	0.0579***
$Ln(y_{jt-1})$	-0.8509	0.0945***	-0.6898	0.0823***
$Ln(DS_{jt-1})$	0.2704	0.4181	-0.3753	0.4104
$Ln(V_{jt-1})$	-0.0187	0.0307	-0.0132	0.0339
$Ln(TC_{jt-1})$	0.0059	0.0391	0.0323	0.0339
$Ln(EI_{jt-1})$	0.0090	0.0986	-0.1535	0.0902*
$Ln(HI_{jt-1})$	0.0617	0.0742	-0.0493	0.0435
$Ln(SA_{jt-1})$	0.0797	0.0598	0.0518	0.0360
$Ln(ST_{jt-1})$	-0.0893	0.0434**	0.0128	0.0363
$Ln(tr_{jt})$	0.6497	0.0894***	0.5078	0.1034***
$Ln(FA_{jt})$	0.1709	0.0496***	0.2579	0.0613***
$Ln(TA_{jt})$	0.0081	0.0463	-0.0924	0.0297***
S_{jt}	0.0596	0.0707	-0.0957	0.0753
D^P_{jt}	-0.0792	0.0330**	0.0198	0.0293
D^M_{jt}	0.0090	0.0273	-0.0094	0.0269
R^2	0.7805		0.7260	
Log pseudolikelihood	3282.0723			
Breusch-Pagan test	9.80 (0.0017)			
$\gamma^i = \gamma^c / \gamma^i = \gamma^c = 1$	3.03 (0.0815) / 21.37 (0.0000)			
$\rho = 0 \begin{pmatrix} \gamma^i = 1, \beta^i_1 = -1 \\ \gamma^c = 1, \beta^c_1 = -1 \end{pmatrix}$	23.10 (0.0001)			
$\beta^i_1 = \beta^c_1$	1.69 (0.1933)			
$\beta^i_9 = \beta^c_9$	0.83 (0.3621)			
$\beta^i_{10} = \beta^c_{10}$	0.92 (0.3386)			
$\beta^i_{11} = \beta^c_{11}$	3.55 (0.0594)			

Notes: Number of observations: 308. Number of groups: 22. All variables in logs except for political variables. *** significant at the 1% level; ** significant at the 5% level; * significant at the 10% level.

6.2. Estimations considering provincial governments and local governments separately

In this subsection evidence is provided using disaggregated data of the provincial and local governments. Appendix 2 provides theoretical support for this.

We have to deal with the constraint that data on subnational governments are only available at provincial level. Therefore, results for local governments will be also provided at provincial level.

The explanatory variables remain the same, except for the fiscal variables. Since we have disaggregated data available at provincial level on own revenues and transfers for provincial and local governments, we are able to construct fiscal variables for both the provincial and local layers of governments separately. Therefore, we jointly estimate equations similar to (8) and (9) for the provincial and local governments, resulting in a SURE model with four equations.

Table 8 shows the estimation results. Regarding the fiscal variables, very interesting results arise from using disaggregated data. For the transfer per capita, $Ln(tr_{jt})$, the results hold for both layers of government. In most cases, the hypotheses $\beta_9^i = \beta_9^c$, $\beta_{9P}^i = \beta_{9L}^i$ and $\beta_{9P}^c = \beta_{9L}^c$ are not rejected at any conventional level,[11] suggesting that public expenditures by both layers of governments are correlated similarly to the transfers coming from the general state budget.

In relation to the fiscal decentralization variables, the above results found for financial autonomy hold for the per capita public investment growth rate of both layers of government and for the per capita current public expenditures of the local governments. It can be also noticed in Table 8 that using disaggregated data leads to find no evidence for tax autonomy. Thus, considering the results shown in Tables 5, 6, 7 and 8, we can conclude that the relevant variable to capture fiscal decentralization in Ecuador is the financial autonomy (FA), since it is strongly robust across all the estimations.

Using disaggregated data also unveils that the equal relationship across types of public spending with financial autonomy obtained above does not hold since the hypothesis $\beta_{10}^i = \beta_{10}^c$ is rejected at any conventional level for both layers of governments, which suggests that financial autonomy affects differently the growth rates of both types of spending. In addition, the hypothesis of an equal relationship between the growth rate of per capita current spending (public investment) and financial autonomy across layers of government, $\beta_{10P}^c = \beta_{10L}^c$ $(\beta_{10P}^i = \beta_{10L}^i)$, is (not) rejected. Therefore, these results could be suggesting that the relation between financial autonomy and the growth rate of per capita current spending (public investment) does (not) differ across layers of government.

As can be seen, the previous results obtained for the significance of the variables capturing the equity-efficiency trade-off hold, regardless of the layer of government.

It is also noticeable in Table 8 that when disaggregated data are used, weaker evidence is found for the coefficients of the variables that capture special needs. In the case of the per capita public investment growth rate of the provincial governments, the result holds for the GVA of the restaurant and hotel sector. The growth rate of per capita current public spending by the provincial government is found to be negatively correlated with the transport capital indicator. The coefficient is significant at the 10% level. For local governments, none of the variables has significant coefficients.

Strikingly, evidence of a correlation of the dependent variables with some political variables is weaker.

[11] Recall that superindeces i and c denote public investment and current spending, respectively, and subindeces P and L denote provincial government and local government, respectively.

Table 8: *Seemingly unrelated regression equations (SURE): Growth rates of per capital public investment and current spending of provincial and local governments*

	Provincial Governments				Local Governments			
	Public Investment		Current Spending		Public Investment		Current Spending	
	Coeff.	SE	Coeff.	SE	Coeff.	SE	Coeff.	SE
$Ln\left(\frac{y_{jt-1}}{ri_{jt-1}}\right)$	0.9167	0.0704***			0.9259	0.0993***		
$Ln\left(\frac{y_{jt-1}}{rc_{jt-1}}\right)$			0.7609	0.0818***			0.7680	0.0671***
$Ln(y_{jt-1})$	-0.9968	0.1634***	-0.7403	0.1759***	-0.8408	0.1199***	-0.7648	0.1017***
$Ln(DS_{jt-1})$	0.1162	0.7416	0.7914	0.7909	-0.1451	0.4644	0.0426	0.3775
$Ln(V_{jt-1})$	0.0433	0.0692	-0.0297	0.0589	-0.0331	0.0437	0.0497	0.0333
$Ln(TC_{jt-1})$	-0.0563	0.0725	-0.1350	0.0738*	0.0282	0.0420	0.0397	0.0333
$Ln(EI_{jt-1})$	0.2634	0.1736	-0.1095	0.2155	0.0552	0.1118	-0.1527	0.1054
$Ln(HI_{jt-1})$	0.1474	0.1141	-0.1309	0.1133	-0.0255	0.0662	0.0032	0.0486
$Ln(SA_{jt-1})$	0.0189	0.0983	0.0852	0.0923	0.0540	0.0600	0.0205	0.0393
$Ln(ST_{jt-1})$	-0.1552	0.0781**	0.0168	0.0961	-0.0597	0.0559	-0.0146	0.0402
$Ln(tr_{jt})$	0.5110	0.1069***	0.4127	0.1311***	0.7283	0.0908***	0.6509	0.0896***
$Ln(FA_{jt})$	0.1167	0.0392***	-0.0081	0.0203	0.1712	0.0504***	0.3736	0.0470***
$Ln(TA_{jt})$	0.0150	0.0180	-0.0103	0.0160	0.1290	0.0841	-0.0636	0.0591
S_{jt}	0.1483	0.1206	-0.1093	0.1581	0.0044	0.0762	-0.0328	0.0746
D^P_{jt}	0.0189	0.0673	-0.0221	0.0499	-0.0733	0.0409*	0.0404	0.0320
D^M_{jt}	0.0542	0.0515	0.0919	0.0444**	-0.0344	0.0318	-0.0552	0.0322*
R^2	0.7448		0.6321		0.7999		0.7616	
Log pseudolikelihood	2807.1246							
Breusch-Pagan test	22.94 (0.0008)							
Hypotheses								
$\gamma^i = \gamma^c / \gamma^i = \gamma^c = 1$	2.41 (0.1203) / 9.17 (0.0102)				1.88 (0.1699) / 12.16 (0.0023)			
$\gamma^i_P = \gamma^i_L / \gamma^i_P = \gamma^i_L = 1$				0.01 (0.9369) / 1.79 (0.4085)				
$\gamma^c_P = \gamma^c_L / \gamma^c_P = \gamma^c_L = 1$				0.00 (0.9448) / 19.44 (0.0001)				
$\rho = 0 \begin{pmatrix} \gamma^i = 1, \beta^i_1 = -1 \\ \gamma^c = 1, \beta^c_1 = -1 \end{pmatrix}$		9.95 (0.0413)				13.14 (0.0106)		
$\beta^i_1 = \beta^c_1$		1.00 (0.3171)				0.24 (0.6242)		
$\beta^i_{1P} = \beta^i_{1L}$				0.76 (0.3840)				
$\beta^c_{1P} = \beta^c_{1L}$				0.02 (0.8984)				
$\beta^i_9 = \beta^c_9$		0.31 (0.5771)				0.42 (0.5168)		
$\beta^i_{9P} = \beta^i_{9L}$				2.72 (0.0990)				
$\beta^c_{9P} = \beta^c_{9L}$				2.30 (0.1290)				
$\beta^i_{10} = \beta^c_{10}$		6.71 (0.0096)				8.73 (0.0031)		
$\beta^i_{10P} = \beta^i_{10L}$				0.75 (0.3852)				
$\beta^c_{10P} = \beta^c_{10L}$				46.41 (0.0000)				
$\beta^i_{11} = \beta^c_{11}$		0.96 (0.3277)				4.23 (0.0396)		
$\beta^i_{11P} = \beta^i_{11L}$				1.87 (0.1715)				
$\beta^c_{11P} = \beta^c_{11L}$				0.76 (0.3840)				

Notes: Number of observations: 308. Number of groups: 22. All variables in logs except for political variables. *** significant at the 1% level; ** significant at the 5% level; * significant at the 10% level.

Regarding convergence to the optimal levels, in line with Table 7, hypothesis $\gamma^i = \gamma^c = 1$ is rejected at 5% for provincial governments and at 1% for local governments. Similarly, the sequential pairs of hypotheses $\gamma^i_P = \gamma^i_L$, $\gamma^i_P = \gamma^i_L = 1$ and $\gamma^c_P = \gamma^c_L$, $\gamma^c_P = \gamma^c_L = 1$ are tested. The results for the first pair of hypotheses suggest that the relationship between the efficiency indicator and the growth rate of per capita public investment is equal across layers of government. Furthermore, the growth rates of provincial and local per capita public investment converge immediately to the optimal level. Regarding the second pair of hypotheses, it is found that the relationship between the efficiency indicator and the growth rate of current public spending is equal across layers of government. However, evidence is found against the joint hypothesis of immediate convergence to the optimal level of current public spending.

Again, the hypothesis $\beta^i_1 = \beta^c_1$ is not rejected at any conventional level. Moreover, the hypotheses $\beta^i_{1P} = \beta^i_{1L}$ and $\beta^c_{1P} = \beta^c_{1L}$ cannot be rejected at any conventional level either.

Overall, the above results suggest that provincial and local governments do not behave differently with respect to the equity-efficiency trade-off.

7. Conclusion

This article analyzed the allocation criteria of financial resources of the subnational governments of Ecuador, focusing especially on the relationship between the per capita growth rate of public spending and fiscal decentralization variables. The empirical strategy is based on a theoretical model of public resource allocation that allows obtaining an equation for the per capita growth rate of public spending as a function of the traditional criteria established in the literature: efficiency, equity or redistribution, special infrastructure needs and political factors. In addition, proxies for financial autonomy and tax autonomy were introduced in the model. Panel data for provinces of Ecuador over the period 2001–2015 were used.

The results suggest that the country's subnational governments were able to deal with the efficiency-equity trade-off in allocating public spending.

Regarding the fiscal variables, although transfers from the general state budget play a key role in the subnational budgets, overall, we found evidence of positive correlations between financial autonomy and the growth rates of subnational governments' public expenditures for both the provincial and local governments. Mixed and weaker evidence was found for tax autonomy.

A battery of tests was carried out which unveiled that provincial and local governments do not behave differently in terms of the equity-efficiency trade-off. The tests also showed that transfers from the general state budget and the rest of the public sector have a similar relationship with public spending by the provincial and local governments. Moreover, although financial autonomy is positively correlated with the growth rate of both per capita public investment and per capita current spending, such correlations seem to be different. In addition, the empirical results suggest that the correlation between the growth rate of per capita current spending (public investment) and financial autonomy is (not) different across layers of governments.

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Appendix 1: Theoretical model for obtaining the optimal levels of public investment per capita and current spending per capita

The collective welfare of the province j is expressed by the regional (provincial and local) planner as follows:

$$W_{jt} = N_{jt} y_{jt}^{\rho} \Psi_{jt}^{1-\rho}, \qquad 0 \leq \rho \leq 1 \tag{A.1}$$

Where y_{jt} is the per capita income in the province j, Ψ_{jt} denotes the province's economic, social and demographic variables and any other relevant characteristics other than political factors, which are assumed to affect the utility of the individuals. N_{jt} is the population. If $\rho = 1$ ($\rho = 0$), the regional planner only cares about the total income/output (specific characteristics) of the province.

The provincial economy j produces an output Y_{jt} in each period t according to a Cobb–Douglas production function as follows:

$$Y_{jt} = A_{jt} K_{jt}^{\mu_j} H_{jt}^{\phi_j} G_{jt}^{\theta_j} \qquad 0 < \mu_j \phi_j, \theta_j < 1 \tag{A.2}$$

Where K_{jt} is the non-residential private capital stock, H_{jt} is the human capital input, G_{jt} is the public capital stock and A_{jt} is the total factor productivity. μ_j, ϕ_j, θ_j are the elasticities of the output with respect to the inputs.

Following Hercowitz and Sampson (1991), Kocherlakota and Yi (1997) and Cassou and Lansing (1998), let G_{jt} and H_{jt} accumulate according to the following motion laws:[12]

$$G_{jt} = G_{jt-1}^{1-(\sigma_j^G + \vartheta_j^G)} CI_{jt}^{\sigma_j^G} RI_{jt}^{\vartheta_j^G} \tag{A.3}$$

$$0 < \sigma_j^G,\ \vartheta_j^G < 1;\ 0 < \sigma_j^G + \vartheta_j^G < 1$$

$$H_{jt} = H_{jt-1}^{1-(\sigma^H + \vartheta_j^H)} CC_{jt}^{\sigma_j^H} RC_{jt}^{\vartheta_j^H} \tag{A.4}$$

$$0 < \sigma_j^H,\ \vartheta_j^H < 1;\ 0 < \sigma_j^H + \vartheta_j^H < 1$$

Where CI_{jt} and RI_{jt} are the public capital investments made by the central and regional (subnational) governments, respectively, in province j in period t. CC_{jt} and RC_{jt} are the current expenditures made by the central and subnational governments, respectively, in province j in period t. Following Diamond (1990) and Baldacci et al. (2008), we assume that current public spending becomes an input for human capital accumulation since it includes salaries in the public education and health sectors and any other current expenditures that foster more skillful and healthier workers.

The advantages of specifications such as equations (A.3) and (A.4) with respect to the standard linear form has already been highlighted by Cassou and Lansing (1998).

The objective of the subnational planner is to choose the levels of RI_{jt} and RC_{jt} that maximize equation (A.1) subject to equations (A.2), (A.3), (A.4) and the budget constraint

$$RI_{jt} + RC_{jt} \leq RR_{jt} \tag{A.5}$$

Where RR_{jt} is the resource constraint of the subnational planner in province j, which is assumed to be fixed for the sake of simplicity and in line with Berhman and Craig (1978).

[12] These authors used similar expressions to model the evolution of private capital stock.

The first order conditions of the maximization problem are:

$$\frac{\partial W_t}{\partial y_{jt}} \cdot \frac{\partial y_{jt}}{\partial G_{jt}} \cdot \frac{\partial G_{jt}}{\partial RI_{jt}} - \lambda_t = 0 \tag{A.6}$$

$$\frac{\partial W_t}{\partial y_{jt}} \cdot \frac{\partial y_{jt}}{\partial H_{jt}} \cdot \frac{\partial H_{jt}}{\partial RI_{jt}} - \lambda_t = 0 \tag{A.7}$$

Where λ_t is the Lagrange multiplier, which can be interpreted as the marginal cost of public revenues.

Substituting partial derivatives in (A.6) and (A.7), the following equations are obtained:

$$\rho\theta_j \vartheta_j^G N_{jt} \Psi_{jt}^{1-\rho} y_{jt}^{\rho-1} \frac{y_{jt}}{RI_{jt}} - \lambda_t = 0 \tag{A.8}$$

$$\rho\theta_j \vartheta_j^H N_{jt} \Psi_{jt}^{1-\rho} y_{jt}^{\rho-1} \frac{y_{jt}}{RC_{jt}} - \lambda_t = 0 \tag{A.9}$$

The solution of this maximization problem provides the optimal levels of public investment and current expenditure per capita made by the subnational government of province j in year t :

$$\widehat{ri}_{jt} = \Omega_{jt}^i \Psi_{jt}^{1-\rho} y_{jt}^\rho \tag{A.10}$$

$$\widehat{rc}_{jt} = \Omega_{jt}^c \Psi_{jt}^{1-\rho} y_{jt}^\rho \tag{A.11}$$

Where $\widehat{ri}_{jt} = \widehat{RI}_{jt}/N_{jt}$, $\widehat{rc}_{jt} = \widehat{RC}_j t/N_{jt}, \Omega_{jt}^i = \dfrac{\rho_j^\theta \vartheta_j^G}{\lambda_t}$ and $\Omega_{jt}^c = \dfrac{\rho_j^\theta \vartheta_j^H}{\lambda_t}$

Appendix 2: Extending the theoretical model

Let us define

$$RI_{jt} = \left(PI_{jt}^{\omega_j^G} LI^{\nu_j^G} \right)^{\frac{1}{\vartheta_j^G}}$$

$$RC_{jt} = \left(PI_{jt}^{\omega_j^H} LI^{\nu_j^H} \right)^{\frac{1}{\vartheta_j^H}}$$

Where PI_{jt} (PC_{jt}) and LI_{jt} (LC_{jt}) are the public investments (current expenditures) in province j in period t made by the provincial and local governments, respectively.

Let us rewrite equations (A.3) and (A.4) as follows:

$$G_{jt} = G_{jt-1}^{1-(\sigma_j^G+\vartheta_j^G+\nu_j^G)} CI_{jt}^{\sigma_j^G} PI_{jt}^{\omega_j^G} LI_{jt}^{\nu_j^G} \tag{A.12}$$

$$0 < \sigma_j^G,\ \vartheta_j^G,\ \nu_j^G < 1;\ 0 < \sigma_j^G + \omega_j^G + \nu_j^G < 1$$

$$H_{jt} = H_{jt-1}^{1-(\sigma_j^H+\vartheta_j^H+\nu_j^H)} CC_{jt}^{\sigma_j^H} PC_{jt}^{\omega_j^H} LC_{jt}^{\nu_j^H} \tag{A.13}$$

$$0 < \sigma_j^H,\ \vartheta_j^H,\ \nu_j^H < 1;\ 0 < \sigma_j^H + \omega_j^H + \nu_j^H < 1$$

Similar to the benchmark model, the provincial planner chooses the levels of PI_{jt} and PC_{jt} that maximize equation (A.1) subject to equations (A.2), (A.12), (A13) and the budget constraint, $PI_{jt} + PC_{jt} \leq PR_{jt}$, where PR_{jt} is the provincial government's resource constraint. However, since data for local governments are only available at the provincial and not at the municipal level, we make a strong assumption. It is assumed that local governments of province j choose jointly the aggregate levels of LI_{jt} and LC_{jt} that maximize equation (A.1) subject to equations (A.2), (A12), (A.13) and the budget constraint, $LI_{jt} + LC_{jt} \leq LR_{jt}$, where LR_{jt} is the total resources available to all local governments in province j.