



# **Fiscal Decentralization and Economic Growth: Evidence from Regional-Level Panel Data for Colombia\***

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## **Abstract**

This paper provides evidence on the positive role of fiscal decentralization on regional economic growth in Colombia since the promulgation of the Political Constitution of 1991. The empirical strategy involved the choice of a suitable estimator for the panel data approach, the Augmented Mean Group Estimator, which allows adding unobserved determinants suggested by literature to traditional long term explanatory factors. The strategy was complemented with exercises that helped us to support the results coming from (i) cross-section models for different periods and various control variables, (ii) test on the complementarity hypothesis between public goods provided by different jurisdictions (spillover effects), and (iii) an assessment of unconditional convergence in regional income differences.

**Keywords:** Fiscal decentralization, Economic growth, Complementarity, Panel Data Models

**JEL Classification:** O40, H77, C33

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## 1. Introduction

The decentralized provision of public goods has usually been seen as an important channel to encourage regional economic development. The canonical theoretical approach assumed that local governments are more efficient allocating public resources, since they have better information and stronger incentives to do things right than the central government. Firstly, local authorities end up supplying the goods that people prefer, as they are closer to population (Oates, 1999). Secondly, because subnational governments that provide basic services are under the scrutiny of their constituents, they have incentives to execute public policies according to the interests of the community (Tiebout, 1956). Decentralization might be also beneficial for governance and market mechanisms, favoring private activities (Tulchin and Selee, 2004; Weingast 1995). In practice, these factors may jointly lead to promote learning, experimentation and competition in the provision of collective consumption goods, thus fostering long term economic growth.

Nevertheless, the wellbeing gained from fiscal decentralized schemes has been controverted by other branches of literature. Based on scale economies, for instance, central governments might be more efficient than local ones producing public goods as well as possible, having advantages in the organization and use of technologies (Stein, 1998). In addition, local governments could be more deficient in planning and implementing projects, mainly in terms of having either uninstructed or experienced human resources (Iimi, 2005). From the perspective of political science, decentralized systems would be more exposed to risks of corruption and the rent-seeking problem, which ends up negatively affecting economic activities (Rodden and Rose-Ackerman 1997, Brueckner 2001, Fisman and Gatti, 2002, Bardhan 2005).

Empirically, there are numerous studies analyzing the effects of fiscal decentralization on economic growth, both across countries and in single cases. The results are ample and pointing in many directions. Surprisingly, early papers of the nineties provided low consensus about the benefits of fiscal decentralization on economic activity, but these findings have been changing recently (Blöchliger (2013), Hyun-A Kim (2013), Asatryan (2010) and Feld (2009)).

Fiscal decentralization was enforced in the early nineties in Colombia, after thirty years of successive efforts. By this time, most Latin American countries were strengthening the role of regional governments on economic development. As a matter of fact, this type of reform was taking place worldwide. According to different studies, 63 out of the 75 countries with a population over 5 million have undergone a major process of decentralization since 1980 (Kyu Sik Lee and Roy, 1999; Manor, 1999; Oxhorn, et.al., 2004). Therefore, decentralization became, in a broad sense, the

core of institutional reforms during the late 20th century, especially in developing countries.

Advances of decentralization in Colombia have touched many aspects. Concerning the availability of resources, the process has been based on a gradual increase of financial transfers from central to regional governments. However, the progress in devolution concerning competencies of responsibilities has been less clear. From a political standpoint, the election of mayors by popular ballot started in 1988, and the popular election of departmental governors began in 1992. The free choice of regional governors and mayors became a key strategy of democratic reformers who wanted to ensure that decentralization would make the state more accessible to citizens as well as to counterbalance the abuse of power by national leaders. Finally, central government fund transfers were supplemented in 2000 with other measures such as those to avoid financial disequilibrium of regional entities and to strengthen physical investment, simultaneously.

Regarding the literature in Colombia, some papers have analyzed the effects of fiscal decentralization on the coverage of education and health services (Melo, 2005, Faguet, et al., 2008 and Faguet, et al., 2009) and other public utilities (Sánchez, 2006). Nonlinearity between decentralization and education coverage and its impacts on quality has also been investigated (Lozano, et al., 2013). Other papers have addressed related issues such as (i) the response by different municipalities to the system for intergovernmental transfers (Loboguerrero, 2008); (ii) the fairness of the transfer system (Bonet, 2006); (iii) the relationship between decentralization and armed conflict (Sanchez et al., 2005, Villa et al. 2014); and (iv) the effect of decentralization on poverty at municipal levels (Ramirez, et al 2014).

Two decades after the adoption of the Constitution in 1991, which encouraged fiscal decentralization in Colombia, there is still no evidence to support whether it has strengthened regional economic growth or not. As we described, the nearest empirical studies have focused on assessing its impact on some productive factors, but not directly on output. This is the gap we try to fill in this paper. The paper also provides evidence on spillover effects linked to the public goods provided by different jurisdictions, as well as on regional growth convergence. Following this introduction, the paper is organized as follows: In Section 2 we give a quick glance to some institutional aspects and chief indicators of fiscal decentralization in Colombia; in Section 3 we briefly describe the economic model adopted to evaluate this subject; in Section 4 we discuss the links between economic theory and the statistical model to be estimated, highlighting the major empirical issues. The results are presented and discussed in Section 5. The paper concludes with some final remarks.

## 2. A Glance to Fiscal Decentralization in Colombia

Although Political Constitution of 1991 propelled Colombia's decentralization process, important measures started actually three decades earlier, when central government began transferring a significant percentage of its tax revenues to the regions (Law 33 of 1968 and Law 46 of 1971). During the 1980s, the replacement of the sales tax by the value added tax, VAT, (Law 14 of 1983) introduced new changes to the transfer system to municipalities. The main was the gradual increase of VAT transfers up to 50% to be reached in 1992 (Law 12 of 1986). The Constitution of 1991 introduced new criteria to define the size of transfers to Departments (so called *situado fiscal*) as well as the extent and purpose of the transfers to municipalities. The constitutional mandates were regulated by Law 60 of 1993. However, because of central government budget constraints, the increasing amount of transfers to regions was only feasible until the early of 2000s. Consequently, by the turn of the century, two additional reforms to the transfer system were implemented.

The first one combined the two existing transfer systems, the *situado fiscal* and the *participación municipal*, into a single basket called the General Participation System, SGP (Legislative Act 1 and Law 715 of 2001). Its radical change was to separate the size of the transfers from the current revenues of the central government by defining real growth rates. The SGP assigned new weights to the three major funding targets: basic education (58.5%), health (24.5%), and a general-purpose destination (17%) that included basic sanitation programs (drinking water, sewage, and garbage collection). As for the geographical distribution criteria, there were no substantial changes with respect to the previous regime: Population size remained the main variable for resource allocation (i.e. population served and to be served in terms of education and health services; urban and rural location; conditions of extreme poverty, etc.). The second reform took place in 2007 and basically aimed at rectifying the transitory scheme used to calculate the amount of transfers set in 2001. This reform introduced higher real growth rates for the SGP until 2016, and added new resources for the education sector.

In the transition towards decentralization, financial transfers became the main source of revenue for many regional governments (municipal and departmental). The prominence of transfers was particularly evident in Colombia, where they represented nearly 50% of the total funding of regional governments by the end of the 1990s. Of course, the increased dependence from them has been different across municipalities. The larger a municipality is (special or first size categories), the more likely it will be to finance its spending with own taxes. By contrast, municipalities of the sixth category (the smallest) only financed 13% of their spending with self-generated taxes at the end of the 90s (See Lozano, et al. 2013).

From an overall tax-collection perspective, sub-national governments in Colombia collect currently only nearly 14% of tax revenues while its execution share on total public expenditures is close to 44%. Calculating the most recognized indices, spending decentralization clearly outpaces revenue decentralization as can be seen at regional level in Figure 1.<sup>1</sup> The degree of decentralization varies widely across regions, with Bogota, Antioquia, Valle and Cundinamarca leading in both, expenditure and revenue indexes.

Figure 1

Figure 2 displays the sources of regional tax revenues as well as spending distributions for leading programs that were financed with both self-generated revenues and central-government transfers. The tax revenue augmented from 2% to 2.8% of GDP for the last twenty years and it was led by taxes on economic activity (taxes on commercial and industrial activities and consumption tax on liquor and cigarettes) and building properties. The overall spending increased near to 5 percentage points of GDP (from 4,8% to 9,4%), and the most significant raise occurred in education and health (human capital), and in infrastructure (physical capital). However, this growth took place mainly throughout the 90s, probably as a result of the lofty social commitments of the PC-91. Indeed, transfers from central government to regions increased from 2% to 4,6% of GDP between 1990 and 2003 and afterwards has been stabilized around 4%.

Figure 2

The increasing sub national expenditures in infrastructure, human capital and other public services could have positive effects on regional economic growth as may be inferred in Figure 3. In the short term the higher spending could stimulate the aggregate demand and, hence, the economic activities, and in a longer time horizon, it could affect positively the factor accumulation and its productivity. The correlation coefficient between the index of decentralization through expenditures and GDP per capita, across all regions, is positive. Even though it is not so high (0,186), its level of statistical significance is 99%. Once again Bogota, Antioquia and Valle have the highest decentralization levels while Arauca and Casanare, the oil regions, attain the highest levels of per capita GDP.

Figure 3

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<sup>1</sup> Indexes are defined as the share of expenditures and revenues of subnational governments in general government (OECD, 2013). We provide more detail on these indicators in section 5.

### 3. Analytical Framework

#### 3.1. The Basic Setup

We start from a simple version of Barro's (1990) endogenous growth model which assumes that the government purchases a portion of private output to provide free public services to private producers (infrastructure services, property rights, etc.). Let  $y$  be the output,  $k$  the private capital, and  $g$  the government purchases, all variables defined in per capita terms. Under constant returns to scale the aggregate production function could be written as:  $y = Ak^\alpha g^\varphi$ , where  $0 < \alpha < 1$ ,  $0 < \varphi < 1$ ,  $\alpha + \varphi = 1$ , and  $A > 0$  denotes the technology parameter. We omit the time subscripts for simplicity.

In order to introduce the fiscal decentralization discussion, government purchases are disaggregated among the shares financed by central, state and local authorities (Davoodi and Zou, 1998). Without loss of generality we consider only two levels: central and local governments (Kim, 2013; Iimi, 2005), which leads the production function to be written as follows:

$$y = Ak^\alpha f^\beta l^\gamma \quad (3.1)$$

where  $f$  denotes per-capita central government purchases, and  $l$  those corresponding to the local government,  $0 < \beta < 1$ ,  $0 < \gamma < 1$ , and  $\beta + \gamma = \varphi$ . Therefore, the degree of fiscal decentralization can be defined as local government spending relative to total public spending. As a result, if local government expending rises relative to central one, the degree of fiscal decentralization increases, and vice-versa. Accordingly, the allocations of total government spending,  $g$ , among different government levels take the following form:

$$f = \theta_f g; \quad l = \theta_l g; \quad \theta_f + \theta_l = 1 \quad (3.2)$$

where  $0 < \theta_i < 1$ , for  $i = f, l$ ; being  $\theta_f$  and  $\theta_l$  the shares of central and local government spending, respectively. On the side of revenue, governments fix a flat tax rate on income,  $\tau$ , keeping its budget constraint balanced,  $g = \tau y$ . The model is closed with standard preferences for a Cass-Koopmans (1965) representative household, where  $c$  is per capita private consumption and  $\rho > 0$  is the time discount rate. As usual, the dynamic budget constraint of the representative agent is given by  $\frac{dk}{dt} = \dot{k} = (1 - \tau)y - c = (1 - \tau)k^\alpha f^\beta l^\gamma - c$ . For a given level of  $g$  and  $\theta_i$ 's, the steady-state solution for per capita output growth is given by:

$$\frac{dy/dt}{y} = \frac{\dot{y}}{y} = \frac{1}{\sigma} \left[ (1 - \tau) \tau^{\frac{1-\alpha}{\alpha}} A \alpha (1 - \theta_l)^{\frac{\beta}{\alpha}} \theta_l^{\frac{\gamma}{\alpha}} - \rho \right] \quad (3.3)$$

The empirical long-term relationship between fiscal decentralization and economic growth may be assessed through the previous equation. As a matter of fact, increasing decentralization has a positive effect on growth as long as the productivity of local government spending is larger than that of the central government, i.e.  $\frac{dy/y}{d\theta_l} > 0$  for  $\theta_l < \frac{\gamma}{\beta+\gamma}$ . Additionally, for a given level of total government spending (as share of GDP), a reallocation of public spending among different levels of governments can lead to higher economic growth if the current allocation differs from the one resulting from a growth-maximizing expenditure problem, given by  $\theta_f^* = \frac{\beta}{\beta+\gamma}$  and  $\theta_l^* = \frac{\gamma}{\beta+\gamma}$ .

### 3.2. Complementarity among public goods and non-observable determinants of growth

Barro's growth model was extended by Nishimura (2006) and Akai et al. (2007) to capture complementarity between public goods provided by the regions within a country. Programs provided in each jurisdiction could have a spillover effect on others, and, therefore, on the national economy. Thus, the discussion about the role of government on growth is not only about benefits of the centralized versus decentralized fiscal regime, but also about spillover impacts of public goods financed across regions.

The complementarity hypothesis is incorporated through an aggregate production function for public goods, which depends partially on an ample set of public inputs financed by subnational governments (programs in education, health, infrastructure, libraries, parks, property rights, social services, etc.). In practice, it implies to allow  $g = \sum_{i=1}^I l_i + f$  in Barro's model, where  $i = 1, \dots, I$  is the number of regional units.

The extended framework, called *human-fallibility model* of the government, assumes that there are  $J$  identical jurisdictions in each region  $i$ , each of them with the same number of firms and households. Some public programs might generate positive spillover effects on growth (externalities) at both inter- and intra-regional levels while others do not. If  $p(j)$  denotes the public programs financed by jurisdiction  $j$ , then the aggregate public good in a region  $i$  ( $l_i$ ) is a function of the public services provided by  $J$ ,

$$l_i = \left( \sum_{j=1}^J \frac{1}{J} p(j)^\rho \right)^{\frac{1}{\rho}}, \quad \rho \geq 0 \quad (3.4)$$



Equation (3.4) represents the public goods production function for region  $i$ , which depends on inputs (programs) provided by the jurisdictions  $J$  (municipalities). Furthermore,  $\rho$  captures the degree of global [inter] complementarity between public services in the terminology of Bénabou (1996). A higher value of  $\rho$  means lower complementarity and vice versa. Empirically, it is usual to approximate the effectiveness of the public programs financed by jurisdiction  $j$  through its expenditures. In section 4 we will add other technical details for the estimation of  $\rho$ .

Aside from the usual factors determining long-term economic growth and the role of regional governments, an important branch of literature has focused on models in which space considerations are crucial (Breinlich, et al, 2013). This approach points out that economic activities tend to gravitate towards areas with relatively good transport links and which are close to large markets, mainly. Therefore, regional growth performance could be connected with geographic features in addition to other non-observable determinants (culture, quality of institution, etc.). If outcomes in one region are closely linked to the outcomes and characteristics of other regions (i.e. there is spatial interdependence), the econometric strategy has to take care of it. Our empirical exercises also pay special attention to these issues. We will further discuss the technical details on this subject in next section.

#### 4. Linking the Economic Theory to a Statistical Model

We begin using the equation:

$$y_{it} = \beta'_i \mathbf{x}_{it} + u_{it} \quad (4.1)$$

where  $\mathbf{x}_{it} = [d_{it} \quad k_{it}]^T$ ,  $\beta_i$  is a vector of region-specific slopes (technology), and  $u_{it}$  is closely related to the unobservable  $TFP$  growth,  $\Delta TFP$ , for  $i = 1, 2, \dots, N$  regions, and  $t = 1, 2, \dots, T$  periods.

The following assumptions, (4.2) to (4.4), lead to a (possibly non-stationary) dynamic factor system representation of the observable and unobservable variables on  $N$  correlated regions,

$$u_{it} = \alpha_i + \lambda'_i \mathbf{f}_t + \varepsilon_{it} \quad (4.2)$$

$$\mathbf{x}_{mit} = \pi_{mi} + \delta'_{mi} \mathbf{g}_{mt} + \rho_{1mi} f_{1mt} + \dots + \rho_{nmi} f_{nmt} + u_{mit} \quad (4.3)$$

$$\mathbf{f}_{.mt} \subset \mathbf{f}_t \quad \mathbf{f}_t = \mathbf{d}' \mathbf{f}_{t-1} + \boldsymbol{\epsilon}_{1t} \quad \mathbf{g}_t = \boldsymbol{\kappa}' \mathbf{g}_{t-1} + \boldsymbol{\epsilon}_{2t} \quad \boldsymbol{\epsilon}_t = [\boldsymbol{\epsilon}'_{1t} \quad \boldsymbol{\epsilon}'_{2t}]' \quad (4.4)$$

Under assumption (4.2) the unobserved  $\Delta TFP$  splits into a common (across regions) unobserved time-varying factor productivity component  $\mathbf{f}_t$ , a fixed regional factor productivity effect,  $\alpha_i$ , and a time and sector-varying  $TFP$  innovation,  $\varepsilon_{it}$ .

Assumption (4.3) implies, in turn, that each observable factor  $x_{mit} \subset \mathbf{x}_{it}$ ; for  $m = 1, 2$  (that is,  $x_{1it} = d_{it}$  and  $x_{2it} = k_{it}$ ), depend on a set of time-varying but variable-specific factors  $\mathbf{g}_{mt}$  that are common across regions, a subset of the factors  $\mathbf{f}_{nmt} \subset \mathbf{f}_t$  driving the TFP, a set of variable-dependent but fixed-across-regions effects  $\pi_{mi}$ , and a time, region and variable idiosyncratic innovation  $v_{mit}$ . Finally, under (4.3) the common factors driving the TFP, fiscal decentralization and private capital growth, follow VAR(1) dynamics.

According to Eberhardt, Banerjee and Reade (2010) the empirical model in (4.1) to (4.4) represents a production related function with (i) observed heterogeneous technology across regions, (ii) possibly integrated observable and unobservable variables, (iii) spillover and spatial cross-correlations between the observable and unobservable variables across regions, (iv) observed and unobserved heterogeneity among variables, (v) endogenous factors of production, and (vi) observable as well as unobservable dynamics. On the latter see Bond & Eberhardt (2013), Baltagi, Bresson & Pirotte (2008) and Hsiao & Pesaran (2008).

The latter two equations lead to three broad classes of fiscal decentralization sources of variation. The first source relates to time-varying shocks that affect fiscal decentralization equally across regions  $\mathbf{g}_{1t}$  such as central government policies associated to transfers. This source is, therefore, the first element of  $\boldsymbol{\epsilon}_{2t}$ . The second source has to do with region specific time varying shocks,  $v_{1it}$ , that may arise, for example, from idiosyncratic tax or spending policies. And third, time-varying but common across regions factor productivity shocks  $\mathbf{f}_{n1t}$  such as country wide efficiency innovations on tax revenue or expending, for instance, and thus, induce common (across region) correlation (feedback) between regional output growth and fiscal decentralization. The third source of shocks is one element of  $\boldsymbol{\epsilon}_{1t}$ .

As a result, provided that the left hand side of (4.1) is the regional per-capita output growth, one time fiscal decentralization shocks have a transitory stationary effect on output growth and a permanent effect on per-capita output. As a matter of fact, anything else left equal, a one-time positive shock to the first element of  $\boldsymbol{\epsilon}_{2t}$ , i.e. a fiscal decentralization innovation, or one element of  $\boldsymbol{\epsilon}_{1t}$ , i.e. TFP common innovation affecting fiscal decentralization, transmit in an AR(1) way to  $\mathbf{g}_t$  or  $\mathbf{f}_t$ , respectively and therefore in the same AR(1) manner to regional per-capita output growth. Therefore, by integrating this response a permanent shift in regional per-capita level arises. Furthermore, a one-time positive time-varying region idiosyncratic fiscal decentralization shock  $v_{1it}$  translates, ceteris paribus, into a one-time regional per-capita output growth of size  $\beta_1$ , which after integration becomes a permanent output level shift of the same size. Therefore, regardless of the source of fiscal decentralization shocks, common or idiosyncratic, per-capita output shifts upward permanently in the long-term.

Estimation is carried out through the Augmented Mean Group, AMG, technique proposed by Eberhardt & Teal (2010) and Bond & Eberhardt (2013). This choice is dictated by the very moderate size of our data, just as in our statistical model choice above. Under these circumstances several of the parameters that are not of interest are treated as a nuisance. In fact, under the assumption that regional technology vectors  $\beta_i$  are random with mean  $\bar{\beta}$ , only this can be consistently estimated according to Coakley, Fuertes & Smith (2006).

## 5. Results

### 5.1 The Dataset

Our dataset contains yearly records of the variables described in Annex 1 for 24 Colombian regions spanning the period 1990-2012. Unfortunately, there is not enough information for all the regions in the country (32), but the regions in our sample (24) explain on average 97.7% of the national GDP. The variables employed in the panel data regressions are described at the Annex 1, as well as other variables used in the cross-section exercises, and those required to assess the complementarity effect among public goods. Two special remarks on the dataset must be made.

The first is referred to the fiscal decentralization indicators based on expenditures and revenues,  $d_{it}$ . We take both the autonomous expenditure and taxes as the most relevant measures in our framework. The expenditure autonomy corresponds to spending made by government of region  $i$  excluding transfers received from the central government (i.e. expenditure financed with its own resources). The second refers to taxes over which subnational governments have some degree of legal autonomy delegated by central government. To complement these measures, we use the share of expenditures of subnational governments in total expenditures of general government, being this ratio one of the most employed indicator for studies at panel data level among countries (OECD, 2013). So, the larger a participation is, the more weigh the decentralized expenditures into the total public outlays.<sup>2</sup> Similarly, we included the share of its own revenue over the total.

The second remark has to do with estimation of the private stock of capital at a regional level,  $k_{it}$ , because this information is not available, unfortunately. We started using the initial value of aggregate stock of capital calculated by the DNP (National

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<sup>2</sup> Public spending executed in region  $i$  takes into account both operational and investment spending made by the department government of  $i$  plus expenditures made by all municipalities belonging to this region. One important source to finance regional expenditures is transfers from central government, especially for education. For a typical region  $i$ , the expenditures in education financed with transfers were, on average, 32% of the total spending between 2002 and 2012. The remaining expenditure (more than two thirds) was made in other programs such as infrastructure, health, debt service, bureaucracy, etc.

Planning Department) with the permanent inventories methodology. This value is updated using the net investment from the national accounts with a standard yearly depreciation rate of 4.92%. The following step involved identifying the public component of capital along the time period (and therefore the private component), using the expenditures in infrastructure as weights (a proxy of public investment) as a percentage of total investment coming also from national accounts. In the final step, regional distribution of private capital is proxied through two complementary tools: firstly, by applying the output distribution among regions as weights under the standard assumption that capital and output grow at equal rates in the steady state. Secondly, by taking into account the regional distribution of capital of the manufacturing firms, which were identified through the Annual Manufacturing Survey.

## 5.2 Growth Regression Models

Before presenting our results, some statistical properties of the variables involved in the panel data models were examined (unit root, stationarity and cross-section dependence). The Appendix 1 presents the results. Firstly, the standard unit root tests discard the presence of unit roots in the variables included in equation 4.1 (for different versions) and, therefore, those versions of this equation correspond to stationary panels. Secondly, the Pesaran's (2004) CD test strongly suggests the existence of variable-wise cross-sectional dependence among the 24 regions in Colombia. Thirdly, on basis of a Principal Components Analysis (PCA), results suggest that unobservable dynamic factors might be required to explain the total variation of regional economic growth in Colombia as is indeed considered by the AMG estimator used in this paper.

Table 1 shows the results of the model described by equations 4.1 to 4.4 based on the AMG estimator, which was designed for moderate panel size and was used in the presence of heterogeneous slope coefficients across regions and possible correlation across the panel members. The sign of parameters are those expected theoretically, and the model seems to explain growth mechanisms aptly. The key coefficients of fiscal decentralization are positive and significant in a statistical sense, implying that the transfer of fiscal functions to sub-national governments may have strengthened economic growth. Using expenditure autonomy indicators, for instance (model 1) the result implies that an increase of 10% of more autonomy in expenditures, for a representative region  $i$ , could lead in the long term to an increase of 2,4% in economic growth.

Table 1

The larger coefficient on the tax autonomy indicator (model 2) is surprising because currently there is a limited space for subnational governments to manage their own taxes. Maybe, there is a potential source of growth to be examined because it is reasonable to argue that fiscal decentralization through expenditures has also been associated to the strengthening of regional income bases. Finally, the fiscal decentralization assessments through the shares of spending and revenue are positive and significant in a statistical sense although with semi-elasticity larger than one.

The positive effect of fiscal decentralization on regional economic growth is explained by channels associated to demand as well as supply. Taking the fiscal decentralization indicator based on expenditures, for instance (model 3), the relative increasing sub national expenditures in infrastructure, human capital and other public services could have positive effects on regional economic growth both in the short term, through the stimulus to the aggregate demand (contemporary effect), and in a longer time horizon, due the positive effects on factor accumulation and its productivity (TFP). It should be recalled that this parameter measures the average effect both through agents and time.

The positive links found between fiscal decentralization and regional economic growth in Colombia is consistent with most recent papers on this subject. Nonetheless, some of them have argued that such relationship is positive but nonlinear, suggesting a hump-shaped association (Akai et. al. 2007; Blöchliger, 2013). The "optimal" level of decentralization derived from this discussion fixes therefore, a limit beyond which additional decentralization may restrain rather than encourage economic activity. We explore this hypothesis using the Colombian data, but no evidence was found perhaps because the series are not long enough.

Regarding the other results, the expected sign of the private capital parameter is confirmed with highest statistical significance across the models as well as the reasonable size of the elasticity. However, what is more remarkable is the positive result for the common unobservable factors that help to explain the economic growth of regions directly as well as factor accumulation and their productivity. In the theoretical setting of Eberhardt & Bond (2009), the unobservable factors represent especially the total factor productivity of the production function. Nevertheless, some particular differential aspects that have been recognized by the literature as crucial determinants of development across countries (regions), such as culture, habits, climate, geographical aspects, quality of institutions, etc., (Acemoglu, et al 2005), which could also be included as non-observable factors. Due to the unavailability of data for these estimations, we were not able to distinguish among parameters, unfortunately.

In order to check the validity of our previous results, residual unit root tests and cross-sectional dependence tests were performed for the residuals of each estimated panel. The results in Table 2 confirm the absence of unit roots since the p-

values are well below 0.05 and present strong evidence of lack in residual cross dependence since the p-values range from 0.45 to 0.77, thus suggesting that models successfully explained this data feature.

Table 2

Furthermore, a PCA analysis of the residuals of each panel estimated reveals that commonality is greatly reduced. The results from Table 3 show an important reduction of the correlation share of the first residual principal component with respect to the common correlation of GDP growth (Appendix 1). Therefore, an important share of commonality was captured by the model, thus validating our empirical strategy.

Table 3

Table 4 shows the results of the growth-regression model, this time in cross-section dimension as an alternative setup to allow introducing other type of controls. Each column represents the model estimated for each indicator of fiscal decentralization in different periods. We are interested in verifying here the fiscal decentralization effects on regional economic growth by controlling the initial level of output and human capital, measured through the initial level in the coverage of education. As can be seen, the sign of parameters for fiscal decentralization and private capital remain at highest level of statistical significance. Interestingly, the fiscal decentralization impact on economic growth assessed through the expenditure and tax autonomy indicators are larger in recent times. Additionally, we remark the negative and significant parameter found for the initial GDP level, suggesting convergence in regional economic growth in Colombia. We will return later with formal tests on this subject. In turn, we found an unexpected sign for the parameter of initial human capital which is not exclusive for our paper and requires a more detailed analysis (see Davoodi and Zou, 1998).

Table 4

### 5.3 Complementarity among public goods

To empirically assess complementarity between public goods provided by subnational governments (section 3.2), we follow the strategy proposed by Akai et al. (2007) which starts by linearizing the production function of section 3.1

$$\ln Y_{i,t} = B + (1 - \beta) \ln K_{i,t} + \beta (\ln l_{i,t} + \ln N_{i,t}) \quad (5.1)$$

where  $\ln Y_{i,t}$  is the logarithm of the per capita gross domestic product of region  $i$ ,  $\ln K_{i,t}$  is the logarithm of the per capita private capital and  $\ln N_{i,t}$  is the number of workers per capita in each region, calculated as the ratio of the economically active population over the total population. In turn, the value of  $\ln l_{i,t}$  corresponds to the logarithmic form of equation (3.4), where  $p(j)$  denotes the realization of public programs financed by jurisdiction  $j$ . That is,

$$\ln l_{i,t} = \frac{1}{\rho} \ln \left\{ \frac{1}{J} \sum_{j=1}^J p_t(j)^\rho \right\} \quad (5.2)$$

For the case of Colombia, we construct  $\ln l_{i,t}$  by defining  $p_t(j) = m_j + d_j$ , where  $m_j$  is the expenditure made by municipality  $j$  and  $d_j$  is the municipality's share (aliquot) in the department expenditure to which it belongs. The size of the population,  $pop$ , of each municipality with respect to its department is used to weight such aliquot, so  $d_j = \frac{pop_j}{pop_i} l_i$ . As is suggested by the literature, public expenditure relevant for this calculation includes especially those related with capital formation (investment), which has a higher power to generate spillovers. So, infrastructure expenditures made in region  $i$  on roads, electricity, parks, mass transit system and so on, could have beneficial effects on neighboring regions by considerations of space or geographical dependence, and vice versa. The parameters are estimated from the following second order non-linear equation by pooled non-linear least squares,

$$\hat{\theta} = \underset{\theta \in R^2}{\operatorname{argmin}} \left\{ \sum_{t=1}^T \sum_{i=1}^N (\ln Y_{i,t} - [B + (1 - \beta) \ln K_{i,t} + \beta (\ln l_{i,t} + \ln N_{i,t})])^2 \right\} \quad (5.3)$$

where  $\theta = [\beta, \rho]^T$  is the parameter vector. The estimation was carried out by unrestricted numerical minimization of the right-hand side term of equation (5.3) using the SAS/IML software. The data covers the thirteen most representative regions of the Colombian labor market for the period 2001-2012.<sup>3</sup> The results are summarized in Table 5 and compared with previously estimations made by Akai et al (2007) for the United States.

Table 5

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<sup>3</sup> The labor market data was taken from Colombia's Statistical Office (DANE). They report information only for the most representative 13 regions. Because of changes in the surveys, information is available from 2001 to 2012.

The null hypothesis of  $\rho = 0$  is rejected with 1% significance level, so that the resulting value of  $\rho$  is significantly positive for Colombia. As is prescribed theoretically, this is the case when public goods provided at subnational levels are complementary among themselves, or they have spillover effects across regions, ultimately strengthening economic growth at the national level. From comparing with the U.S., we conclude that regional public goods in Colombia have a lower complementary effect because the larger parameter  $\rho$ , the lower its effect (section 3.2). The private capital parameter  $(1 - \beta)$  is highly significant and close to what was obtained through the panel data regressions. In turn, the value of  $B$  must be taken cautiously, since this is not a dynamic growth analysis; therefore, implications for the Solow residual are not entirely clear.

#### 5.4 Regional growth convergence

An important feature of this dataset is the large gap in per capita GDP levels among regions in Colombia. In 2010, for instance, the richest regions (Casanare and Meta) attained almost 7 times more than the poorest (Sucre, Nariño and Chocó), being the national average around of COP\$7.8 million (see Lozano et. al., 2013) The natural question is if such cross-regional differences in per capita incomes have been temporary or permanent. If the differences are temporary, unconditional convergence (to a common long-run level) may be occurring. This situation is usually captured by the unconditional  $\beta$ -convergence test. Now, if income differences are temporary but there remain doubts whether the dispersion of these differences is declining over time, then the  $\sigma$ -convergence test helps solve this uncertainty. In contrast, if the differences are permanent, a crucial inquiry is to determine if permanence reflects a structural heterogeneity between regions or simply the role of initial conditions in determining long-run outcomes. In practice, the conditional  $\beta$ -convergence test implies employing an ample set of controls in the estimation.<sup>4</sup>

In order to formalize empirically the convergence hypothesis, the initial level of output is typically correlated with its growth rates. For the case of relatively homogeneous groups of economic units at regional level (as states of the US or Australia, provinces in Canada, prefectures in Japan, and counties in Sweden), the unconditional  $\beta$ -convergence hypothesis has been typically applied. In this case, controls are not used in estimation. Even though there is some variation in estimated convergence rates at international level, the range is relatively small: between 1% and 3%, per year (Barro and Sala-i-Martin, 1992).

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<sup>4</sup> If initial conditions determine long-run outcomes and countries with similar initial conditions exhibit similar long-run outcomes, then it's possible to talk of convergence clubs (Durlauf, et. al, 2005).



Figure 4(left panel) and Table 6 show the results of the unconditional  $\beta$ -Convergence in economic growth for Colombian regions. The average growth rate of each region's per capita income for 1980-2012 is shown on the vertical axis, and is negatively related to the log of per capita income in 1980, which is shown on the horizontal axis. Clearly, there is a phenomenon in which a poor region tends to catch up with a rich one in terms of the level of per capita income, and the gap is closed at a yearly rate of 0.86%. When public accounts are subtracted from the overall GDP, with the idea of obtaining a measure of Private GDP, the yearly rate falls to 0.66%.

Figure 4

Table 6

The unconditional  $\beta$ -Convergence test is performed also for the period after the promulgation of the political constitution of 1991, which encouraged fiscal decentralization in Colombia. Table 6 clearly shows that the gap in per capita income between poor and richer regions closes at a greater yearly rate of 1.61% for the more recent period (1.24% with private accounts exclusively). These simple exercises would lead us to recognize the positive contribution of subnational governments in recent times to close the differences of economic growth among regions. As we stated at the beginning of the paper, the main argument in favor of decentralization claims that subnational governments have a better understanding of local needs. If local governments have made progress in meeting uncovered needs, then they would play an important role in the regional income convergence.

Finally, we performed the  $\sigma$ -convergence test, according to which convergence implies a decline in the standard deviation of the logarithm for per capita product across regions in Colombia from 1980 to 2012. Figure 4 (right panel) clearly shows the decreasing dynamic of this dispersion between 1980 and mid-2000. However, it starts to increase afterwards, curiously.

## 6. Concluding Remarks

In this paper we provided empirical evidence on the role of fiscal decentralization in Colombia's regional economic growth. The period analyzed covers the last two decades, which is suitable since the Political Constitution of 1991 tried to encourage regional development. Also, around this time, most Latin American countries reinforced the role of regional governments in their development strategy, thus turning decentralization into the core of institutional reforms at the end of the 20th century, especially in developing countries.

The empirical strategy involved the choice of an adequate technique for the panel data approach which would allow us to include an ample set of factors suggested by the literature as a determinant of economic growth, as well as the successful management of the main econometric problems. The Augmented Mean Group (AMG) estimators proposed by Eberhardt & Bond (2009), Eberhardt & Teal (2010) and Bond & Eberhardt (2013) helped us with these purposes. The strategy was complemented with other empirical tools such as the cross-section models for different periods, together with the use of other controls, the tests on unconditional convergence in regional income differences, and, especially, the proofs on the complementarity hypothesis between public goods provided by different jurisdictions.

Our results confirm the positive link between fiscal decentralization and economic growth across regions in Colombia, implying that the transfer of fiscal functions to sub-national governments has been conducive to economic growth. These results are robust to the four most used indicators of fiscal decentralization: two based on expenditures and taxes autonomy and two based on their expenditure and revenue shares. The relationship found is also consistent with recent papers on this subject, even though no evidence was found over its nonlinearity.

The positive effects of fiscal decentralization on regional growth were also confirmed through cross-section models controlling the initial level of output and human capital. The expected signs on parameters of the remaining factors explaining growth are confirmed, as is the reasonable size of their elasticities. Nevertheless, the positive result for the common, non-observable factors that help explain economic growth directly as well as factor accumulation is also remarkable. Among them is total factor productivity, which could be affected in turn by differential aspects across regions such as culture, habits, climate, geographical aspects, quality of institutions, and so on. Although in comparison with the U.S. regional public goods in Colombia have a lower complementary effect, there is no doubt of their positive contribution to aggregate economic growth.

Finally, we tried to assess whether the per capita income differences among regions in Colombia has been declining, given the huge discrepancies observed three decades ago. Through unconditional  $\beta$ -Convergence and  $\sigma$ -convergence tests we found that the gap in per capita income between poor and richer regions closes at a yearly rate of 1.61% for the most recent period, and that the dispersion of these income differences is declining over time. Based on these results, we highlight the positive contribution of governmental activities.

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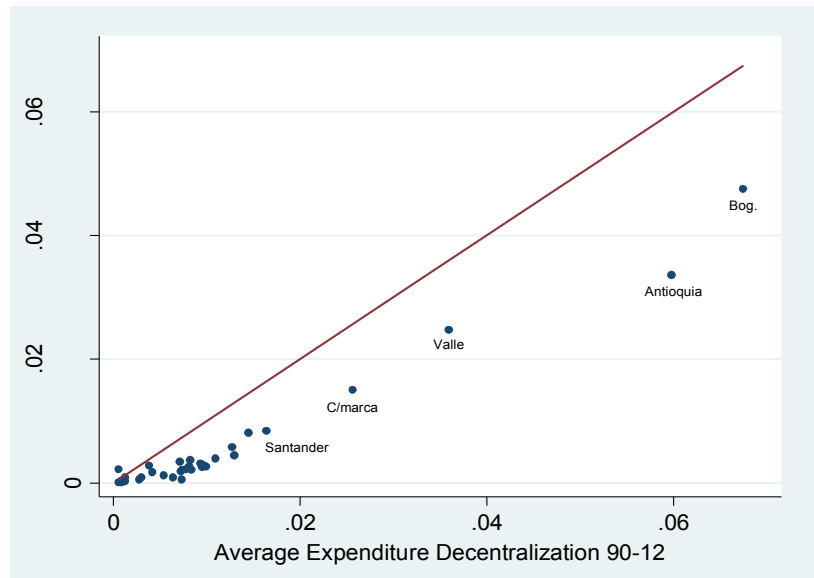
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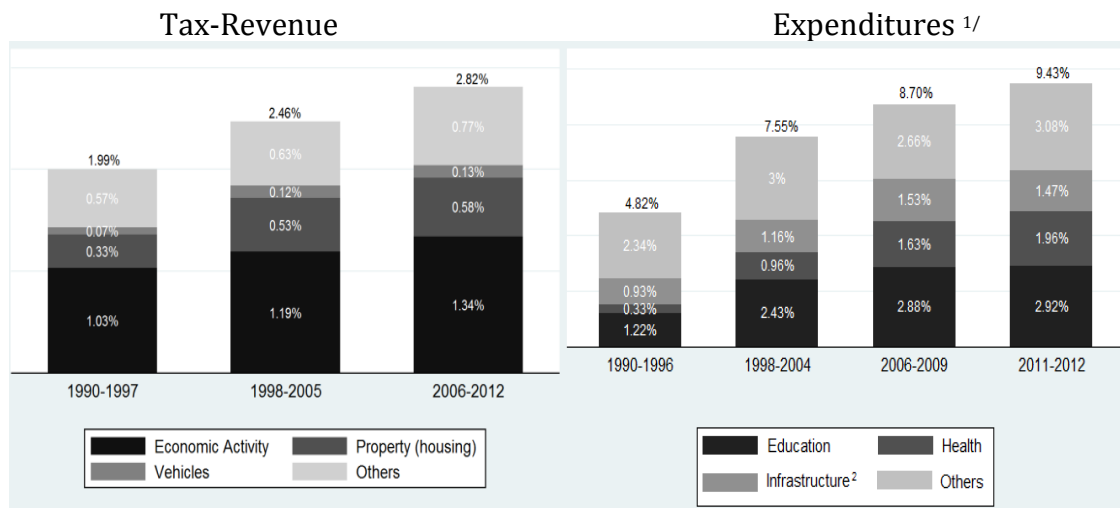
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Figure 1: Indexes of Fiscal Decentralization: Revenue vs Expenditures 1990-2012



Source: Calculations by the authors

Figure 2. Tax Revenue and Expenditures of Subnational Governments (Percentages of GDP)

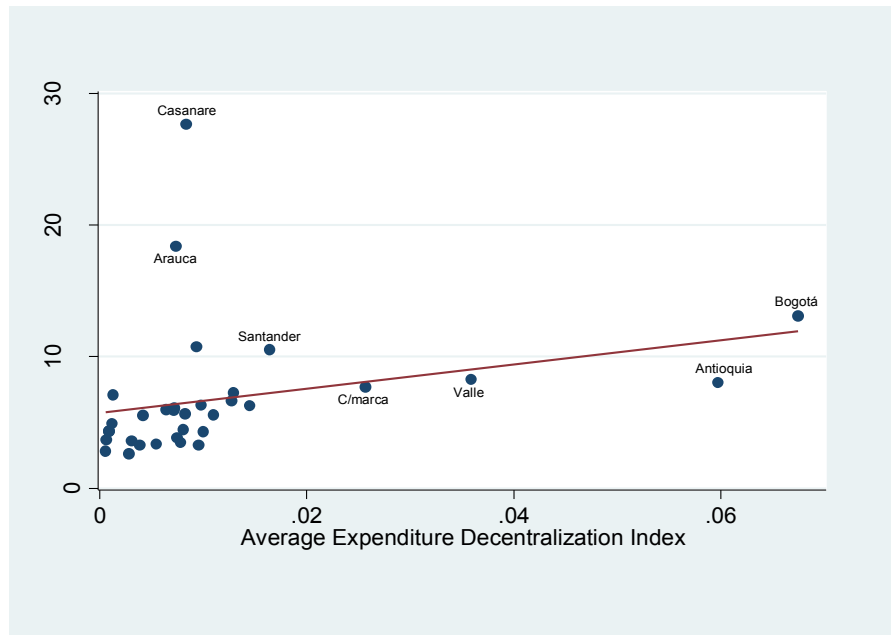


1/ Expenditures financed with both own-revenues and transfers from central government.

2/ For data restrictions, the infrastructure spending to GDP ratio for 2011-2012 correspond to authors' calculations

Source: Calculations by the authors

Figure 3: Simple correlation between decentralization and Regional GDP  
(Averages 1990-2012)



Source: Calculations by the authors

Figure 4: Convergence Test for Regional Economic Growth in Colombia

Unconditional  $\beta$ -Convergence

$\sigma$ -Convergence

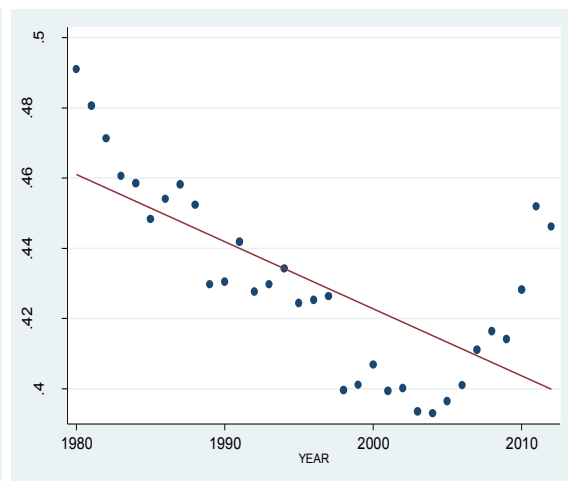
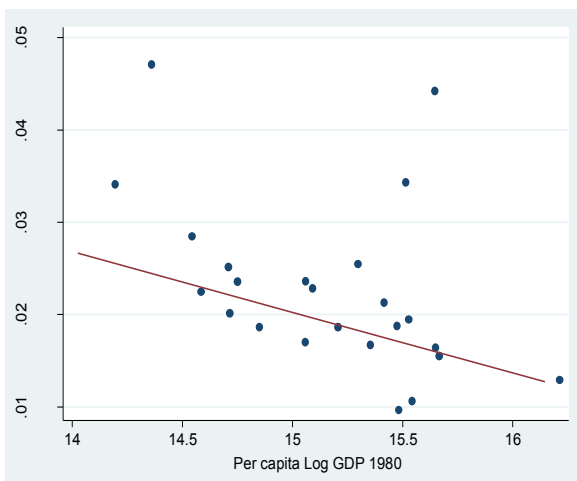




Table 1. Panel Data Results  
 Dependent Variable: GDP Per-capita (Annual Growth Rate)

Variables Fiscal Decentralization	Fiscal Autonomy		Fiscal Shares	
	(1)	(2)	(3)	(4)
Expenditure Autonomy, $d_{it}$	0.0246***			
Tax Autonomy, $d_{it}$		0.1302***		
Expenditure Share, $d_{it}$			1.5404***	
Revenue Share, $d_{it}$				1.5100*
Private Capital Per-cap, $k_{it}$	0.6159***	0.5946***	0.6026***	0.6110***
Common Factors Effect, $\lambda_i$	0.8323***	0.8084***	0.7672***	0.8461***
Constant (regional fixed effect), $\alpha_i$	-0.0158***	-0.0507***	-0.0325***	-0.0231**

Number of obs. = 528

Number of groups = 24

\*\*\* p < 0.01, \*\* p < 0.05, \* p < 0.1

The common dynamic process included as an additional regressor.

Source: Calculations performed by the authors.

Table 2. Levin-Lin-Chu Unit Root Test and Pesaran CD Cross-Section Dependence Tests for residuals of panel with different fiscal decentralization indicators

Residuals from Panel with each Fiscal Decentralization Indicator	Levin-Lin-Chu Test		Pesaran CD Test	
	Coefficient	p-value	Coefficient	p-value
$d_{it}$ – expenditure autonomy	-1.14	0.00	-0.23	0.82
$d_{it}$ – tax autonomy	-1.09	0.00	0.76	0.45
$d_{it}$ – expenditure share	-1.15	0.00	-0.30	0.76
$d_{it}$ – revenue share	-1.13	0.00	-0.29	0.77

Levin-Lin-Chu test - Under the null hypothesis of non-stationarity

Pesaran CD test - Under the null hypothesis of cross-section independence  $CD \sim N(0,1)$

Source: Calculations by the authors

Table 3. Principal Component Analysis of the Residuals with Different Indicators of Fiscal Decentralization

	Fiscal autonomy				Fiscal share			
	$d_{it}$ – Expenditure		$d_{it}$ – Taxes		$d_{it}$ – Expenditure		$d_{it}$ – Revenue	
Order	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
1	0.20	0.20	0.19	0.19	0.19	0.19	0.21	0.21
2	0.13	0.33	0.12	0.31	0.13	0.32	0.13	0.33
3	0.12	0.45	0.12	0.43	0.12	0.44	0.12	0.46
4	0.10	0.55	0.11	0.54	0.09	0.54	0.10	0.56
5	0.09	0.64	0.09	0.63	0.08	0.62	0.08	0.64
6	0.07	0.71	0.07	0.69	0.08	0.70	0.08	0.72
7	0.06	0.77	0.05	0.75	0.06	0.76	0.05	0.77
8	0.05	0.82	0.05	0.80	0.05	0.81	0.05	0.82

(1) Corresponds to the proportion of explained variance proportion and (2) corresponds to the explained variance

Source: Calculations by the authors

Table 4. Cross-section Results

Dependent Variable: GDP Per-capita (Average Annual Growth Rate)

Variables	Expenditure	Tax	Expenditure	Revenue
	Autonomy	Autonomy	Share	Share
	2000-2012	2000-2012	1990-2012	1990-2012
Fiscal Decentraliz. Indicator $d_i$	0.0906***	0.0312***	0.1588***	0.1324***
Private Capital $k_i$	1.0679***	0.7697***	0.4127***	0.6260***
Initial Level GDP Per-capita	-8.92e-09**	-9.83e-09**	-1.10e-08***	-1.12e-08***
Initial Level Education Coverage	-0.0787***	-0.0382***	-0.0181***	-0.0307***
Constant	-0.0018	0.0308***	0.0354***	0.0412***
Number of obs.	24	23	22	22

Source: Calculations by the authors

Table 5. Estimation of the Complementarity Effect of the Public Goods

Dependent Variable: Log of GDP Per-capita (Thirteen Most Representative Regions)

Parameter	Colombia: 13 Regions for 2001-2012 Authors' Calculations			USA : 50 States for 1992-1997 Akai et. Al. (2007)		
	Estimate	T Statistic	P Value	Estimate	T Statistic	P Value
$B$	3.38	11.63	0.000	3.35	3.67	0.000
$\beta$	0.47	5.19	0.000	0.34	5.35	0.000
$\rho$	0.78	3.26	0.000	0.48	3.98	0.000

Source: Calculations by the authors

Table 6. Test of Unconditional  $\beta$ -Convergence of the Regional Economic Growth in Colombia

	Growth of Regions for 1980-2012 Authors' Calculations		Growth of Regions for 1990-2012 Authors' Calculations	
	Total GDP	Private GDP	Total GDP	Private GDP
Constant	0.15286	0.11871	0.2691	0.20688
$\beta$	-0.00857	-0.00656	-0.01611	-0.0124
P Value	0.027	0.097	0.002	0.012
$R^2$	0.2029	0.1204	0.2812	0.1880

Source: Calculations by the authors

## Annex 1 . Dataset Description

### Panel Data Models

Variable	Description
$y_{i,t}$	Per capita regional real GDP based on product and population data from the Colombian statistics bureau (DANE). $Y_{it}/P_{it}$ $P_{it}$ : regional population
$k_{i,t}$	Per capita private capital. Additional information on its construction can be found in section 4.1. $K_{it}/P_{it}$
$d_{i,t}$	FD-Expenditure autonomy $\frac{RE_{it} - T_{it}}{RE_{it}}$ $RE_{it}$ : Government expenditure of region $i$ . $T_{it}$ : Transfers received from the central government by region $i$ . Source: Authors' calculation based on DNP and MHCP data
$d_{i,t}$	FD-Tax Autonomy $\frac{AT_{i,t}}{TR_{i,t}}$ $AT_{i,t}$ : Taxes over which subnational governments have some degree of autonomy from the general government tax revenue. $TR_{i,t}$ : Total tax revenues of each region. Source: Authors' calculation based on DNP data
$d_{i,t}$	FD-Expenditure Share $\frac{RE_{it}}{\sum_{i=1}^{24} RE_{it} + CE_t}$ $RE_{it}$ : Government expenditure of region $i$ . $CE_t$ : Central Government expenditures Source: Authors' calculation based on DNP data
$d_{i,t}$	FD-Revenue share $\frac{T.REV_{it}}{\sum_{i=1}^{24} T.REV_{it} + C.REV}$ $T.REV_{it}$ : Total revenue of region $i$ . $C.REV$ : Central Government total revenue. Source: Authors' calculation based on DNP data

### Other Models

Variable	Description
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$\ln N_{i,t}$	<p>Number of workers per capita.</p> $\frac{\text{Economically Active Population}}{\text{Total Population}}$ <p>Source: DANE</p>
$\ln l_{i,t}$	<p>Logarithm of the aggregate public good in a region, <math>i</math>.</p> $\ln l_{i,t} = \frac{1}{\rho} \ln \left\{ \frac{1}{J} \sum_{j=1}^J p_t(j)^\rho \right\}$ <p><math>\rho</math>: Degree of global [inter] complementarity between public services.</p>
$p_t(j)$	<p>Realization of public programs financed by jurisdiction <math>j</math>.</p> $p_t(j) = m_j + d_j$ <p><math>m_j</math>: Expenditure of municipality <math>j</math>.</p> <p>Source: Authors' calculation based on DNP data</p>
$d_j$	<p>Size of population, <math>pop</math>, of each municipality with respect to its department.</p> $d_j = \frac{pop_j}{pop_i} l_i$ <p>Source: DANE</p>
$d_{i,t}$	<p>Average fiscal decentralization indicator</p> $\frac{\sum_{t=1}^{22} d_{i,t}}{n}$ <p>Source: Authors' Calculation</p>
Initial level variables	<p>Population initial level: 1990 population.  Education initial level: 1996 education coverage level.  Source: DANE</p>

DANE: Departamento Nacional de Estadística  
DNP: Departamento Nacional de Planeación  
MHCP: Ministerio de Hacienda y Crédito Público

Appendix 1. Test on Unit Roots and Cross-Section Dependence for variables included in the panel data models

Levin-Lin-Chu Unit Root Test and Pesaran CD Cross-Section Dependence Tests

Variable	Levin-Lin-Chu Test			Pesaran CD Test	
	Coefficient	p-value	lags	CD Test	p-value
$y_{it}$	-1.07	0.00	1	21.80	0.00
$k_{it}$	-1.21	0.00	1	37.31	0.00
$d_{it}$ – exp autonomy	-0.02	0.00	1	52.31	0.00
$d_{it}$ – tax autonomy	-0.34	0.00	1	38.49	0.00
$d_{it}$ – expedit share	-0.27	0.02	3	47.92	0.00
$d_{it}$ – revenue share	-0.25	0.00	1	38.37	0.00

Levin-Lin-Chu test – Under the null hypothesis of non-stationarity

Pesaran CD test - Under the null hypothesis of cross-section independence  $CD \sim N(0,1)$

Source: Calculations by the authors

The standard unit root tests discard the presence of unit roots in the variables included in equation 4.1 (for different versions) and, therefore, such equation does not correspond to a co-integrated panel. The results of the table above show p-values well below 0.05 for the corresponding Levin, Lin, and Chu unit root tests (Levin, Lin, & Chu, 2002). In turn, the optimal number of lags show that there is little self-correlation in the variable-wise. The higher number of optimal lags appears in the fiscal decentralization based on expenditures (3 lags), while the rest of variables require only 1 lag for whiteness. These findings were also corroborated with other panel unit root tests (Im, Pesaran and Shin, 2003) with the same results. Therefore, the different versions of equation 3.1 correspond to stationary panels. The Pesaran's (2004) CD test strongly suggests the existence of variable-wise cross-sectional dependence among the 24 regions in Colombia. Indeed, results show extremely low p-values for the null of cross-sectional independence among regions and the levels of simple and absolute correlation show a moderate relationship among variables, suggesting that cross-sectional dependency is pervasive in our dataset.

To explore the existence of unobservable dynamic factors such as sources of growth, we performed a Principal Components Analysis (PCA) on all the series of the regional GDP growth. The results of the table below reveal that the first principal component explains 35% of the correlation between regions, while the second and third components explain 12% and 9%, respectively. All these results suggest that dynamic factors might be required to explain the total variation of regional economic growth in Colombia as is indeed considered by the AMG estimator used in this paper.

### Principal Component Analysis of Regional GDP Growth

Order	Eigenvalue	Difference	Proportion	Cumulative
1	8.35	5.51	0.35	0.35
2	2.84	0.78	0.12	0.47
3	2.06	0.09	0.09	0.55
4	1.97	0.41	0.08	0.63
5	1.56	0.17	0.07	0.70
6	1.39	0.36	0.06	0.76
7	1.03	0.14	0.04	0.80
8	0.89	0.19	0.04	0.84

Source: Calculations by the authors

In all, the time series panels containing regional per capita output growth, the growth of private capital, and the different fiscal decentralization indicators are stationary. Furthermore, there is clear evidence over cross-region dependency which may be related to spillovers and geographical correlation. Finally, there is evidence of the existence of unobserved factors driving output,  $f_t$ , which may account, partially at least, for variations of output growth.



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