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Abstract

Tax decentralisation should improve the efficiency of local governments and ultimately boost output growth. The empirical evidence is however mixed. The current work looks at two channels through which tax decentralisation may affect economic growth: labour productivity and employment rate. The empirical analysis conducted on 20 OECD countries over the period 1980-2010 shows that the ultimate effect of fiscal decentralisation on growth depends on which channel prevails, thus rendering the direct estimation of tax decentralisation on growth ambiguous. Tax decentralisation make the employment rate grow faster, while it has either no effect of reduces labour productivity growth. When the analysis is conducted using an IV approach with instruments based on institutional similarities and geographic distance, the positive and significant effect on employment rate growth is offset by the reduction of labour productivity growth, resulting in the absence of any statistically significant effect on output growth.

Keywords: economic growth; labour productivity; employment rate; tax decentralisation
JEL Classification: O40, O47, H70, H77

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1 Introduction

The decentralisation of taxing powers is seen as a way of promoting the autonomy of local governments, with the aim of improving the efficient provision of public goods, and ultimately boost economic growth. One way in which tax decentralisation can affect output growth is inducing competition among local jurisdictions for attracting mobile factors of production. Competition could have beneficial effects on growth if it helps "taming" public sector expansion (Brennan and Buchanan, 1980), or it facilitates an efficient allocation of resources when citizens "vote with their feet" (Tiebout, 1956). Furthermore, Edwards (2005) shows that tax competition would provide a strong incentive to local governments for investing in human capital; similarly, Hatfield (2015) shows that capital mobility across jurisdictions induces local governments to implement growth-friendly tax policies. At the same time, tax competition could harm growth if it triggers a race to the bottom, resulting in under-provision of public goods and services (Zodrow and Mieszkowski, 1986). Koethenbuerger and Lockwood (2010) argues that tax decentralisation would reduce growth and increase output volatility. Other theoretical models predict mixed effects of tax competition on output growth (Rauscher, 2005, 2007).[1]

Since it is not possible to conclude whether tax decentralisation is growth-enhancing from a theoretical perspective, the empirical literature has set on resolving this uncertainty. Results are however mixed: some empirical studies find a positive correlation, few others a negative one, and others no correlation at all. It may depend on differences in the way in which tax decentralisation is defined and the way in which these empirical studies deal with the omitted variable bias and reverse causality problem. The latter could be particularly problematic, given the difficulty to find valid instruments for fiscal decentralisation indicators. However, there is the possibility that the problem lies in the reduced-form model used in most of the literature, where the impact of fiscal decentralisation on output growth is directly estimated. These empirical studies do not consider the channels through which tax decentralisation affects output growth, thus overlooking the possibility that channels work in opposite directions, offsetting each other.

The novelty of our empirical analysis is to explicitly consider two channels through which tax decentralisation can affect per capita output growth: the growth of labour productivity and the employment growth rate. Our empirical strategy consists in estimating the effects of tax decentralisation separately on both channels, so that the estimated coefficients provide an approximation for the overall effect on output per capita growth. The analysis is conducted on a panel of 20 OECD countries over the period 1980-2010, which allows to identify the effects of tax decentralisation on economic growth, controlling for country specific and time specific effects to reduce the risk of omitted variables. In order to account for the possibility that output growth determines labour productivity and the employment rate — for instance, larger growth may require more workers so it tends to increase the employment rate — a Two-Stage Least Squares (2SLS) estimator is used with two sets of instruments: the lagged values of tax decentralisation indicators, as it is common in the literature, and a novel set, based on geographical contiguity and institutional similarities (Ligthart and van Oudheusden, 2017).

The results of the empirical analysis show that the effects of tax decentralisation on output growth depend on the estimation methodology and the type of instruments used: the effect is pos-

[1] For an insightful survey on the effects of fiscal decentralisation on economic growth see Baskaran et al. (2014).

itive with the OLS estimator; its magnitude is reduced when tax decentralisation is instrumented with its own lagged values; and disappears when instruments bases on institutional similarities and geographical distance across countries are used. This ambiguous results depend on which channel prevails, as the two channels react in opposite way to tax decentralisation: the growth of the employment rate is enhanced, while labour productivity growth is reduced. The effects on the channels are quite robust to different estimation methodology, set of instruments and the use of alternative indicators of tax decentralisation that consider the degree of tax autonomy of subnational governments. Moreover, they remain robust even when the cyclical component has been removed from the indicators of tax decentralisation by using Hodrick and Prescott (1997) method.

Overall, the analysis shows that tax decentralisation has an opposite effect on the two channels, so that the ultimate effect on output growth depends on which one prevails. In particular, tax decentralisation tends to boost employment growth. This is consistent with the view that local government responsible to finance their budget have a strong incentive to enlarge their tax base implementing policies that can better address local labour market issues. Moreover, there are evidence that tax decentralisation may also support labour-intensive sectors, such as public administration (Martinez-Vázquez and Yao, 2009; Adam et al., 2014), stimulating job creation at the expense of productivity. The positive and significant effect on the growth rate of employment is however offset by the reduction in the labour productivity growth, resulting in the absence of any statistically significant effect on output growth. The effects on labour productivity are consistent with the idea that infrastructure and innovation policies require scale economies that are difficult to achieve at the local level (Stegarescu et al., 2002). Our analysis provides evidence that focusing on the channels allows to reconcile the results of the existing empirical studies.

The rest of the paper is organised as follows. Section 2 provides an extensive survey of the empirical evidence highlighting the sensitivity of different approaches and the need to look for the channels. Section 3 discusses the properties of the indicator we use to capture tax decentralisation. Section 4 provides a detailed description of the empirical strategy including a discussion of the econometric model and the control variables. Section 5 presents the results of the panel regression analysis, providing economic explanations and discussing some of the implications. Finally, section 6 concludes providing final remarks.

2 Empirical evidence on OECD countries

The empirical literature on fiscal decentralisation and its impact on output growth has significantly expanded since the late 1990s, when the first studies appeared, although it has not reached yet a consensus. Table 1 provides a detailed overview on the existing empirical evidence on OECD countries, displaying sample size, decentralisation measures, methodology and main findings.

One of the possible sources of diverging results is the definition and measured of fiscal decentralisation. As shown in Table 1, most of the studies are based on Government Finance Statistics (GFS) of International Monetary Fund (IMF) indicators. The advantage of using accounting indicators rests in their wider country and time coverage. Yet, some authors criticised the use of GFS-style decentralisation measures (Ebel and Yilmaz, 2003; Rodden, 2004;

Stegarescu, 2005), because they fail to reliably inform about the "true scope for autonomous decision making on the lower levels of government" (Feld and Schnellenbach, 2011, p. 238), overestimating the actual degree of fiscal decentralisation. On the expenditure side, the traditional GFS-style measures include both self-financed spending of subnational governments and mandatory spending by central government at local level that might indicate an incorrect higher level of expenditure decentralisation. On the side of revenue, they do not distinguish between piggybacked taxes, shared taxes and own taxes of subnational governments, causing overestimation of the GFS measures of (tax) revenue decentralisation. In order to address this issue, Stegarescu (2005) provides a series of new indicators based on own-source revenue of local governments, following the methodology proposed by OECD (1999). These indicators are qualitatively better than the GFS ones because they account for the varying degrees of subnational government fiscal autonomy. Nevertheless, Bodman (2011) recognizes that they could overstate the degree of effective decentralisation because budget data are aggregated across all levels of government, without taking into account differences in the degrees of competences among them. The main shortcomings of Stegarescu's indicators is however the limited country (only 23 OECD countries) and time coverage (up to year 2001).

Empirical studies that use GFS indicators find none (Davoodi and Zou, 1998) or negative (Martínez-Vázquez and McNab, 2003; Rodríguez-Pose and Ezcurra, 2011) effect of fiscal decentralisation on economic growth. In particular, Davoodi and Zou (1998) conclude that the absence of an effect in developed countries is due to the fact that they "*are simply too homogeneous vis-a-vis developing countries, leaving hardly any cross-country variation in fiscal decentralization to be linked systematically to cross-country differences in growth*" (p. 254).

Ebel and Yilmaz (2003) replicate the work of Davoodi and Zou (1998) with indicators of revenue autonomy finding a positive and significant correlation between the degree of subnational revenue autonomy and long-run economic growth. They argue that the insignificant effect of decentralisation found by Davoodi and Zou (1998) is due to erroneous measurement of decentralisation through the GFS-style indicators. The use of alternative indicators that better account for the degree of subnational government fiscal autonomy does not seem to lead to a convergence of results, as several empirical studies show a negative relationship using Stegarescu's indicators (Bodman, 2011; Baskaran and Feld, 2013; Filippetti and Sacchi, 2016).[2]

One possible explanation is that the empirical methodology matters for the results. In recent studies, the estimates become more precise with new and more sophisticated econometric methods. A growing number of empirical studies have implemented panel data techniques to investigate the link between fiscal decentralisation and economic growth. The role played by methodology in driving estimation results emerges clearly by comparing empirical analyses conducted by Thornton (2007) and Baskaran and Feld (2013). Both analyses use indicators of decentralisation based on fiscal autonomy but different econometric approaches for running regressions. By performing cross-sectional analysis, Thornton (2007) does not find any significant effect of subnational revenue autonomy on economic growth. The panel data analysis conducted by Baskaran and Feld (2013) shows that decentralisation impacts significantly on economic

[2]Filippetti and Sacchi (2016) also show that the relationship between fiscal decentralisation and economic growth is conditional on the institutional setting, revealing that fiscal decentralisation is growth enhancing in countries where local governments have strong political and administrative authority.

growth only when it is measured through own-source revenue of subnational governments. Another example that highlights the importance of methodology is Feld (2005) who finds that the significant negative effect of fiscal decentralisation on economic growth in pooled regressions, disappears when fixed-effects are included in the regressions. Asatryan and Feld (2015) focus on developed countries using a Bayesian model averaging approach, and find that the negative evidence is not robust to the inclusion fixed-effects.

Most of the empirical studies do not account for the potential reverse causality between decentralisation and economic growth. Most of the works that explicitly deal with reverse causality use the lagged values of fiscal decentralisation as instruments (Martínez-Vázquez and McNab, 2003; Gemmell et al., 2013; Baskaran and Feld, 2013; Filippetti and Sacchi, 2016). This approach produces a loss of observations that increases the number of missing values in unbalanced panel data, reducing the precision of estimations. Few studies make use of external instruments to check for more robust results. Baskaran and Feld (2013) use the qualitative indicator of subnational fiscal autonomy realised by Hooghe et al. (2010). This instrument could be exogenous because it is not affected by annual fluctuations in growth rates and, at the same time, it affects the degree of subnational government taxation. More recently, Ligthart and van Oudheusden (2017) propose a set of novel external instrumental variables based on countries similarities and geographical distance, behind the conjecture that countries that share similar characteristics show the same pattern of fiscal decentralisation. The IV estimations tend to confirm the results obtained with the alternative approaches (mainly OLS). In Martínez-Vázquez and McNab (2006) the Within IV estimator provides more significant estimates than the other estimators when the sample is limited to developed countries, while in Baskaran and Feld (2013) the results are not fully robust when controlling for endogeneity.

Finally, existing studies investigate the direct effect of tax decentralisation on output growth without considering the possible channels through which the effect unfolds. The theoretical literature has identified different plausible channels through which tax decentralisation affects economic growth without, however, coming to a definitive conclusion whether decentralisation is beneficial or harmful for economic growth. The possibility that the effect of decentralisation on one channel offsets the effect on other channels might be a further explanation of the heterogeneity in empirical results.

[Table 1]

3 Indicators of tax decentralisation

Three indicators of tax decentralisation are used in our empirical analysis conducted on an unbalanced panel of 20 high-income OECD countries[3] over the period 1980-2010. The first one is the share of tax revenue of subnational governments (i.e., state and local) over total (consolidated) tax revenue. It represents an accounting measure of decentralisation, as it is based on figures reported in the budget of local administrations. This indicator is obtained from the OECD

[3]Our sample includes: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom, United States.

Fiscal Decentralisation database, and is referred to as *Taxdec*. It provides a good representation of tax decentralisation by quantifying the degree of decentralisation using accounting values, thus it allows to conduct cross-country analysis. A drawback of this accounting indicator is the absence of information about the actual power of subnational governments to influence their tax policy, thus overestimating the effect of decentralisation as there is no discrimination between subnational own taxes and piggybacked or shared taxes (Ebel and Yilmaz, 2003; Stegarescu, 2004, 2005).

The second indicator is provided by Stegarescu (2004, 2005), which includes only subnational taxes whose rate, base or both are autonomously defined by local governments. It is, therefore, based on accounting values but weighted according to the actual possibility of the local government to influence them. This indicator is referred to as tax autonomy, *Taxaut*. It is computed as the share of subnational government *own* tax revenue on general government total tax revenue. The problem with this indicator is its time coverage, extended up to year 2001.

These two indicators present few missing observations: just 1 missing value for *Taxdec*[4] and 11 missing values for *Taxaut*. Table 2 displays the average values of each indicator for the relevant period. The indicator *Taxdec* tends to underestimate the degree of tax revenue decentralisation for countries such as Germany, Spain, Sweden and Switzerland. The difference between *Taxdec* and *Taxaut* is more than ten percentage points and becomes more severe for Germany. A similar outcome is observed when the average *Taxdec* is calculated over the shorter period 1980-2001. Thus, the main difference between the two indicators can be imputed to their different budget determinants.

[Table 2]

Since both indicators overstate the degree of effective decentralisation because they aggregate budget data over all levels of local government, we use an additional indicator of tax decentralisation. We call it as *Taxaut-regio*. This indicator, constructed by Hooghe et al. (2016), measures the ability of regional governments to set independently rates and/or bases of taxes. Higher levels of this indicator implies higher degree of regional government tax autonomy. An advantage in using this qualitative indicator is that it is defined upon constitutional rules. Therefore, its variations reflect an effective change in the degree of subnational government tax autonomy. Instead, it is more difficult to identify the source of variation in the two budget-based measures of tax decentralisation because their changes can be simultaneously caused by business fluctuations and fiscal federalism reforms. A drawback in using qualitative indicators is that they change rarely over time, revealing a low within variance that could be not sufficient to estimate efficiently their coefficients in models with fixed-effects.

4 Empirical strategy

It has been widely recognized that the output per capita can be expressed as the interaction between two factors, the labour productivity and the employment rate. Equation (1) shows the factor decomposition,

[4]The missing value refers to Italy in 1986, and it is dealt by interpolation using the simple average of the indicator between 1985 and 1987.

$$\underbrace{\left(\frac{GDP}{pop}\right)}_{output\,per\,capita} = \underbrace{\left(\frac{GDP}{emp}\right)}_{labour\,productivity} \times \underbrace{\left(\frac{emp}{pop}\right)}_{employment\,rate} \tag{1}$$

where GDP represents gross domestic product expressed in purchasing power parity and constant US Dollars; *emp* and *pop* are the employment level and the population in each country, respectively. The output per capita depends on the number of people employed and their level of productivity. For any level of productivity an increase in the amount of workers over the population would increase output per capita; and given the employment rate, if those workers become more productive it would boost output per capita.

The empirical strategy is based on the linearisation of this factor decomposition, obtained by considering the annual percentage changes in each component as shown in equation (2).

$$\%\Delta\frac{GDP}{pop} = \%\Delta\frac{GDP}{emp} + \%\Delta\frac{emp}{pop} \tag{2}$$

where $\%\Delta$ represents the annual percentage change.

The identification of the impact of tax decentralisation on each channel is, therefore, obtained by separately estimating an equation for each term of equation (2).[5]

$$\%\Delta\left(\frac{GDP}{pop}\right)_{i,t} = c + \phi\, TD_{i,t} + \beta\, x'_{i,t} + \theta\, z'_{i,t-1} + f_i + \tau_t + \epsilon_{i,t} \tag{3}$$

$$\%\Delta\left(\frac{GDP}{emp}\right)_{i,t} = c + \phi_1 TD_{i,t} + \beta_1 x'_{i,t} + \theta_1 z'_{i,t-1} + f_i + \tau_t + \epsilon_{i,t} \tag{4}$$

$$\%\Delta\left(\frac{emp}{pop}\right)_{i,t} = c + \phi_2 TD_{i,t} + \beta_2 x'_{i,t} + \theta_2 z'_{i,t-1} + f_i + \tau_t + \epsilon_{i,t} \tag{5}$$

Each element of equation (2) enters as dependent variable of the empirical specifications (3)-(5) that include country fixed-effects f_i, to control for unobserved characteristics of the *i-th* country, and time fixed-effects τ_t, to control for idiosyncratic shocks spread across countries.[6] The right-hand side of each specification includes the same indicator of tax decentralisation (TD) as well as a $1 \times K$ vector $x'_i = (x_i^1, ..., x_i^K)$ of control variables at time *t*. The vector z includes controls for the levels of real per-capita GDP (in logarithmic form) and tertiary education (Barro, 1991, 1996), both at time $t-1$. Since their initial values would be dropped in the fixed-effect model because they are invariant over time, their lagged values are included. A constant term *c* and normally distributed error ϵ with zero mean and constant variance are also included in the panel regression.

The coefficients attached to the TD indicator in (4) and (5) represent the contribution of each channel to the overall effect of TD on output per capita growth. Since the relationship is

[5]This empirical strategy has been developed in the context of urban sprawl by Banzhaf and Lavery (2010).

[6]In Tables 5 and 6 the results of Hausman (1978) test suggest that the fixed-effects model is correctly specified. Indeed, it rejects the null hypothesis of no correlation between observable variables and unobserved effect at 1% level.

linearised the sum of the two coefficients ϕ_1 and ϕ_2 is *almost* equal to the estimated coefficient ϕ. The difference is given by the size of $(\phi_1 \cdot \phi_2)$, "which can be expected to be small"(Banzhaf and Lavery, 2010, p. 172). This allows to identify the direction of the effects produced by tax decentralisation on each component of economic growth.

Output per hours worked is used as an alternative indicator of labour productivity. The advantage of using hours worked instead of employment is to correct for the downward bias introduced by part-time workers in the original indicator. The econometric model is modified according to the following factor decomposition of per capita output growth, where the number of workers (employment) is substituted by *hours* worked as illustrated in equation (6).

$$\Delta\% \frac{GDP}{pop} = \Delta\% \frac{GDP}{hours} + \Delta\% \frac{hours}{pop} \tag{6}$$

4.1 Estimation methodology

The baseline model is estimated using the OLS estimator with heteroskedastic and autocorrelated consistent (HAC) standard errors.[7] However, the estimation based on the OLS methodology may suffer from reverse causality because tax decentralisation maybe driven by output growth (Martínez-Vázquez et al., 2016). An instrumental variables approach is adopted to overcome this problem. The validity of this approach depends on the quality of the instruments, that should be correlated to the tax decentralisation indicators and uncorrelated to the dependent variable, as well as being orthogonal to the error term.

It is difficult to find instruments for fiscal decentralisation that satisfy all conditions simultaneously.[8] For this reason, most empirical studies have addressed endogeneity by using the lagged values of fiscal decentralisation indicators as instruments (Gemmell et al., 2013; Filippetti and Sacchi, 2016). However, the use of the lagged values causes loss of observations and information, making point of estimates less precise. Ligthart and van Oudheusden (2017) propose a set of novel instrumental variables. Those instruments are based on the conjecture that countries with similar institutional features, such as the political system, the legal system, size or geographical location should display similar fiscal decentralisation patterns. Building on this approach, we define two external instruments and use them in the 2SLS panel data regression analysis.[9] The first instrument Z_i^1 consists of the weighted average of fiscal decentralisation of countries with a similar institutional setting as country i. The concept of similarity is based on the presence of autonomous regions as defined in the Database of Political Institutions (Thorsten et al., 2001), according to which a region, area, or district is autonomous or self-governing.[10]

[7] Regarding the presence of heteroskedasticity, see the results of the Breusch and Pagan (1979) test displayed in Tables 5 and 6. The Bartlett-kernel approach is used to solve autocorrelation detected with the Arellano and Bond (1991) test. The bandwidth is selected according to the order of serial correlation detected in the errors. See the test results in Tables 5 and 6.

[8] See Martínez-Vázquez et al. (2016) for a comprehensive discussion.

[9] Since TD has missing values, the number of countries changes over time when the instruments are calculated. This drawback is addressed by the substitution of missing values with interpolated data (Ligthart and van Oudheusden, 2017).

[10] Furthermore, they must be constitutionally designated as autonomous or independent or special. Federal Districts or Capital Districts do not count as autonomous regions. Disputed autonomy is not recorded. Indian reservations are

The instrument is described in equation (7).

$$Z_{it}^{1} = \sum_{j=1}^{N} q_{ij} \cdot TD_{jt} \qquad q_{ij} = \begin{cases} \frac{\gamma_{ij}}{\sum_{j=1}^{N} \gamma_{ij}} & \text{for } i \neq j \\ 0 & \text{for } i = j \end{cases} \tag{7}$$

Tax decentralisation *TD* of the *j*-th country at time *t* is weighted by q that depends on similarity (γ) between countries *i* and *j*. The dummy γ assumes value 1 when the two countries are similar, and zero otherwise. The similarity depends on the presence, or absence, of autonomous regions. Therefore, the weight q_{ij} is zero if country i and j are not similar (for instance, i has autonomous regions while j does not), while it assumes value one for all regions similar to i, i.e., they are all with autonomous regions or without.

The second instrument is based on the idea that geographical proximity should explain similar patterns of fiscal decentralisation as neighbouring countries tend to mutually mimic each others' fiscal policies (Ligthart and van Oudheusden, 2017). This idea is at the base of the application of spatial econometric models to the analysis of fiscal interactions between jurisdictions (Brueckner, 2003; Revelli, 2005). Accordingly, the instrument for country i consists of the sum of fiscal decentralisation across countries weighted for their geographical proximity to country i:

$$Z_{it}^{2} = \sum_{j=1}^{N} w_{ij} \cdot TD_{jt} \qquad w_{ij} = \begin{cases} \frac{\omega_{ij}}{\sum_{j=1}^{N} \omega_{ij}} & \text{for } i \neq j \\ 0 & \text{for } i = j \end{cases} \tag{8}$$

where ω assumes value 1 if the geographical distance between the capital cities of countries *i* and *j* is less than 1,000 kilometres, and 0 if the distance is above this threshold.[11]

Table 3 shows the pairwise correlation between fiscal decentralisation and the instruments. A positive (negative) correlation between the instruments and the indicators of tax decentralisation suggests a certain degree of complementarity (substitution) in fiscal decentralisation decisions of countries that are geographically close or share common features. The pairwise correlation reveals that the instrument Z^1 (Z^2) is negatively (positively) correlated with each indicator of tax decentralisation at the significant level of 1%. According to this result the 2SLS estimates, obtained using these instruments, should not suffer from efficiency loss compared to the OLS estimates.

[Table 3]

4.2 Control variables

A set of control variables is included to account for factors that affect output growth independently of fiscal decentralisation. Since "*growth theory is not explicit about what variables belong*

not counted as autonomous.

[11] The distance between the capital cities of countries is collected from CEPII database (Mayer and Zignago, 2011) available at: http://www.cepii.fr/anglaisgraph/bdd/distances.htm.

in the "true" regression" (Sala-i-Martin et al., 2004, p.813), the choice is based on previous empirical works and tend to reflect the most important determinants in advanced economies (e.g., Levine and Renelt, 1992; Barro, 1996; Sala-i-Martin et al., 2004).

We include three groups of control variables: socio-demographic, macroeconomic and institutional. The group of socio-demographic variables consists of: total population growth (*Pop. growth*); the *Fertility rate*, measured as total births per woman; and the number of tertiary year schooling (*Schooling*). For a given starting level of real per-capita GDP, two opposing effects impact its growth rate: on the one hand, there is a negative effect caused by higher population growth and fertility rates which dilute the capital of the economy since a portion of the investment is used to provide capital for new workers, rather than to raise capital per worker (Barro, 1996); on the other hand, there is a positive effect caused by higher initial levels of education which raises the economy's ability to absorb new technologies, the capability of doing research and development (R&D), and, more generally, to concentrate on high value-added sectors.

The group of macroeconomic indicators includes investment as share of GDP, government consumption, trade openness, inflation rate, and the first order lagged value of the level of per capita GDP. We use the investment share of GDP (*Investment ratio*) as a proxy for growth of physical capital. It is generally accepted that the investment ratio positively affects economic growth and a number of empirical studies confirm this (e.g., Long and Summers, 1991; Mankiw et al., 1992; Levine and Renelt, 1992).

The economic literature that has investigated the impact of the size of government on economic growth seems to have reached a consensus on the fact that there is a negative correlation between the two variables (in OECD countries) and this result holds independently of the way government size is measured (Bergh and Henrekson, 2011).[12] Since it does not make sense to measure the impact of an aggregate such as the government size on growth (Bergh and Henrekson, 2011), we try to capture the effect of government consumption only (Barro, 1991, 1996). Hence, we proxy the size of the government by government consumption as a share of PPP converted GDP per-capita (*Gov. Consump.*).

Trade openness, measured as the sum of exports and imports on GDP, captures the effect of international trade on output growth, including the possibility to import and adopt new technologies. On the one side, the theoretical literature has not offered a justification for the proposition that trade openness unambiguously leads to higher long-run economic growth (Eriș and Ulașan, 2013, p. 869). On the other side, the empirical evidence has been inconclusive. Several studies find a significant positive correlation between trade openness and economic growth (Barro, 1996; Karras, 2003; Chang et al., 2009). Eriș and Ulașan (2013), utilising Bayesian model averaging techniques, find no evidence that trade openness is directly and robustly correlated with economic growth in the long run period. Hence, the debate on the impact of trade openness on output growth is still an open issue, especially when considering samples of developed countries.

The *inflation rate*, measured by the consumer price index, represents an indicator of macroeconomic stability. The growth literature[13] has shown an inverse relation between the growth rates of GDP and prices. This indicator also helps to control for the effect of the business cycle on our estimation results.

[12] Bergh and Henrekson (2011) offers one of the most comprehensive critical survey articles on this subject.

[13] For a thorough discussion see, among others, the work of Barro (1995, 1996).

The level of per-capita GDP is included in logarithmic form and lagged of one year to reflect the endowments of physical capital, natural resources and the level of technology which is unobserved, as well as to account for economic convergence. Moreover, the lagged value is used because the level of GDP per capita at the beginning of the period cannot be included because of multicollinearity issues with the country fixed effects.

Finally, two constitutional controls are included in the model. The first one concerns the federal form of government (*Federal gov.*). The effect of fiscal decentralisation may be different in these two types of countries because of the different administrative relationship across levels of government — i.e., more autonomous in federal countries. The constitutional control is a dummy that assumes value 1 if country is federal, and zero otherwise.[14] The second indicator reflects the membership to the European Union (*EU*) and consists in a dummy variable that takes value 1 for member states (since year of accession) and zero, otherwise. We expect a positive sign of this variable on output growth because the EU countries share a common market that fosters trade exchanges among them, turning out into higher growth rates in employment and GDP in the EU zone.

Descriptive statistics on the controls and the dependent variables are displayed on Table 4.

[Table 4]

5 Estimation results

The results of the baseline model estimated with the OLS estimator and standard errors corrected for heterogeneity and autocorrelation are illustrated in Tables 5 and 6. They show that tax decentralisation has a positive and statistically significant impact on output per capita growth; 10 percentage point increase in *Taxdec* results in an increase of 0.6 percentage points of the annual growth rate of GDP per capita. This positive impact stems from boosting the employment rate, as the growth of labour productivity is not statistically different from zero (see columns 3 and 5 of Table 5). These results are also confirmed by the use of *Taxaut-regio* as indicator of tax decentralisation (Table 6). Stegarescu's indicator of subnational tax revenue autonomy does not show any significant effect on per capita output growth and its main components.

[Table 5]

[Table 6]

The OLS results could be biased because of reverse causality. Increasing output growth may lead to more tax revenue decentralisation, as richer constituencies would pressure for more administrative powers. We control for reverse causality instrumenting the two budget measures of tax decentralisation with their own lagged values, as standard in the literature.[15] The assumption is that past decentralisation trends should explain current levels of growth and not *vice versa*. In

[14] Information on federalism are extracted from the Comparative Political database realised by Armingeon et al. (2015).

[15] The indicator *Taxaut-regio* is assumed to be exogenous because it is determined by changes in constitutional rules rather than output fluctuations (Baskaran and Feld, 2013).

particular, the third and fourth lagged value of the dependent variable are used as instruments in the 2SLS panel regression (Gemmell et al., 2013). They can be valid instruments as long as they are uncorrelated to the error term. They satisfy this condition with few exceptions (see column 1 and 2 of Table 5), as the Arellano and Bond (1991) test results displayed in Table 5 show that the error term in the most of the panel regressions is autocorrelated of an order greater than 1. Additionally, the instruments should be correlated with the endogenous variable. This condition is tested with the Kleibergen and Paap (2006) *rk* Lagrange Multiplier (LM) test, robust to both heteroskedasticity and auto-correlation, while the strength of the correlation – necessary to empirically identify the parameters of interest – is tested by the Kleibergen-Paap *rk* Wald F-statistic (Kleibergen and Paap, 2006; Baum et al., 2007). Overall, the validity of the set of instruments is checked using the Hansen (1982)'s J test of over-identification robust to heteroskedastic errors.

The 2SLS estimates reported in column 1 of Table 7 confirm a growth-enhancing effect of tax decentralisation measured by *Taxdec*. Output growth is driven by rising employment growth rate with no significant effect of labour productivity (see columns 3 and 5). The positive and significant estimated coefficient of the employment growth rate should be considered with caution because the Hansen (1982) J statistic rejects the null-hypothesis at the 10% level of significance, suggesting that the instruments is weak for such regression.

Contrary to the OLS estimation, the results of the instrumental variable approach using the degree of subnational government tax autonomy as indicator of tax decentralisation become statistically significant. Columns 2 and 6 of Table 7 show that an increase in *Taxaut* of 10 percentage point boosts growth of both output per capita and employment rate by 1.4 and 1.9 percentage points, respectively. Although both results should be taken cautiously because the Hansen's J test rejects the null, the coefficient magnitude of *Taxaut* is larger than for *Taxdec*. This result shows the importance of the delegation of administrative powers, not only of the relative budget. A positive effect of *Taxaut* on the growth of the working hours per capita is observed on column 10 of Table 7. In this case, the Kleibergen-Paap tests and the Hansen-J-test revail that the set of instruments are strong and valid overall.

[Table 7]

The instrumental variables approach is important for the correct identification of the effect of tax decentralisation on growth and on the channels. However, it depends on the explanatory power of the instruments used. For this reason Table 8 reports the estimation results of the empirical specifications with alternative instruments, based on geographical proximity and institutional similarities. It shows that the effect of tax decentralisation on output growth becomes insignificant as the negative effect on labour productivity offsets the positive effect on the employment rate. Indeed, the results confirm that the effect on output growth depend on the balance between these two channels. The use of different instruments does not affect the positive and significant impact of tax decentralisation on the employment rate, while it strengthens the impact on labour productivity. In detail, increasing *Taxdec* by 10 percentage points reduces labour productivity growth by 1.2 percentage points (see column 3) and increases the employment growth rate by 1.1 percentage points (see column 5), thus resulting in no effect on per capita output growth. Furthermore, these results are highly statistically significant (1% level). The impact of *Taxdec* on the two channels of economic growth is confirmed also when productivity

is measured in terms of GDP per hours worked and employment is proxied by working hours per capita. These results are robust to the use of *Taxaut*. Columns 6 and 10 of Table 8 show that an increase in *Taxaut* of 10 percentage point boosts growth rate of employment (and working hours per-capita) by about 1.9 percentage points. Column 8 shows that a 10 percentage point increase in *Taxaut* reduces the growth of labour productivity by 1.3 percentage points.

The new set of instruments perform better than the instruments based on the lagged values of tax decentralisation. Table 8 shows that the Kleibergen-Paap (KP) rk Wald F-statistic is larger than 10, suggesting that the new set of instruments is strong according to the "thumb rule" of Staiger and Stock (1997). Moreover, the Hansen-J-test accepts always the null, confirming again their validity in the panel regression analyses.

[Table 8]

The negative impact of tax decentralisation on labour productivity seems to contradict the established view that sees fiscal decentralisation as a way to improve the efficiency in the production and supply of public goods and services at local level (Martínez-Vázquez and McNab, 2003), and trigger a healthy competition among jurisdictions that can lead to an efficient use of public resources (Brennan and Buchanan, 1980). However, if competition does not work because of scarce mobility of the tax base, inefficiencies in the public goods production remain, undermining productivity gains and economic growth.

Furthermore, infrastructures and R&D that are essential to stimulate productivity, require an efficient scale of production which is usually larger than local jurisdictions. The delegation of taxing powers, thus fiscal resources, to subnational government can thus reduce the resources available at the central level to implement such policies. Such public goods produce externalities across jurisdictions that could benefit from a policy coordination of a central institution when coordination among local governments is absent or inefficient. In this context, centralisation of policy coordination could improve the efficiency in public goods provision with an increase in the rates of productivity and output growth (Stegarescu et al., 2002).

The increase in the employment growth rate is consistent with the increased competition at the subnational level that creates job opportunities, for instance, by activating idle local resources. The same competition, however, may result in concentration of productive firms/economic activities in few "winning" regions which is not enough to compensate for the lost productivity in "losing" regions. Furthermore, tax decentralisation means that the regional budget depends on local economic activities, so local governments are keen in retaining firms and employment, even though these activities are not very productive. For instance, if the devolution of taxing powers stimulate the creation of new employment opportunities in low productive and more labour-intensive sectors, such as the public administration and agriculture, it would decrease labour productivity and increase employment (Martinez-Vázquez and Yao, 2009; Adam et al., 2014).

The estimated coefficients of the control variables present the expected signs, confirming theoretical predictions (Barro, 1991, 1996). The estimation provides evidence of economic convergence. Richer countries (i.e., higher initial level of GDP per capita) tend to grow less than poorer countries. The analysis shows that this effect passes through labour productivity, while

the employment growth rate is not statistically affected by the level of output per capita. Investment as share of GDP tends to increase output growth via the employment rate. It is also confirmed when working hours per-capita is used instead of employment. It does not have any direct effect on labour productivity. The degree of trade openness boosts output growth mainly through labour productivity, reinforcing the idea that trade openness works mainly through technology diffusion but does not necessarily generate new jobs. A high inflation rate introduces uncertainty in the economy that reduces the employment growth and increases labour productivity growth, resulting in a lower output growth. Also the size of government consumption hinders output growth through the reduction of the employment rate growth.

Focusing on the socio-demographic controls, higher fertility rates significantly reduce per capita output growth through a reduction in the growth of the employment rate (Becker and Barro, 1988). Instead, population growth does not affect economic growth nor its factor components. Only in few regressions, education attainment of the labour force appears to be positively and significantly correlated with output per capita growth, without any clear-cut indication on the transmission channels.

We find that federal countries have lower output growth rates than unitary countries, due to lower growth rates in employment. The European Union membership leads to a better output growth performance due to higher growth rates in employment that more than compensate for lower growth rates in labour productivity.

5.1 Robustness

Since changes in fiscal decentralisation may reflect business cycle fluctuations rather than changes in competencies, we use the Hodrick and Prescott (1997) filter to separate the cyclical component from the trend in the two budget-based measures of tax decentralisation. The trends of the tax decentralisation indicators enter in the 2SLS regressions with the names *Taxdec-hp* and *Taxaut-hp*.[16] We perform the 2SLS panel regressions with also the trend component of the instrumental variables based on institutional similarities and geographical distance. The analysis confirms previous results (Table 9). The negative effect of *Taxdec-hp* on the labour productivity growth are off-set by those on the employment, without any significant change in the output growth. High degrees of sub-national tax autonomy measured by *Taxaut-hp* leads to an increase in the growth rate of employment, causing a significant growth-enhancing.

The inclusion of some countries may drive the results. For instance, Luxembourg and Belgium can be outliners because of the small population size and decentralisation trends, respectively. Luxembourg is excluded because it has a very small population (Thiessen, 2003). Belgium is removed because it embraced federalism in the early of 1990s, showing a more closed pattern of decentralisation to those of the rest of advanced economies only at the end of the 2000s. By performing all IV regressions without Luxembourg and Belgium, the results still hold. The main difference with the previous estimates is the coefficients of $Taxdec$ on column 1 of Tables 7 and on column 9 of Table 8 that loses statistical significance.

[Table 9]

[16]The missing values of *Taxaut-hp* have been interpolated in order to perform the Hodrick and Prescott (1997) filter.

6 Conclusion

Tax decentralisation affects output growth through labour productivity and employment. The empirical analysis conducted on a panel of 20 OECD countries reveals that tax decentralisation increases the growth of the employment rate and through this channel affects output growth. The impact on labour productivity however is mixed, in some specifications the impact is not significant while in others it is negative. Therefore the impact on output growth is mainly due to the growth of people employed.

The impact on these two channels is quite robust to different specifications of the model, however the ultimate impact on output growth depends on the methodology and the set of instruments used in the panel regression analysis. For instance, tax decentralisation has a positive effect on growth when the lags of fiscal decentralisation indicators are used as instruments, but looses any significant effect when a new set of instruments based on countries similarities and geographic distance is used. In particular, the estimates with the new set of instruments show the presence of a counterbalanced effect of tax decentralisation on the labour productivity growth and the employment growth which turn out into an insignificant effect on economic growth.

The empirical analysis provides a possible way to reconcile some of the heterogeneous results in the empirical literature, which struggles with the identification of the overall effect because of the balancing role played by the two channels. In terms of policy, it provides robust evidence that tax decentralisation boost job creation, but it should be complemented with other policies to increase labour productivity.

Further research into the effect of tax decentralisation on employment and especially productivity is needed to better understand the relationship between decentralisation and growth.

Table 1: Fiscal decentralization and economic growth in OECD countries: Empirical evidence

Author (year)	*Sample*	*Period*	*FD variable*	*FD data source*	*Methods*	*Aut., Non-linear*	*Main effect*
Davoodi and Zou (1998)	46 developed and developing countries	1970-1989	SNG share of total gov. exp. (net of intergovernmental transfers)	GFS	P		None for developed countries
Castles (1999)	21 OECD	1960-1992	SNG share of states and local taxes in total revenue	OECD	C		Positive
Ebel and Ylmaz (2002)	19 OECD	1997-1999	Sub-national tax autonomy; Subnational non-tax autonomy; Subnational fiscal dependency (i.e., the ratios of intergovernmental transfers to total subnational revenue); Subnational tax sharing	OECD	C	A	SNG (non-)tax autonomy: positive; SNG tax sharing: negative
Thiessen (2003)	21 high-income countires	1973-1998	SNG expenditures (revenues) in consolidated gov. expenditures (revenues); unweighted average of the two indicators ; hump-shaped indicators	GFS	P/C	NL	Inverted U-shaped relationship
Eller (2004)	22 OECD	1972-1996	Share of sub-national government expenditures in general government expenditures net of intergovernmental transfers; Ratio of subnational government revenues to total government revenues; hump-shaped indicators of decentralization.	GFS	P/C	NL	Revenue decentralisation: none; Medium (low) level of expenditure decentralisation: positive (negative)
Feld (2005)	19 OECD	1973-1998	Share of State and local gov. expenditure from total gov. expenditure (%); share of State and local gov. revenue from total revenue of which State and local gov. autonomously decide on tax rates or tax bases (%); share of State and local gov. revenue from total revenue of which State and local gov. autonomously decide on tax rates or tax bases or obtain from joint taxation system (%)	Stegarescu (2005)	P	A	Negative in pooled regressions; none or positive in fixed-effects regressions
Martinez-Vazquez and McNab (2006)	64 developed and developing countries	1972-2003	SNG share of total gov. expenditure/revenue	GFS	P, IV		Negative in regressions with developed countries
Thornton (2007)	19 OECD	1980-2000	SNG own tax revenue	OECD (1999)	C	A, NL	None
Bodman (2011)	18 OECD	1975-2008, 1981-1998	SNG share of general government expenditure/revenue; Stegarescu's indicators; additional indicators	GFS, Stegarescu (2005)	C/P	A, NL	None in regressions with standard decentralisation measures; no hump-shaped relationship
Buser (2011)	20 OECD	1972-2005	Share of SNG revenue net of grants; Share of SNG expenditure net of grants ; Average of SNG revenue and expenditure shares; Share of SNG own source revenue	GFS	P	A, NL	Positive but decreasing with higher levels of decentralisation; Subnational revenue autonomy: positive
Rodrguez-Pose and Ezcurra (2011)	21 OECD	1990-2005	SNG share of total gov. revenue/expenditure; SNG share in total gov. current (capital, economic affairs, health, education, social protection) expenditure	GFS	P	NL	Negative; inverted U-shaped in regressions with current expenditure decentralisation
Baskaran and Feld (2013)	23 OECD	1975-2008	SNG tax revenues as share of total gov. tax revenues; Stegarescu's indicator of tax revenue autonomy and its extension with OECD data; SNG expenditures as share of total gov. expenditures	GFS, OECD, Stegarescu (2005)	P, IV	A, NL	Negative; not hump-shaped relationship
Blochliger and Egert (2013)	All OECD	1970-2011	SNG share of GG tot. expenditures (or revenue, tax revenues); SNG tax autonomy	OECD	P	A, NL	Positive effect that decreases with higher levels of decentralisation
Gemmell, Kneller and Sanz (2013)	23 OECD	1972-2005	SNG expenditure minus transfers from subnational to central gov. on CGG expenditures; SNG expenditure minus grants from other governments to CGG expenditures; SNG revenue minus grants from other governments on CGG revenue; indicator of SNG own tax revenue; indicator of SNG autonomous and shared own revenue	OECD	P, IV	A	Expenditure decentralisation: negative; Revenue decentralisation: positive
Asatryan and Feld (2015)	23 OECD	1975-2000	Stegarescu's (2005) indicators of tax revenue autonomy; ratio of subnational-to-total gov. expenditure /revenue/tax revenue	OECD, Stegarescu (2005)	P	A, NL	No robust negative relationship
Filippetti and Sacchi (2016)	21 OECD	1970-2010	SNG share of own tax revenue on GG total tax revenues; SNG share of property (or income) taxes on GG total tax revenues; SNG share of public expenditure on GG total public expenditure; Regional authority index	GFS, Marks et al., 2008, Stegarescu (2005)	P, IV	A	Negative or positive impact dependent on institutional setting
Ligthart and van Oudheusden (2017)	56 developed and developing countries	1990-2007	SNG share of GG tot. expenditure & revenue; SNG autonomous tax revenue on total gov. tax revenue	GFS, OECD	P, IV	A	OECD-27: none; OECD-14: positive

Note: A= Local fiscal autonomy, C=Cross-section; GG = General Government; CGG= Consolidated General Government; GFS = Government Finance Statistics (IMF); IV= instrumental variable; NL= Non-linear effect; P=Panel data; SNG= Sub-national Government; *Source*: Authors' compilation.

Table 2: Simple mean of tax revenue decentralisation indicators over the period 1980-2010

Country	*Taxdec* (1980-2010)	*Taxaut* (1980-2001)
Australia	19.94	20.47
Austria	13.25	3.50
Belgium	6.84	14.94
Canada	46.24	52.42
Denmark	30.95	30.11
Finland	21.90	26.48
France	9.98	16.74
Germany	29.90	7.36
Greece	1.16	0.25
Ireland	2.35	2.73
Italy	8.35	3.59
Luxembourg	5.74	8.66
Netherlands	2.87	4.29
Norway	17.25	25.10
Portugal	4.94	1.80
Spain	8.36	12.58
Sweden	31.42	42.98
Switzerland	41.47	56.20
United Kingdom	6.47	8.97
United States	33.17	37.16
OECD	17.13	18.82

Source: Authors' calculation based on data from OECD Fiscal Decentralisation Database and Stegarescu (2004, 2005).

Table 3: Correlations between endogenous and instrumental variables

		Endogenous variables	
		Taxdec	Taxaut
Instruments	Z^1	-0.533***	-0.647***
	Z^2	0.505***	0.418***

Note: Z^1 and Z^2 are computed for each indicator of fiscal decentralisation. ***= 1% level.

Table 4: Descriptive Statistics and data sources for 20 OECD countries

Definition	*Abbrev.*	*Obs.*	*Mean*	*St. Dev.*	*Within-var.*	*Between-var.*	*Min*	*Max*	*Source*
Dependent Variables									
Growth rate of GDP per capita, %	Δ% GDP p.c.	620	1.84	2.40	2.33	0.60	-8.7	10.02	OECD.Stat
Growth rate of GDP per person employed, %	Δ% Productivity	620	1.47	1.82	1.75	0.51	-6.45	7.32	OECD.Stat
Growth rate of Employment-to-population ratio, %	Δ% Empl-pop	620	0.37	1.73	1.69	0.39	-8.83	7.33	OECD.Stat
Growth rate of GDP per working hours, %	Δ% GDP-hours	585	1.86	1.88	1.78	0.62	-6.23	10.48	OECD.Stat
Growth rate of Working hours per capita, %	Δ% Hours p.c.	585	0.03	2.02	1.99	0.39	-12.24	5.79	OECD.Stat
Fiscal Decentralization Variables									
SCG tax revenue (minus intergovernmental transfer spending)-to-consolidated total GG revenue, %	Taxdec	620	17.12	13.88	2.87	13.93	0.76	49.22	OECD-FDD
SCG tax revenue (minus intergovernmental transfer spending)-to-consolidated total GG revenue % filtered by Hodrick and Prescott (1997) method	Taxdec-hp	620	17.12	13.85	2.72	13.93	0.80	49.16	OECD-FDD
SCG own tax rev.-to-GG total tax rev. %	Taxaut	429	18.91	17.07	2.93	17.22	0.05	58.68	Stegarescu (2004, 2005)
SCG own tax rev.-to-GG total tax rev. % filtered by Hodrick and Prescott (1997) method	Taxaut-hp	440	18.85	17.01	2.78	17.20	0.18	58.82	Stegarescu (2004, 2005)
Regional tax autonomy	Taxaut-regio	620	2.07	1.64	0.53	1.59	0	5.1	Hooghe et. al (2016)
Social & Demographic Variables									
Population growth, (% annual)	Pop. growth	620	0.59	0.48	0.34	0.35	-0.43	2.89	WDI
Fertility rate, total (births per woman)	Fertility rate	620	1.66	0.26	0.16	0.21	1.16	3.21	WDI
Tertiary year schooling	Schooling	620	0.54	0.27	0.16	0.23	0.08	1.61	BL 2.0
Macroeconomic Variables									
Investment Share of PPP Converted GDPpc (2005 const. prices)	Investment ratio	620	23.42	3.87	2.57	2.97	13.71	34.07	PWT 7.1
General government final consumption (% of GDP)	Gov. Consump.	620	7.13	1.67	0.98	1.38	3.02	11.3	WDI
Openness at 2005 constant prices, %	Trade Openness	620	70.27	50.16	19.88	47.21	11.83	326.54	PWT 7.1
Consumer price index, 2010=100	Inflation rate	620	71.02	20.57	19.50	6.73	5.2	105.7	OECD.Stat
GDP per capita (constant 2005 USD), in natural logarithmic	Per-capita GDP	620	10.35	0.38	0.20	0.32	9.26	11.36	WDI
Political & Constitutional Variables									
European Union (EU) membership (EU=1; otherwise=0)	EU membership	620	0.66	0.47	0.23	0.42	0	1	Author's elaboration
Federal Government (1= federal; otherwise=0)	Federal Gov.	620	0.38	0.48	0.11	0.48	0	1	Author's elaboration on the Armingeon et al. (2015) data

Note: WDI = World Bank's World Development Indicators; PWT7.1 = Penn World Tables Version 7.1; OECD-FDD = OECD's Fiscal Decentralization Database; BL2.0 = Barro-Lee Educational Attainment Dataset version 2.0 available at: http://www.barrolee.com/, see Barro and Lee (2013).

Table 5: OLS estimation results

	Δ% GDP per-capita		Δ% GDP per-worker		Δ% Employment rate		Δ% GDP per-hour worked		Δ% Working hours per-capita	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Taxdec	0.059**		-0.002		0.059**		0.001		0.023	
	(2.17)		(-0.09)		(2.52)		(0.03)		(0.65)	
Taxaut		0.013		-0.040		0.055		-0.052		0.061
		(0.39)		(-1.46)		(1.63)		(-1.59)		(1.57)
Pop. growth	-0.339	-0.202	-0.205	-0.196	-0.136	-0.019	-0.232	-0.336	-0.120	0.255
	(-1.18)	(-0.38)	(-0.72)	(-0.39)	(-0.51)	(-0.04)	(-0.60)	(-0.50)	(-0.34)	(0.41)
Fertility rate	-3.843***	-2.856***	-1.062*	-0.566	-2.679***	-2.172***	-0.554	-0.153	-2.838***	-2.945***
	(-4.76)	(-3.46)	(-1.67)	(-0.71)	(-4.15)	(-3.03)	(-0.62)	(-0.14)	(-3.62)	(-3.44)
$Schooling_{t-1}$	0.827	2.914	1.621*	1.237	-0.800	1.594	1.979*	1.537	-0.984	1.562
	(0.69)	(1.61)	(1.65)	(0.88)	(-0.72)	(1.11)	(1.75)	(1.02)	(-0.75)	(0.86)
Investment ratio	0.209***	0.184***	0.015	0.038	0.191***	0.144***	-0.019	-0.029	0.220***	0.180***
	(4.13)	(2.97)	(0.39)	(0.78)	(4.85)	(3.40)	(-0.43)	(-0.55)	(4.73)	(3.10)
Gov. consump.	-0.428***	-0.384*	-0.170	-0.089	-0.251**	-0.292**	-0.282*	-0.132	-0.057	-0.186
	(-2.80)	(-1.93)	(-1.22)	(-0.55)	(-2.00)	(-2.13)	(-1.81)	(-0.73)	(-0.36)	(-1.09)
Trade openness	0.025**	0.080***	0.026**	0.052***	-0.001	0.028**	0.018	0.042**	0.004	0.031**
	(1.98)	(4.71)	(2.23)	(3.09)	(-0.12)	(1.99)	(1.48)	(2.09)	(0.38)	(2.05)
Inflation rate	-0.050*	-0.051*	0.041**	0.037	-0.090***	-0.085***	0.037	0.019	-0.094***	-0.096***
	(-1.90)	(-1.90)	(2.01)	(1.47)	(-3.53)	(-3.65)	(1.36)	(0.73)	(-2.96)	(-3.15)
Per-capita GDP_{t-1} (log)	-8.232***	-8.513***	-8.606***	-9.950***	0.397	1.428	-7.025***	-7.465***	-1.521	-2.375
	(-4.54)	(-3.96)	(-5.36)	(-4.89)	(0.24)	(0.75)	(-3.57)	(-3.03)	(-0.68)	(-0.95)
EU membership	1.087**	1.073**	-0.338	-0.454	1.386***	1.495***	-0.578	-1.105**	1.710***	2.099***
	(2.57)	(2.20)	(-0.87)	(-1.11)	(3.54)	(3.11)	(-1.43)	(-2.48)	(3.48)	(3.48)
Federal gov.	-0.408	-1.743***	-0.399	-0.433	-0.015	-1.309***	-0.463	-0.214	0.071	-1.486*
	(-0.94)	(-3.20)	(-1.08)	(-0.96)	(-0.04)	(-2.68)	(-0.80)	(-0.28)	(0.14)	(-1.88)
R^2	0.233	0.259	0.123	0.138	0.242	0.301	0.064	0.076	0.190	0.236
F-test	0.000	0.000	0.000	0.000	0.000	0.000	0.003	0.007	0.000	0.000
BP-test	0.045	0.021	0.000	0.980	0.027	0.025	0.000	0.000	0.000	0.001
Hausman test	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.003	0.000	0.000
AR(1) test	0.000	0.000	0.000	0.005	0.000	0.000	0.000	0.019	0.000	0.000
AR(2) test	0.000	0.000	0.724	0.932	0.000	0.001	0.892	0.317	0.047	0.225
AR(3) test	0.006	0.095	0.904	0.675	0.394	0.571	0.486	0.873	0.960	0.848
AR(4) test	0.436	0.786	0.874	0.512	0.919	0.913	0.704	0.385	0.287	0.407
Group No.	20	20	20	20	20	20	20	20	20	20
Obs. No.	600	409	600	409	600	409	570	379	570	379

Note: Standard errors robust to both heteroskedasticity and autocorrelation. t-statistics in parenthesis. p-value is reported for the tests. Significant at level ***1%, **5%, *10%.

Table 6: OLS estimation results with the regional tax autonomy indicator

	Δ% GDP per-capita	Δ% GDP per-worker	Δ% Employment rate	Δ% GDP per-hour worked	Δ% Working hours per-capita
	(1)	(2)	(3)	(4)	(5)
Taxaut-regio	-0.011	-0.258	0.245**	-0.153	0.159
	(-0.08)	(-1.56)	(2.23)	(-0.96)	(1.24)
Pop. growth	-0.342	-0.130	-0.214	-0.190	-0.162
	(-1.16)	(-0.45)	(-0.79)	(-0.48)	(-0.45)
Fertility rate	-3.751***	-1.163*	-2.489***	-0.641	-2.704***
	(-4.60)	(-1.86)	(-3.84)	(-0.72)	(-3.42)
$Schooling_{t-1}$	0.692	1.427	-0.739	1.863	-0.933
	(0.57)	(1.44)	(-0.66)	(1.64)	(-0.71)
Investment ratio	0.210***	0.011	0.196***	-0.020	0.222***
	(4.24)	(0.30)	(4.94)	(-0.47)	(4.75)
Gov. consump.	-0.386**	-0.147	-0.233*	-0.266*	-0.060
	(-2.57)	(-1.06)	(-1.90)	(-1.73)	(-0.38)
Trade openness	0.026**	0.024**	0.002	0.017	0.005
	(2.02)	(2.12)	(0.22)	(1.41)	(0.49)
Inflation rate	-0.045*	0.043**	-0.086***	0.038	-0.094***
	(-1.75)	(2.10)	(-3.47)	(1.42)	(-2.95)
Per-capita GDP_{t-1} (log)	-8.287***	-8.618***	0.354	-7.041***	-1.569
	(-4.60)	(-5.38)	(0.21)	(-3.58)	(-0.69)
EU membership	0.834**	-0.362	1.164***	-0.593	1.730***
	(2.08)	(-1.07)	(3.21)	(-1.46)	(3.52)
Federal gov.	-0.252	0.103	-0.362	-0.156	-0.195
	(-0.49)	(0.22)	(-0.82)	(-0.25)	(-0.35)
R^2	0.224	0.129	0.235	0.066	0.192
F-test	0.000	0.000	0.000	0.003	0.000
BP-test	0.034	0.000	0.030	0.000	0.000
Hausman test	0.000	0.000	0.000	0.002	0.000
AR(1) test	0.000	0.000	0.000	0.001	0.000
AR(2) test	0.000	0.939	0.000	0.529	0.049
AR(3) test	0.021	0.638	0.500	0.827	0.861
AR(4) test	0.813	0.606	0.904	0.894	0.217
Group No.	20	20	20	20	20
Obs. No.	600	600	600	570	570

Note: Standard errors robust to both heteroskedasticity and autocorrelation. *t*-statistics in parenthesis. *p*-value is reported for the tests. Significant at level ***1%, **5%, *10%.

Table 7: The 2SLS estimation results with lagged instruments

	Δ% GDP per-capita		Δ% GDP per-worker		Δ% Employment rate		Δ% GDP per-hour worked		Δ% Working hours per-capita	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Taxdec	0.059*		-0.028		0.084***		-0.052		0.086	
	(1.72)		(-0.94)		(2.73)		(-0.87)		(1.56)	
Taxaut		0.139**		-0.056		0.193***		-0.044		0.178**
		(2.08)		(-1.03)		(3.02)		(-0.73)		(2.34)
Pop. growth	-0.231	0.130	-0.179	-0.131	-0.054	0.244	-0.227	-0.277	-0.037	0.493
	(-0.77)	(0.23)	(-0.61)	(-0.24)	(-0.19)	(0.54)	(-0.56)	(-0.38)	(-0.10)	(0.77)
Fertility rate	-4.496***	-4.045***	-1.348	-0.984	-3.053***	-2.932***	-1.118	-0.906	-2.982***	-2.907***
	(-4.08)	(-3.57)	(-1.62)	(-0.97)	(-3.62)	(-3.17)	(-1.04)	(-0.68)	(-3.12)	(-2.72)
$Schooling_{t-1}$	0.705	3.550	1.478	0.863	-0.768	2.592	1.687	0.572	-0.926	2.701
	(0.53)	(1.40)	(1.38)	(0.46)	(-0.62)	(1.49)	(1.37)	(0.30)	(-0.64)	(1.25)
Investment ratio	0.249***	0.223**	0.034	0.094	0.211***	0.126**	-0.003	-0.002	0.231***	0.167**
	(4.39)	(2.54)	(0.78)	(1.55)	(4.51)	(2.32)	(-0.06)	(-0.03)	(4.27)	(2.27)
Gov. consump.	-0.335*	-0.439**	-0.119	-0.016	-0.213	-0.418**	-0.273	-0.202	-0.067	-0.287
	(-1.94)	(-1.98)	(-0.78)	(-0.09)	(-1.50)	(-2.41)	(-1.60)	(-0.92)	(-0.39)	(-1.44)
Trade openness	0.025*	0.072***	0.023*	0.056***	0.002	0.016	0.017	0.042*	0.008	0.027
	(1.77)	(3.28)	(1.80)	(2.68)	(0.28)	(0.96)	(1.24)	(1.90)	(0.76)	(1.50)
Inflation rate	-0.064**	-0.089**	0.024	0.003	-0.086***	-0.089***	0.032	0.004	-0.095***	-0.108***
	(-1.99)	(-2.55)	(1.09)	(0.11)	(-2.88)	(-3.07)	(1.06)	(0.12)	(-2.66)	(-2.81)
Per-capita GDP_{t-1} (log)	-9.451***	-10.963***	-8.603***	-11.573***	-0.834	0.607	-7.017***	-8.183***	-2.290	-3.318
	(-4.23)	(-3.67)	(-4.69)	(-4.93)	(-0.43)	(0.29)	(-3.12)	(-2.84)	(-0.91)	(-1.13)
EU membership	1.328***	1.221**	-0.570	-0.710*	1.846***	1.892***	-0.731	-1.241**	1.983***	2.404***
	(2.81)	(2.17)	(-1.44)	(-1.73)	(4.22)	(3.28)	(-1.64)	(-2.48)	(3.48)	(2.96)
Federal gov.	-0.437	-2.870***	-0.197	-0.394	-0.236	-2.437***	-0.186	-0.259	-0.207	-2.464**
	(-0.94)	(-2.82)	(-0.57)	(-0.70)	(-0.61)	(-2.66)	(-0.31)	(-0.30)	(-0.37)	(-2.26)
R^2	0.263	0.251	0.111	0.153	0.252	0.239	0.061	0.080	0.186	0.205
F-test	0.000	0.000	0.000	0.000	0.000	0.000	0.006	0.029	0.000	0.000
KP-rk-LM p-value	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
KP-rk-Wald F-statistic	50.42	36.00	70.95	37.60	56.30	35.03	26.25	38.01	21.61	35.47
Hansen-J-statistic	0.516	0.036	0.319	0.592	0.076	0.071	0.240	0.430	0.060	0.202
Group No	20	20	20	20	20	20	20	20	20	20
Obs. No	540	347	540	347	540	347	525	332	525	332

Note: Instruments: the third and fourth order lagged values of fiscal decentralisation indicators in regressions (1)-(10); Standard errors robust to both heteroskedasticity and autocorrelation. t-statistics in parenthesis. p-value is reported for the tests. Significant at level ***1%, **5%, *10%.

Table 8: The 2SLS estimation results with the alternative instruments

	Δ% GDP per-capita		Δ% GDP per-worker		Δ% Employment rate		Δ% GDP per-hour worked		Δ% Working hours per-capita	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Taxdec	-0.003		-0.119***		0.112***		-0.192***		0.118*	
	(-0.07)		(-2.89)		(2.64)		(-2.96)		(1.70)	
Taxaut		0.095		-0.099		0.194***		-0.129*		0.187**
		(1.42)		(-1.63)		(2.93)		(-1.90)		(2.71)
Pop. growth	-0.345	-0.263	-0.218	-0.152	-0.130	-0.123	-0.215	-0.264	-0.129	0.138
	(-1.20)	(-0.50)	(-0.74)	(-0.29)	(-0.48)	(-0.29)	(-0.54)	(-0.38)	(-0.36)	(0.22)
Fertility rate	-3.741***	-2.849***	-0.869	-0.571	-2.766***	-2.160***	-0.211	-0.219	-3.006***	-2.837***
	(-4.58)	(-3.44)	(-1.33)	(-0.71)	(-4.27)	(-3.03)	(-0.22)	(-0.20)	(-3.81)	(-3.25)
$Schooling_{t-1}$	0.693	3.028*	1.367	1.155	-0.686	1.788	1.436	1.472	-0.718	1.669
	(0.57)	(1.66)	(1.37)	(0.82)	(-0.61)	(1.22)	(1.20)	(0.99)	(-0.53)	(0.92)
Investment ratio	0.210***	0.174***	0.016	0.045	0.191***	0.127***	-0.020	-0.017	0.221***	0.160**
	(4.25)	(2.72)	(0.44)	(0.93)	(4.74)	(2.83)	(-0.45)	(-0.31)	(4.53)	(2.64)
Gov. consump.	-0.385**	-0.490**	-0.089	-0.013	-0.288**	-0.472***	-0.172	-0.026	-0.111	-0.360*
	(-2.46)	(-2.22)	(-0.61)	(-0.07)	(-2.16)	(-2.89)	(-1.07)	(-0.13)	(-0.67)	(-1.87)
Trade openness	0.026**	0.075***	0.028**	0.056***	-0.002	0.019	0.020	0.047**	0.002	0.023
	(2.05)	(4.47)	(2.33)	(3.24)	(-0.24)	(1.34)	(1.54)	(2.27)	(0.24)	(1.499
Inflation rate	-0.045*	-0.052*	0.052**	0.038	-0.095***	-0.087***	0.046*	0.020	-0.098***	-0.098**
	(-1.73)	(-1.88)	(2.44)	(1.49)	(-3.55)	(-3.46)	(1.65)	(0.77)	(-3.00)	(-3.07)
Per-capita GDP_{t-1} (log)	-8.290***	-8.305***	-8.716***	-10.101***	0.446	1.784	-7.535***	-7.760***	-1.271	-1.890
	(-4.62)	(-3.82)	(-5.30)	(-4.88)	(0.27)	(0.92)	(-3.66)	(-3.06)	(-0.56)	(-0.75)
EU membership	0.822*	1.142**	-0.839*	-0.504	1.611***	1.613***	-0.541	-1.178**	1.692***	2.220***
	(1.70)	(2.23)	(-1.85)	(-1.19)	(3.68)	(3.09)	(-1.28)	(-2.56)	(3.42)	(3.48)
Federal gov.	-0.267	-2.553***	-0.133	0.151	-0.135	-2.687***	-0.056	0.539	-0.128	-2.723**
	(-0.58)	(-2.76)	(-0.34)	(0.22)	(-0.37)	(-2.66)	(-0.09)	(0.56)	(-0.24)	(-2.43)
R^2	0.223	0.246	0.079	0.129	0.232	0.246	-0.000	0.061	0.175	0.201
F-test	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.007	0.000	0.000
KP-rk-LM p-value	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
KP-rk-Wald F-statistic	26.37	11.28	42.64	15.39	31.91	12.64	23.18	15.92	17.12	15.92
Hansen-J-statistic	0.441	0.597	0.114	0.192	0.424	0.410	0.404	0.242	0.407	0.368
Group No	20	20	20	20	20	20	20	20	20	20
Obs. No	600	409	600	409	600	409	570	379	570	379

Note: Standard errors robust to both heteroskedasticity and autocorrelation. t-statistics in parenthesis. p-value is reported for the tests. Significant at level ***1%, **5%, *10%.

Table 9: The 2SLS estimation results with tax decentralistaion measures and alternative instruments filtered by Hodrick and Prescott (1997) method

	Δ% GDP per-capita		Δ% GDP per-worker		Δ% Employment rate		Δ% GDP per-hour worked		Δ% Working hours per-capita	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Taxdec-hp	0.001		-0.121***		0.117***		-0.177***		0.112*	
	(0.03)		(-2.98)		(2.84)		(-2.88)		(1.70)	
Taxaut-hp		0.125*		-0.086		0.210***		-0.084		0.177***
		(1.88)		(-1.51)		(3.37)		(-1.23)		(2.59)
R^2	0.225	0.238	0.090	0.149	0.235	0.257	0.025	0.083	0.181	0.217
F-test	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.004	0.000	0.000
KP-rk-LM p-value	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
KP-rk-Wald F-statistic	30.73	13.44	52.68	19.31	38.01	15.32	30.17	20.37	21.67	20.37
Hansen-J-statistic	0.449	0.795	0.228	0.276	0.654	0.361	0.708	0.232	0.677	0.316
Group No	20	20	20	20	20	20	20	20	20	20
Obs. No	600	420	600	420	600	420	570	390	570	390

Note: Standard errors robust to both heteroskedasticity and autocorrelation. t-statistics in parenthesis. p-value is reported for the tests. Significant at level ***1%, **5%, *10%.

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