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Fiscal Federalism and its Impact on Economic Activity, Public Investment and the Performance of Educational Systems

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by Hansjörg Blöchliger, Balázs Égert and Kaja Fredriksen

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ABSTRACT / RÉSUMÉ

Fiscal federalism and its impact on economic activity, public investment and the performance of educational systems

Intergovernmental fiscal frameworks usually reflect fundamental societal choices and history and are not foremost geared towards achieving economic policy objectives. Yet, like most institutional arrangements, fiscal relations affect the behaviour of firms, households and governments and thereby economic activity. This paper presents empirical research on the potential effects of fiscal decentralisation on a set of outcomes such as GDP, productivity, public investment and school performance. The results can be summarised as follows: decentralisation, as measured by revenue or spending shares, is positively associated with GDP per capita levels. The impact seems to be stronger for revenue decentralisation than for spending decentralisation. Decentralisation is strongly and positively associated with educational outcomes as measured by international student assessments (PISA). While educational functions can be delegated either to sub-central governments (SCG) or to schools, the results suggest that both strategies appear to be equally beneficial for educational performance. Finally, investment in physical and – especially – human capital as a share of general government spending is significantly higher in more decentralised countries.

JEL classification codes: H10; H70; H75; H77; I22; O43

Keywords: Fiscal federalism; fiscal decentralization; public spending; education decentralization; economic growth; productivity; education decentralization; public investment; PISA

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Le fédéralisme budgétaire et son impact sur l'activité économique, l'investissement public et la performance des systèmes éducatifs

Les cadres budgétaires intergouvernementaux sont habituellement le reflet de choix sociétaux fondamentaux ainsi que de l'histoire, et n'ont pas pour vocation première d'atteindre des objectifs de politique économique. Pourtant, comme la plupart des modalités institutionnelles, les relations budgétaires influent sur le comportement des entreprises, des ménages et des pouvoirs publics et, partant, sur l'activité économique. Le présent document fait une synthèse des études empiriques consacrées aux effets potentiels de la décentralisation budgétaire sur une série de résultats comme le PIB, la productivité, l'investissement public et les performances des établissements scolaires. Ces résultats peuvent être résumés comme suit : la décentralisation, mesurée en pourcentage des recettes ou des dépenses, est corrélée positivement avec le niveau de PIB par habitant. L'impact semble plus marqué pour la décentralisation des recettes que pour celle des dépenses. La décentralisation semble être fortement et positivement corrélée avec les résultats de l'éducation tels que mesurés par le Programme international pour le suivi des acquis des élèves (PISA). Si les fonctions éducatives peuvent être déléguées soit aux échelons infranationaux de l'administration, soit aux établissements scolaires, les résultats donnent à penser que les deux stratégies semblent également bénéfiques pour les performances des écoles. Enfin, l'investissement dans le capital physique mais, plus particulièrement, dans le capital humain exprimé en part des dépenses des administrations publiques, est nettement plus élevé dans les pays décentralisés.

Classification JEL : H10 ; H70 ; H75 ; H77 ; I22 ; O43

Mots clés : Fédéralisme budgétaire ; décentralisation budgétaire ; dépenses publiques ; décentralisation de l'éducation ;décentralisation budgétaire ; croissance économique ; productivité ; investissement public ; PISA

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TABLE OF CONTENTS

FISCAL FEDERALISM AND ITS IMPACT ON ECONOMIC ACTIVITY, PUBLIC INVESTMENT AND EDUCATION PERFORMANCE 5
1. Introduction and main findings 5
2. Fiscal decentralisation across OECD countries 6
3. Decentralisation and economic performance 9
3.1. Decentralisation and growth: some stylised facts 9
3.2. Inter-jurisdictional competition and productivity in the public sector 10
3.3. Decentralisation is positively, but weakly related to economic activity 12
3.4. How much could countries gain from more decentralisation? 13
4. Decentralisation and public investment 14
4.1. Linking decentralisation to the determinants of growth 14
4.2. What is public investment? 14
4.3. Public investment is higher in decentralised countries, especially on education 15
5. Decentralisation and performance in primary and secondary education 17
5.1. The education production function 17
5.2. More decentralised countries achieve higher PISA results 19
6. Bringing the threads together 21

ANNEX A1. THE IMPACT ON PRODUCTIVITY, INVESTMENT AND GROWTH 23
1. Introduction 23
2. Previous research 23
3. Modelling decentralisation and growth 24
3.1. Model and estimation issues 24
3.2. Testing non-linear effects 25
3.3. Data 26
4. Results 27
4.1. Bivariate regressions 27
4.2. Annual specification 27
4.3. Selected years specification 31
4.4. Non-linearities 33

ANNEX A2. DECENTRALISATION, PUBLIC INVESTMENT AND EDUCATIONAL PERFORMANCE 39
1. Introduction and summary 39
2. Previous research 39
2.1. Public investment 39
2.2. Education performance 40
3. The model and the data 41
3.1. Public investment 41
3.2. Education performance 42
4. The impact of fiscal decentralisation on the composition of public spending 44
4.1. Fiscal decentralisation is associated with higher physical and human capital spending 44
5. The impact of fiscal decentralisation on student performance 48

5.1. Education decentralisation improves student performance 48
5.2. Both empowering schools and lower levels of government are beneficial..... 50
5.3. The size of effects varies according to the type of responsibility..... 51

BIBLIOGRAPHY 54

Tables

1. Decentralisation is positively but weakly associated with economic activity 12
2. Decentralisation and the share of public capital plus education spending 16
3. Education decentralisation and PISA score..... 20
A1.1. Decentralisation and: GDP, TFP, investment and human capital 27
A1.2. Annual times series results: decentralisation and GDP 29
A1.3. Annual times series results: decentralisation and TFP 30
A1.4. Annual time series results: decentralisation and investment 30
A1.5. Selected years results: decentralisation and GDP..... 31
A1.6. Selected years results: decentralisation and TFP..... 32
A1.7. Selected years results: decentralisation and investment 33
A1.8. The non-linear effect of fiscal decentralisation on the level of per capita income 34
A1.9. Literature review 36
A2.1. Decentralisation and the share of public capital and education spending 46
A2.2. Decentralisation and the share of education spending..... 46
A2.3. Decentralisation and the share of public capital spending..... 47
A2.4. Education decentralisation and PISA score..... 49
A2.5. Education decentralisation versus fiscal decentralisation..... 50
A2.6. Overall decentralisation, decentralisation to lower level of government and school autonomy ... 51
A2.7. Education decentralisation, school autonomy and PISA score 51
A2.8. Education decentralisation according to function and PISA score..... 53

Figures

1. Decentralisation varies considerably across OECD countries..... 7
2. Decentralisation has slightly increased and converged over the past 15 years 7
3. The SCG spending and tax composition changes with the degree of decentralisation 9
4. Decentralisation and economic performance 10
5. Returns to decentralisation are decreasing 13
6. Some countries might gain considerably from decentralising..... 14
7. Simple correlation between spending decentralisation and education results..... 18
8. Decentralisation and school autonomy are substitutes rather than complements..... 21
A2.1. Correlation between lower level government decentralisation and school autonomy 50

Boxes

1. The challenge of measuring fiscal decentralisation..... 8
2. Empirical design..... 11

FISCAL FEDERALISM AND ITS IMPACT ON ECONOMIC ACTIVITY, PUBLIC INVESTMENT AND EDUCATION PERFORMANCE

By Hansjörg Blöchliger, Balázs Égert and Kaja Fredriksen[1]

1. Introduction and main findings

Intergovernmental fiscal frameworks usually reflect fundamental societal choices and history and are not foremost geared towards achieving economic policy objectives. Yet, like most institutional arrangements, fiscal relations affect the behaviour of firms, households and governments and thereby economic activity. Firms' investment decisions are affected by the productivity of the public sector, and differences between costs and benefits of service provision across jurisdictions may induce them to change their location. Similarly, labour supply decisions by households will be affected by differences in taxation across jurisdictions, and households may migrate if they consider the ratio of services received in relation to taxes paid superior elsewhere. The combined actions of households and firms may in turn lead to policy reactions at both the national and sub-national level, triggering reforms to intergovernmental fiscal relations. As a result, the mutual interactions between governments, both central and sub-central, households and firms may affect the long-term growth path of a country.

The major findings are the following:

- Across countries, sub-central fiscal power, as measured by revenue or spending shares, is positively associated with economic activity. Doubling sub-central tax or spending shares (e.g. increasing the ratio of sub-central to general government tax revenue from 6 to 12%) is associated with a GDP per capita increase of around 3%. The impulse stems both from productivity and human capital improvements, while capital investment appears to have little economic effect.
- Revenue decentralisation appears to be more strongly related with income gains than spending decentralisation. This empirical finding may reflect that "true" fiscal autonomy is better captured by the sub-central revenue share, as a large part of sub-central spending may be mandated or regulated by central government.
- The relationship between decentralisation and GDP is weaker for more decentralised countries, probably reflecting that wide sub-central fiscal powers could also have detrimental economic effects and that certain policy areas are not suitable for decentralisation. However, the estimated relationship never becomes negative and is not hump-shaped, i.e. "more decentralisation always tends to be better".
- Investment in physical and human capital as a share of general government spending is significantly higher in more decentralised countries. On average, a 10% point increase in decentralisation increases the share of investment in total government spending from around 3%

1. The authors were members of the Economics Department when this paper was written. I thank Jorgen Elmeskov, Kaja Fredriksen, Peter Hoeller, Mauro Pisu, Jean-Luc Schneider, and various delegates of the Fiscal Relations Network for valuable comments. Special thanks go to Chantal Nicq and Susan Gascard for excellent editorial assistance.

to 4%. The impact is stronger for investment in human than physical capital, and stronger for revenue than for spending decentralisation.

- Decentralisation is strongly and positively associated with educational outcomes as measured by international student assessments (PISA). Decentralisation of various educational functions and regulations appear to be particularly beneficial. A 10% point increase in education decentralisation improves PISA results by four points, corresponding to an average improvement by around four positions in the PISA country ranking. The results again suggest that the *shape* of policy decentralisation is crucial for success.
- Educational functions can be delegated either to sub-central governments (SCG) or to schools. OECD-wide there is a negative relationship between decentralisation and school autonomy, i.e. the two forms of devolution are substitutes rather than complements. Highly decentralised countries provide schools with little autonomy and *vice versa*. However, both strategies appear equally beneficial for educational performance.

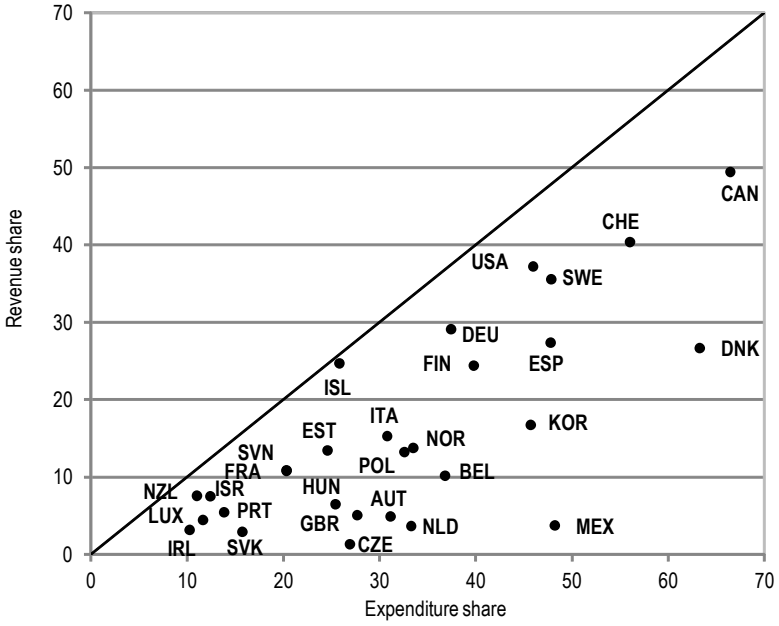
The remainder of the paper is organised as follows: Section 2 retraces the evolution of fiscal decentralisation in the OECD economies from 1995 to 2011. Section 3 provides an analysis of the channels through which fiscal decentralisation can affect growth – mainly as a result of inter-jurisdictional fiscal competition – and summarises the results of an empirical investigation for OECD countries. Section 4 deals with the relationship between decentralisation and government investment and presents the results of an empirical investigation linking the degree of decentralisation and the level of government spending on physical capital and education. Section 5 assesses to what extent educational outcomes as measured by international students assessments (PISA) are influenced by sub-central powers and school autonomy. The paper adopts a *national* view of growth, i.e. it deals with the impact of intergovernmental fiscal frameworks on national economic performance rather than the development of individual SCGs or differences in growth rates across them. Also, issues of regional disparities or regional convergence/divergence are not considered.

2. Fiscal decentralisation across OECD countries

The degree of decentralisation varies widely across countries but has changed little over the past 15 years, with a few notable exceptions. OECD-wide, the sub-central spending share averaged around 31% in 2010, with values ranging between 66% for Canada and 11% for Ireland, while the tax revenue share was at around 15%, with values between 50% for Canada and 1% for the Czech Republic (Figure 1). Spending is clearly more decentralised than revenues, with a considerable part of sub-central spending covered by intergovernmental grants. Tax autonomy, i.e. the share of taxes over which SCGs have some power to set the base or the rate is even lower at around 11% of all tax revenue and several countries provide none at all. Constitutional provisions explain only a part of the differences in sub-central autonomy as various federal countries appear more "centralised" than some unitary ones. While both revenue and spending became more decentralised over the past 20 years, spending decentralisation clearly outpaced revenue decentralisation, resulting in a higher vertical fiscal imbalance and growing intergovernmental grants (Figure 2). Only a few countries – in particular Spain and Italy that embarked on a secular decentralisation process and a few Eastern European economies such as Estonia and Poland – underwent considerable changes in sub-central spending and taxation powers. Decentralisation appears to converge towards an intermediate level, with a few highly decentralised countries re-centralising and several highly-centralised countries devolving fiscal powers to lower government levels. Also, tax autonomy seems to converge towards arrangements where SCGs have some power to set tax rates on nationally-set tax bases. Box 1 provides more information on how fiscal decentralisation is measured.

Figure 1. Decentralisation varies considerably across OECD countries

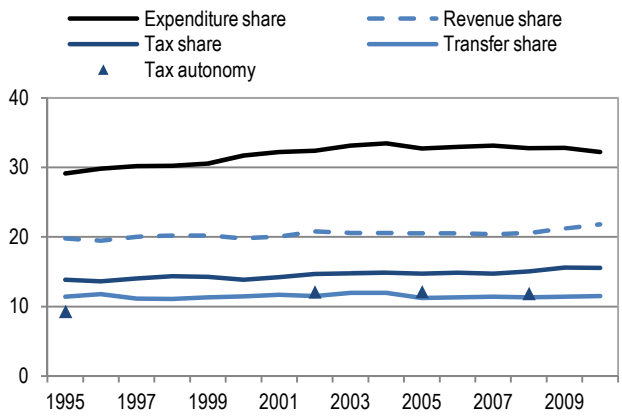
SCG shares in general government revenue and spending, 2011



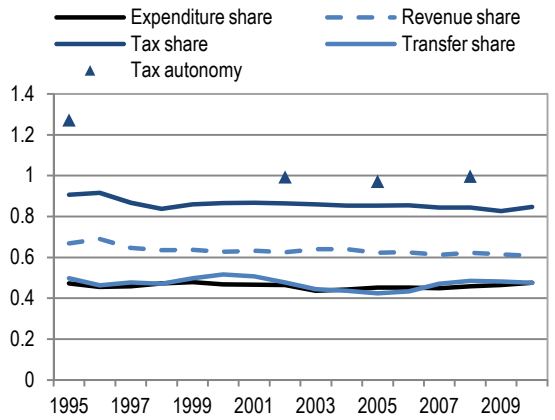
Source: OECD Fiscal Decentralisation database.

Figure 2. Decentralisation has slightly increased and converged over the past 15 years

A. Decentralisation indicators, annual average



B. Decentralisation indicators, annual variation coefficient



Source: *OECD Fiscal Decentralisation Database*.

Box 1. The challenge of measuring fiscal decentralisation

The common measure to assess fiscal decentralisation is the share of resources assigned to SCGs. Spending, revenue or tax ratios drawn from the OECD National Accounts or OECD Revenue Statistics allow measuring the extent of sub-central fiscal powers. These ratios, however, only poorly measure the true fiscal discretion that SCGs enjoy in practice. On the revenue side, central government may limit tax autonomy, i.e. the ability to set tax bases and/or rates, while on the expenditure side, central government regulation may strongly influence SCG spending, thereby reducing discretion in setting policy. In some countries, the transfer of financial responsibility hardly reflects more than a change in accounting, as essential regulatory power remains at the central level. The traditional decentralisation ratios are therefore often inadequate, which becomes apparent once they are used to test how fiscal frameworks affect outcomes such as economic growth, efficiency in the provision of services, or citizen's satisfaction. In recent years, the OECD Fiscal Network has worked on new indicators, focusing on sub-central tax autonomy or on sub-central spending power, to complement and improve decentralisation statistics (Kim, et al., 2013).

Since intergovernmental fiscal frameworks have many dimensions and since it is difficult to judge *ex ante* which indicator best reflects the relationship between decentralisation and economic performance, the various empirical analyses presented in this paper use a wide array of indicators. The various decentralisation indicators are inserted into otherwise identical equations, so that the results can be compared. The merits of each indicator are hence judged by the results it delivers, thereby helping to identify those frameworks that are most conducive to growth. The following four decentralisation indicators are used alternatively and, in order to avoid multi-collinearity, one by one (sequentially) in the empirical analysis:

- Spending decentralisation (the ratio of sub-central to general government spending);
- Revenue decentralisation (the ratio of sub-central own revenue to general government revenue);
- Tax revenue decentralisation (the ratio of sub-central tax revenue to general government tax revenue);
- Tax autonomy (the ratio of taxes over which SCGs have some base or rate-setting autonomy to general government tax revenue), taken from the OECD Fiscal Decentralisation database.

When measuring the impact of decentralisation on educational performance, two additional indicators are used:

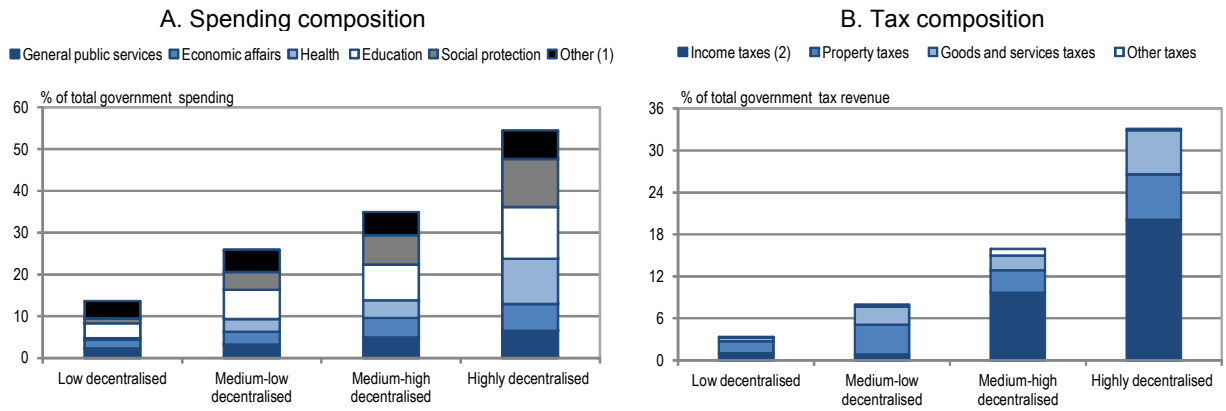
- An institutional indicator of decentralisation in educational systems, showing at which level of government a wide array of education policy decisions are taken (taken from the OECD Education database);
- The share of sub-central education spending to general government education spending (taken from the OECD COFOG database).

Despite this agnostic view about the relevance and reliability of the various indicators, there is *a priori* evidence that some of them are better than others in reflecting true sub-central fiscal policy autonomy. Revenue shares appear to better reflect fiscal and regulatory power than spending shares, because sub-central spending is often financed by large transfers with many regulatory strings attached. Institutional indicators that encompass several dimensions of policy making are probably best in providing insights into SCGs' actual power. Since institutional indicators provide a richer picture of the policy framework than simple spending and revenue ratios, they provide a better basis for specific policy guidance. Examples for institutional indicators are the Fiscal Network's tax autonomy indicators or the spending power indicators, the latter being available for a few countries only. The institutional indicator on education decentralisation provided by the OECD's Education at a Glance database is also broad-based and policy-relevant, with several dimensions reflecting sub-central power in primary and secondary education.

The policy and spending areas for which SCGs are in charge vary with the extent of decentralisation (Figure 3). In highly centralised countries the bulk of SCG spending is comprised of local services such as (primary and secondary) education, economic affairs, recreation and other residential services. In more decentralised countries the spending structure looks a bit different, with health care and social welfare becoming relatively more important, while education remains a core responsibility. The tax structure also changes with increasing decentralisation. While SCGs in centralised countries rely mainly on the property tax – which in virtually all OECD member countries is an exclusive sub-central tax – SCGs in more decentralised countries rely more heavily on income taxes and, to a lesser extent, consumption taxes. As a

result, while spending for services such as education and health care increases with increasing decentralisation, so does funding through more progressive taxation, which may potentially create structural funding imbalances in poorer SCGs and may also induce changes in behaviour as they affect incentives.

Figure 3. The SCG spending and tax composition changes with the degree of decentralisation



1. Other includes defense, public order, environment, housing and recreation.
2. Including social security and payroll taxes.

Source: *OECD Tax Revenue Database*.

Reforms to intergovernmental fiscal frameworks can explain a part of the evolution of decentralisation indicators over the past 15 years. The most common fiscal federalism reforms include: the devolution of new responsibilities for public services to the sub-central level, especially in the area of economic affairs and social welfare; the upgrading and amendment of equalisation and other intergovernmental grant systems, particularly a move from earmarked to non-earmarked grants; the introduction or tightening of sub-central fiscal rules; a move from grants to tax sharing; and sub-central tax reforms, mostly entailing a stronger harmonisation of central and sub-central tax bases.[2] Most reforms were quite encompassing and covered more than one of the areas mentioned above. They have considerably changed sub-central fiscal policy especially on the spending and transfer side, while intergovernmental tax systems tended to be more stable. Reforms that confer more tax autonomy to SCGs were particularly difficult from a political economy perspective. It is still unclear to what extent the ongoing episode of fiscal consolidation will affect the fiscal power of the sub-central government level and the long-term trend towards decentralisation.

3. Decentralisation and economic performance

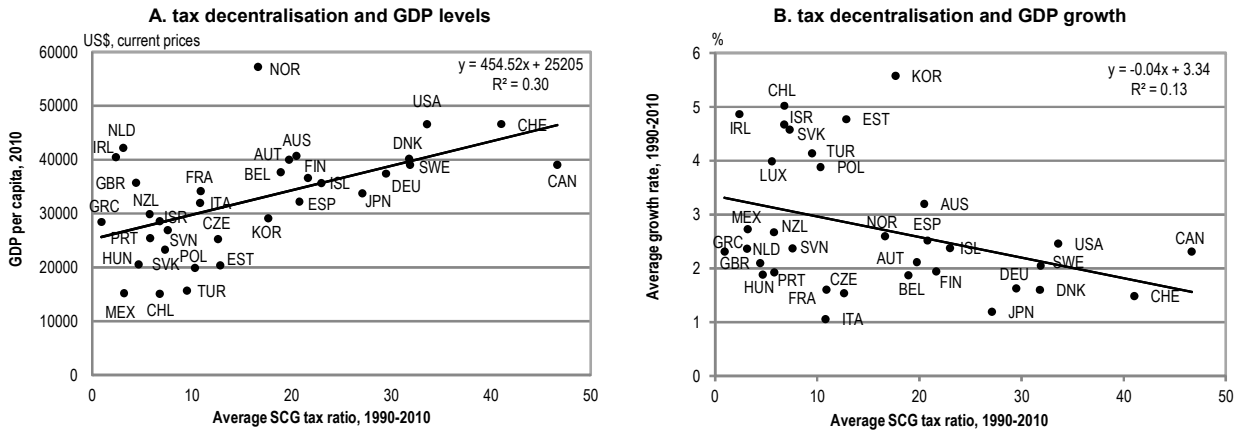
3.1. Decentralisation and growth: some stylised facts

Across the OECD, decentralisation appears to be positively associated with GDP per capita *levels* but negatively associated with GDP per capita *growth*. The latter is probably influenced by convergence between countries (Figure 4, Panels A and B). The relationship is stronger for revenue decentralisation than for spending decentralisation, suggesting that a budget's revenue side is a better gauge for the link between fiscal frameworks and economic performance than the spending side. Decentralisation is also positively linked to total factor productivity and human capital, but no significant relationship emerges

2. Blöchliger and Vammalle (2012) provide an overview on fiscal federalism reforms and their budgetary implications.

between decentralisation and business investment. Again, the total revenue and tax revenue variables have a stronger link than the spending decentralisation variables, with the tax autonomy indicator yielding the most significant relationship. All in all, intergovernmental fiscal frameworks appear to be associated with both economic activity and its main determinants such as human capital and productivity.

Figure 4. Decentralisation and economic performance



Source: *OECD Fiscal Decentralisation Database* and OECD National Accounts.

Although simple correlations suggest a link between the two main variables of interest, they have to be taken with care, as they leave out other factors affecting economic performance. Other determinants of economic performance such as capital and labour input or the productivity level need to be taken into account, which will be done within a proper production function framework.

3.2. Inter-jurisdictional competition and productivity in the public sector

Production functions can help assess the relationship between decentralisation and growth in a more rigorous way. In this context, GDP per capita of an economy is assumed to rest on three pillars: the stock of physical capital; human capital; and technological progress, captured by total factor productivity or TFP, reflecting the overall efficiency level of an economy. TFP is influenced by a country's institutions and policies, of which intergovernmental fiscal frameworks form an integral part. Decentralised fiscal frameworks can raise TFP through an increase in the efficiency and productivity of the public sector, which in turn instils higher productivity in the private sector. Decentralisation may also affect the stock of physical capital (through more public and private investment), human capital (through education spending by central and sub-central governments) and labour utilisation, although the latter will not be assessed. Fiscal frameworks may thus affect several main determinants of growth. The estimation strategy is laid out in more detail in Box 2.

Public sector productivity is influenced by competition between SCGs and inter-jurisdictional mobility. Most SCGs aim at attracting and retaining mobile production factors, in order to promote investment and economic activity. They can do so by using fiscal policy, among other instruments. Since firms are choosing their location based on where they expect the highest returns on investment, and since returns depend (partly) on public inputs, SCGs have an incentive to raise the productivity of their public sector. SCGs may also try to improve the relationship between taxation and public service levels, by lowering taxes or by spending more in areas such as infrastructure or education. Competition between SCGs works hence in two ways: *i)* it can increase spending on productive services and spending that

benefits the corporate sector relative to spending on consumptive, residential and social services,[3] and *ii)* it can increase the efficiency of all public spending irrespective of whether they are productive or consumptive, corporate or residential. The more decentralised a country, the stronger these competitive forces could be. Competition and inter-jurisdictional mobility could be weakened by large intergovernmental transfer systems, in particular fiscal equalisation. The pressure for productivity improvements may not even require spatial mobility to exist: Voters may press their governments for tax and spending policy changes by simply claiming what they observe in neighbouring jurisdictions, without an intention to move ("yardstick competition").

Box 2. Empirical design

The model

The empirical tests relating decentralisation and growth are based on an augmented neoclassical growth model in which total output depends on physical and human capital, labour, and total factor productivity. TFP in turn depends on a set of institutions and policies, among them the degree of decentralisation. The estimation uses a Cobb-Douglas type production function. The overall long-term impact of decentralisation on output is estimated within a framework of a truncated error correction model.

$$dY_t=a+b*(Y_{t-1}+c_1*K_{t-1}+c_2*H_{t-1}+c_3*X_{t-1}+c_4*DEC_{t-1})+e_t \quad (1)$$

where dY denotes the change in GDP, K is physical capital, H is human capital, X is a set of control variables and DEC represents the various decentralisation indicators. In addition, separate estimations are made for the impact of decentralisation on, respectively, TFP, human capital, and business investment. All equations are estimated on pooled data as well as with a combination of country and time fixed effects. Given that the decentralisation indicators, in particular the tax autonomy indicator, change little over time and can thus be viewed as a country fixed effect, the equations are also run using time fixed effects only. Equations are estimated in logarithmic form; hence the coefficients shown in the tables show the effect of per cent changes (not percentage point changes) in decentralisation ratios on the independent variable.

Data

Equations are estimated on a dataset comprising all OECD member countries. Y is GDP per capita, K the total investment to GDP ratio and H the average years of schooling. The set of the X control variables comprise population growth, inflation, openness, the general government tax composition and the size of the intergovernmental grant system. The four DEC decentralisation variables – spending ratio, total revenue ratio, tax revenue ratio and the tax autonomy indicator (Box 1) – are inserted *sequentially* into the equations, in order to avoid multi-collinearity. Most data are available for the period 1995 to 2010, but since one of the four decentralisation indicators – tax autonomy – is available for the years 1995, 2002, 2005 and 2008 only, regressions are run separately for the entire period as well as for those years only. The data sample is further divided into sub-periods to check for trend breaks, as well as run separately for federal and unitary countries, in order to gauge institutional differences not covered by the decentralisation indicators. Finally, all relationships are tested for non-linearities, e.g. "diminishing returns to decentralisation".

More details on the empirical design can be found in Annex A1.

Causality in the relationship between decentralisation and growth may however run the other way round, i.e. higher living standards may be the root rather than the consequence of decentralised fiscal frameworks. Indeed the pioneering decentralisation studies of the 1970s and the 1980s found that a decentralised public sector was a "superior good", demand for which was growing with rising income levels. These studies argued and showed that high income levels promote decentralisation.[4] Since both types of studies – the older ones arguing for a link from growth to decentralisation and the newer ones arguing the reverse – are using largely the same indicators and datasets, one could even suspect that the

3. Capital is more mobile than labour, which explains why sub-central competition for firms is generally higher than competition for residents (Blöchliger and Pinero-Campos, 2011).

4. Examples include Oates (1972) or Pommerehne (1977). Later again, some studies linked economic performance to decentralisation rather than the other way round, e.g. Bahl and Nath (1986) or Tanzi (2000).

results are a mere reflection of spurious correlation. For several reasons it is very difficult in a cross-country study on decentralisation and growth to derive a clear order of cause and effect, and one cannot exclude that the two variables strongly interact or that they are simultaneously determined by a third factor, such as a society's preference for small or big government.[5]

3.3. Decentralisation is positively, but weakly related to economic activity

The economic effects of decentralisation, as captured in multivariate regressions, appear to be positive (Table 1). Doubling decentralisation ratios (e.g. moving from a SCG tax revenue share of 6 to 12%) is associated with a GDP per capita increase of around 3%, and a productivity increase of more than half a per cent on average. The investment effect is negligible. The institutional set-up of countries (federal versus unitary) has only a small impact, with the results suggesting that differences in intergovernmental fiscal frameworks are larger *within* each of the two country groups than *between* them. The relationship between decentralisation and labour utilisation was not tested, since no clear hypothesis could be established. Other elements of the intergovernmental fiscal framework appear to have a small effect on economic activity: the impact of the size of intergovernmental transfers is mostly negative but insignificant, and – a bit surprising – the same holds true for the tax structure as represented by the share of property and consumption taxes in the total tax take. Finally, tax autonomy in general appears to have little influence on economic activity, but the insignificant results may be due to the small sample.[6]

Table 1. Decentralisation is positively but weakly associated with economic activity

Elasticities between output variables and decentralisation indicators

	All countries			Federal countries			Unitary countries		
	GDP per capita	Productivity	Investment	GDP per capita	Productivity	Investment	GDP per capita	Productivity	Investment
Tax autonomy	0.003	0.002	-0.075	0.011	-0.012	0.323**	0.003	0.001	3.8
Tax revenue decentralisation	0.033**	0.006**	0	-0.01	-0.002	-0.002	0.033**	0.008*	-0.002
Revenue decentralisation	0.032**	0.005**	0.001	-0.003	-0.008	-0.003	0.031**	0.008	-0.001
Spending decentralisation	0.03**	0.004**	0.005	0.01	-0.011	-0.001	0.027*	0.005	0.007

Note: Coefficients are derived from various multi-variate regressions linking a set of output variables (GDP, productivity and investment) to the four decentralisation indicators and a set of controls, using time fixed effects. Decentralisation indicators are inserted sequentially into the equations in order to avoid multicollinearity. Coefficients are partial elasticities and represent percentage changes, e.g. 0.032 means that a 100% increase in decentralisation (e.g. a revenue share increase from 6% to 12%) is associated with a GDP level increase of 3.2%. A * means significance at the 10% level, ** at the 5% level and *** at the 1% level. Coefficients for variables other than decentralisation indicators are provided in Annex A1.

Source: *OECD Fiscal Decentralisation Database* and OECD National Accounts.

Revenue-side decentralisation has a stronger and more significant impact than spending-side decentralisation, which may reflect problems with measuring true spending autonomy. In particular, regressions over sub-periods suggest that tax autonomy has emerged as a significant driver for both GDP and productivity in the last decade or so, corroborating recent experience with regard to sub-central tax competition and its impact on firms' and households' behaviour. Inter-jurisdictional tax competition appears to have intensified since the turn of the millennium, and that taxation has become a powerful tool in sub-central economic and fiscal policy. Finally, the main impulse from decentralisation to growth

5. The causality of the relationship could be tested using the instrumental variables (IV) or generalised method of moments (GMM) approaches. However, there are no good instruments for decentralisation, and the number of countries in the dataset is too small for a GMM estimation to be applied.

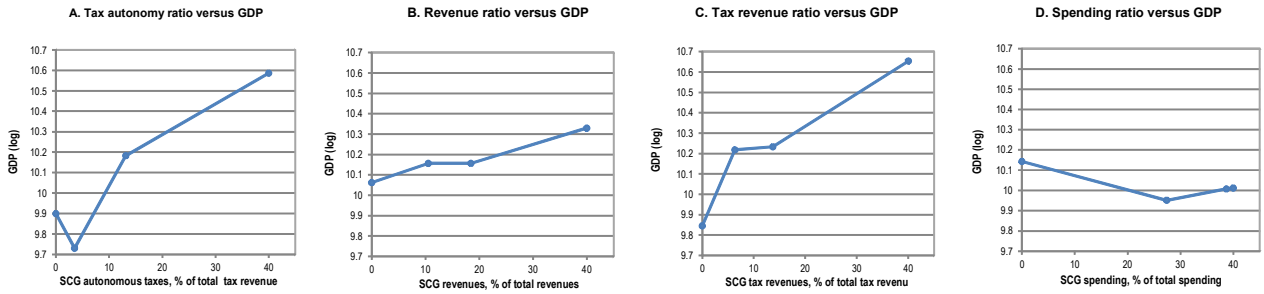
6. The economic effects of decentralisation are similar to the effects of a reduction of the tax burden: a reduction of the tax burden by 1% yields around the same effect on GDP as an increase of 1% in the decentralisation ratio (Bouis et al., 2011).

appears to work through the channel of productivity improvements and higher human capital, while the effect on corporate investment is smaller. The results corroborate other cross-country studies, which often find a non-significant relationship, but argue that revenue autonomy has a stronger impact on economic activity than spending autonomy.[7]

3.4. How much could countries gain from more decentralisation?

The relationship between decentralisation and economic activity could be non-linear, with the positive effect fading away with increasing levels of decentralisation. Some evidence even suggests a hump-shaped relationship, portraying a level of "optimal decentralisation" beyond which additional devolution would restrain rather than foster economic activity. The reasoning behind the idea of optimal decentralisation is that negative factors such as diseconomies of scale and scope, internal trade barriers, distorting local tax systems, rent seeking of local vested interests and other negative implications of decentralised policymaking might overwhelm the positive aspects once devolution extends beyond a critical level. Moreover, the benefits and costs of decentralisation may vary according to the size and fragmentation of a country.[8] A number of additional tests reveal that the relationship may indeed be non-linear but becomes weaker the higher the degree of decentralisation (Figure 5). Highly centralised countries could gain more from devolving fiscal powers to SCGs than countries with a large sub-central government sector, especially if they decentralise on the revenue side. Also, as the figure reveals, the relationship is not hump-shaped, unlike some recent empirical research would suggest.[9] More devolution has always a positive economic effect.

Figure 5. Returns to decentralisation are decreasing



Note: The line shows the relationship between decentralisation ratios and the log of GDP. The slope of the different lines reflects the strength of the relationship, i.e. the size of the coefficients between the different thresholds.

Source: *OECD Fiscal Decentralisation Database* and OECD National Accounts.

Incorporating the non-linear character of the relationship allows for an assessment of what a country might gain in terms of higher GDP if it moved to the benchmark of the most decentralised country. To be more specific, the gains were calculated for each federal country if it moved tax decentralisation to the level of Canada, and for each unitary country if it moved tax decentralisation to the level of Sweden (Figure 6). Further decentralisation could potentially be associated with an average increase of GDP of around 1% to 2% for federal countries and 3% to 4% for unitary countries, with values for more centralised

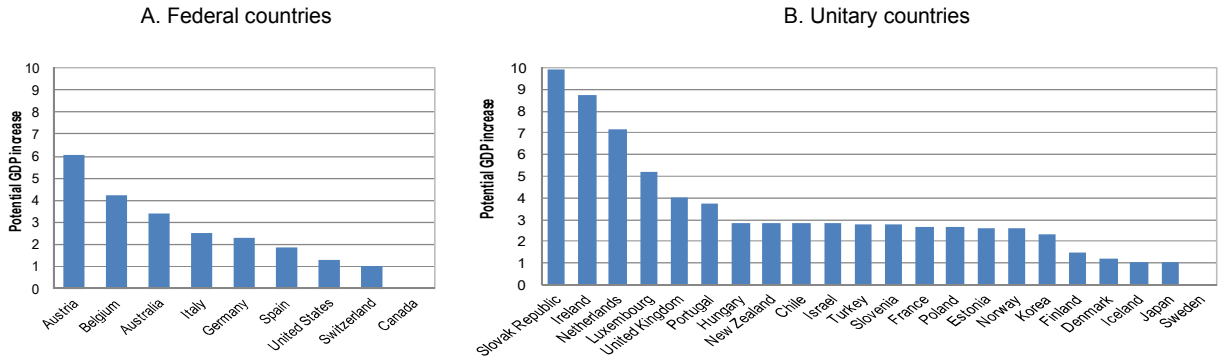
7. See for instance Yilmaz (1999), Rodriguez-Pose (2009) or Asatryan (2010).

8. The optimal level of decentralisation might differ between a small country with many municipalities and a large country with few regions.

9. Bodman and Ford (2006) and Thiessen (2003) both use a quadratic rather than a linear specification and suggest, based on their results, that a medium level of decentralisation is best for growth and human capital accumulation.

countries being larger. Given the decreasing returns of decentralisation, highly centralised countries could gain considerably more than countries closer to the median. While this is an interesting way of showing non-linear and threshold effects of potential policy reforms, this mechanical exercise should not be overrated since it is based on bivariate estimations and does not take into account other factors affecting GDP per capita.

Figure 6. Some countries might gain considerably from decentralising



Note: GDP changes are calculated in per cent on the basis of estimating threshold effects (non-linearities) in bivariate relations between tax revenue decentralisation and GDP per capita. Benchmark countries are Canada (for federal countries) and Sweden (unitary countries). The Czech Republic, Greece and Mexico are excluded due to a very low SCG tax ratio, yielding implausible results.

Source: Calculations based on regression results.

4. Decentralisation and public investment

4.1. Linking decentralisation to the determinants of growth

The channel that runs from decentralisation to economic activity is long and winding, with a multitude of factors potentially interacting. Exploring the shorter channels from decentralisation to the *determinants* of growth can be a complementary way of analysis. As shown in the previous section, decentralisation appears to be linked to main determinants of economic activity, such as education or – albeit much less significant – physical capital. Testing for the relationship between decentralisation and some growth determinants more thoroughly can help gauge the relative significance of each determinant and provide some guidance as to which policy areas would be the most beneficial to decentralise.

The following sections deal with decentralisation and their impact on production factors from two different angles. This section deals with the relationship between decentralisation and public spending on physical investment and on education. If inter-jurisdictional competition is more intense the more decentralised a country, SCGs could be assumed to spend relatively more on productive investment such as infrastructure or education and less on other public spending. The next section deals with the relationship between decentralisation and educational performance. If SCGs have strong incentives to provide efficient education systems, educational performance would be higher in more decentralised countries. Details on the empirical strategy can be found in Annex A2.

4.2. What is public investment?

Public or government investment encompasses all spending to increase the stock of fixed public capital. Government investment provides an input for economic activity within a jurisdiction and by doing so increases the productivity and competitiveness of the corporate sector located therein. While the term "capital spending" leaves a notion of brick and mortar, investment in a broader sense also includes

education, research and innovation, i.e. investment in human capital or, in a wider sense, the "soft infrastructure" of a jurisdiction. Indeed, for the rest of this section the term "investment" is used in a broad sense and includes both fixed capital spending and spending on education. While both infrastructure and education spending tend to create externalities – infrastructure used by individuals and firms not resident in the territory, locally educated people emigrating to other jurisdictions –, thereby potentially discouraging investment at the sub-central level, the empirical evidence suggests that such cross-border externalities are relatively small in general, though they can be considerable for small entities. There is evidence that, in some countries, SCGs may even over- rather than under-invest (Delgado and Alvarez, 2007). In any case, it suggests that the benefits of sub-central government investment in the form of more economic activity or higher tax revenues tend to accrue in the investing jurisdiction. Central government often fosters sub-central investment by tying grants to SCG investment spending (central government capital grants matching sub-central capital in the form of "co-funding") or tackling specific infrastructure externalities.

General government gross fixed capital formation (physical investment) trended down from around 5% of GDP in 1980 to 3% in 2006 – probably reflecting decreasing investment needs as the physical infrastructure was maturing – and then increased slightly again due to the stimulus programmes during the 2008-09 crisis.[10] OECD-wide, SCGs make up around two thirds of total government capital spending, with percentages ranging from more than 90% (Canada) to less than 20% (Greece). Given its "residual" nature in the budgeting process, investment levels fluctuate strongly over the cycle and even more so at the sub-central than at the central government level. Education spending accounts for around 6% of GDP, with SCGs making up more than half of education spending on average, and again differences across countries are large. Simple correlations against revenue decentralisation suggest that more decentralised governments spend slightly more on infrastructure and education.

4.3. Public investment is higher in decentralised countries, especially on education

When looking at the more elaborate relationship using multivariate regressions, investment in physical and human capital is related to the extent of fiscal decentralisation of a country (Table 2). Both on the spending and the revenue side, decentralisation indicators are related with investment, except for tax autonomy. Typically a 10% point increase in decentralisation increases the investment share by 1.1 percentage points, thereby lifting the share of public investment in total government spending from around 3% to more than 4% on average. More specifically, while spending decentralisation contributes little to boosting economic activity, it provides incentives for SCGs to provide education spending and – to a lesser extent – spending on physical capital. In many countries, earmarked and matching intergovernmental grants targeted at SCG investment enhance these incentives.[11] Results for unitary countries are more significant both statistically and economically than for federal countries, suggesting that decentralisation would have a stronger impact in the (more centralised) unitary countries than in federal countries where SCG investment responsibilities are already large. This said, some non-linearities (not tested) might be hidden in the investment channel, as devolving more fiscal power to SCGs could boost investment especially in countries with decentralisation ratios below the OECD average.

10. The investment behaviour of central and sub-central governments since the crisis began in 2008 is described in Kim and Vammalle (2011).

11. Central governments are often co-funding sub-central investment projects, especially those with an inter-jurisdictional scope. Indeed, capital grants belong to the most common form of earmarked matching grants, providing SCGs with incentives to spend on physical capital. Also the European Union Structural Fund provides mainly capital grants.

Table 2. Decentralisation and the share of public capital plus education spending

Unbalanced panel, time fixed effects, all OECD countries

Dependent variable: Share of public physical and human capital spending												
	All countries				Federal countries				Unitary countries			
	Exp	Rev	Taxrev	Taxaut	Exp	Rev	Taxrev	Taxaut	Exp	Rev	Taxrev	Taxaut
Government size	-0.61***	-0.60***	-0.61***	-0.60***	0.01	-0.39***	-0.37***	0.00	-0.58***	-0.77***	-0.77***	-0.52***
Population	-0.03***	-0.03***	-0.03***	-0.03**	0.01***	-0.04	0.02	0.02**	-0.03**	-0.02	-0.02	-0.04
Decentralisation	0.11***	0.11***	0.15***	0.16**	0.35***	0.13***	0.12***	0.32***	0.13***	0.33***	0.33***	0.10*
R2 adjusted	*0.42*	*0.40*	*0.44*	*0.44*	*0.85*	*0.61*	*0.60*	*0.85*	*0.45*	*0.53*	*0.53*	*0.36*
No observation	*329*	*329*	*335*	*75*	*126*	*126*	*125*	*22*	*205*	*205*	*205*	*54*

Note: *** means significance at the 1% level, ** means significance at 5% level and * means significance at 10% level.

Coefficients derive from linear multivariate regressions using time fixed effects. Decentralisation indicators are inserted sequentially into the equations in order to avoid multicollinearity. Coefficients are point elasticities and therefore represent per cent point changes, *e.g.* 0.11 means that a 10% point decentralisation increase is associated with a capital spending share increase of 1.1% points.

Source: *OECD Fiscal Decentralisation Database* and OECD National Accounts.

The association of decentralisation with physical and human capital is not equally strong, however. While more decentralisation appears to be linked to higher education spending, the evidence is relatively weak for physical capital, especially in federal countries (see Annex A2). Thus, while fiscal decentralisation seems to change the composition of public spending, it is education budgets rather than traditional forms of capital investment that become larger when fiscal power is devolved. SCGs with wide fiscal powers seem to consider human capital formation as a more important economic policy device than physical capital formation. Providing SCGs with more fiscal power, especially in countries below the respective OECD average, could therefore result in more educational investment and enhanced human capital.

5. Decentralisation and performance in primary and secondary education

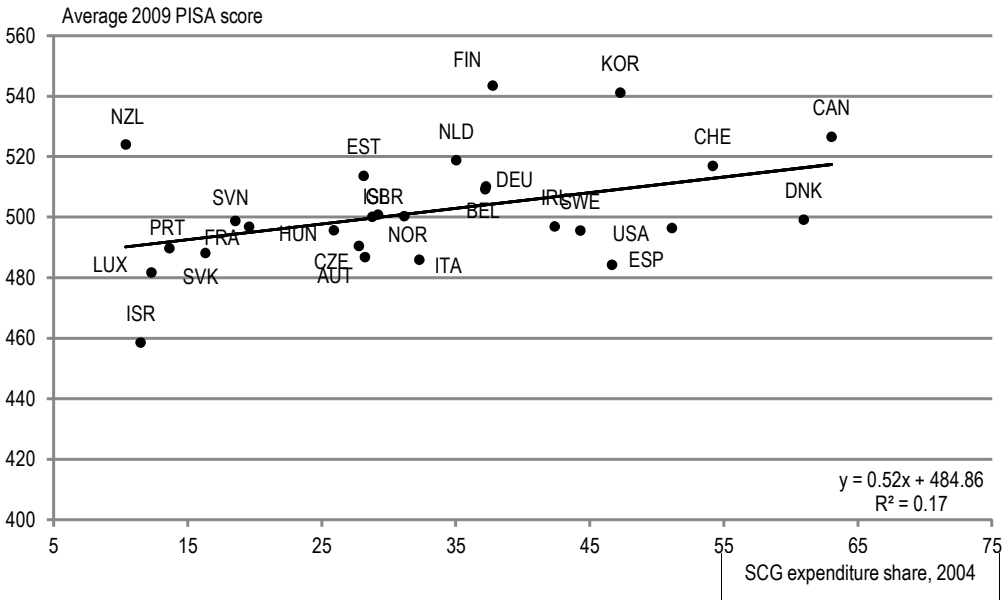
The last relationship to be tested is between decentralisation and performance in a crucial policy area, namely primary and secondary education. While an assessment of public sector efficiency and quality is often difficult due to data limitations, there is one area where international comparisons are abundant. This is the primary and secondary education sector, which is covered by the PISA (Programme of International Students Assessment) datasets on education inputs, outputs and outcomes. These datasets make it possible to estimate a relationship between institutional frameworks – the extent of decentralisation in our case – and educational performance in the form of internationally comparable test results. Since education and human capital in turn are essential ingredients of the production function, exploring the channel from decentralisation to education helps explore the channel from decentralisation to economic performance.

5.1. The education production function

The delegation of power in primary and secondary education is thought to foster the efficiency and quality of educational systems. In the last three decades most OECD countries underwent comprehensive educational reforms, with more than 50% of education funded by the sub-central government level and education being the single most important sub-central spending item today. Decentralisation of education functions is thought to increase responsiveness to the demands of local constituencies, improve the quality of schools, raise the potential for innovation and adaptation in learning, and improve financial and human resource management in the educational sector.[12] The pressure to deliver on education originates in competitive forces and benchmarking across SCGs and increased accountability of educational providers. By offering "good" educational policy (high quality teaching, a stimulating school environment, etc.), SCGs may attract or retain firms interested in a well-educated workforce and residents interested in more and better opportunities for their children. Some SCGs have started to use education as an important policy tool by targeting highly mobile families and by investing heavily in schools. The more autonomous SCGs in all matters of education policy, the stronger such strategic interactions. The simple correlation between PISA results and the spending share suggests a positive relationship between decentralisation and educational outcomes (Figure 7).

12. An overview on the most recent developments in education decentralisation can be found in OECD (2011).

Figure 7. Simple correlation between spending decentralisation and education results



Source: *Fiscal Decentralisation Database* and *Education at a Glance*. For the decentralisation indicator the year 2004 is taken as this is around the time when the 2009 panel started secondary education. Data without Mexico.

The generation of knowledge can be modelled by an "education production function", i.e. by analysing the relationship between educational inputs and educational performance.[13] In its most general form, educational performance – usually in the form of examination and test results – depends on three main factors: the characteristics and innate capabilities of the students, the characteristics of teachers and schools, and the properties of the wider institutional environment, which is power delegation in this case. Students' characteristics are often captured by indicators of socio-economic background such as income and educational degrees of parents. School characteristics are usually captured by total spending or spending on teachers, thought to be an important determinant of teaching quality – although most empirical studies over the past three decades found only a weak relationship between salaries and teaching quality. The extent of sub-central autonomy enters as the "third factor" that affects student performance. This factor captures the perceived advantages that local constituencies have in managing and combining the other input resources – students and teachers – in the school. In order to reflect sub-central autonomy in education, an indicator of education decentralisation, provided by the OECD Education at a Glance database, is added to the four traditional decentralisation indicators. This institutional indicator – the Education at a Glance decentralisation indicator – reflects not only financial but also regulatory and operational powers of SCGs in running the education system.

13. Education production functions in their most general form are described in Hanushek (1996) or Wössmann (2007). Using an education production function approach, Sutherland and Price (2007) find a slightly positive relationship between various forms of decentralisation and school performance.

5.2. More decentralised countries achieve higher PISA results

Using PISA results as an indicator for performance and a set of input variables like student background, education spending and the decentralisation variables, an education production function was estimated. The empirical investigation reveals a strong relationship between decentralisation and educational outcomes, although only for the Education at a Glance decentralisation indicator (Table 3). A 10% increase in decentralisation improves PISA results by four points, which corresponds to an average improvement by around four positions in the PISA country ranking. The traditional decentralisation indicators (spending, revenue and tax decentralisation as well as the sub-central education spending share) are, in general, insignificant. The results suggest that decentralisation is more than just about the sub-central share in general government outlays but also encompasses responsibility over regulation and management in a certain policy area. The fact that the institutional indicator – which reflects not only fiscal but also regulatory decentralisation – provides better and more significant results suggests that true sub-central power does not merely lie in the right to spend money but in shaping the way and for which functions the money is spent. Providing SCGs with education money does little to improve education, if it is not accompanied by some flexibility in education management. The remaining variables (spending on education, student background) provide the expected positive and significant results.

Decentralisation in the education sector has various facets, with powers not only delegated to lower level governments or special school districts, but also – as with other public sector areas like health care or public transportation – to the providers themselves, namely the schools and their managing bodies. Countries pursue different ways of endowing citizens with the power to shape educational inputs, either by giving sub-central governments the authority to decide on educational matters or else by giving the schools the flexibility to do the same thing. Scrutinising the relationship between sub-central power and school autonomy suggests that the two forms of power delegation tend to be substitutes rather than complementary. Countries with less SCG power provide schools with more autonomy and *vice versa* (Figure 8), with federal countries usually providing much power to SCGs but little to schools. Indeed, the drivers behind the two roads towards devolution may be quite different. While decentralisation of educational powers to local governments is generally undertaken as part of a broader, more general public sector reform, school autonomy reforms tend to be led more by specific concerns about educational performance and the operational tools needed to improve the latter. Put in other words: decentralisation is often motivated by wider political objectives, while school autonomy is a management device. While school autonomy and sub-central government autonomy might be seen as alternative ways to increase the performance of the education system, the empirical results suggest that both types of autonomy have similar positive effects on school performance (see Table A2.6).

Table 3. Education decentralisation and PISA score

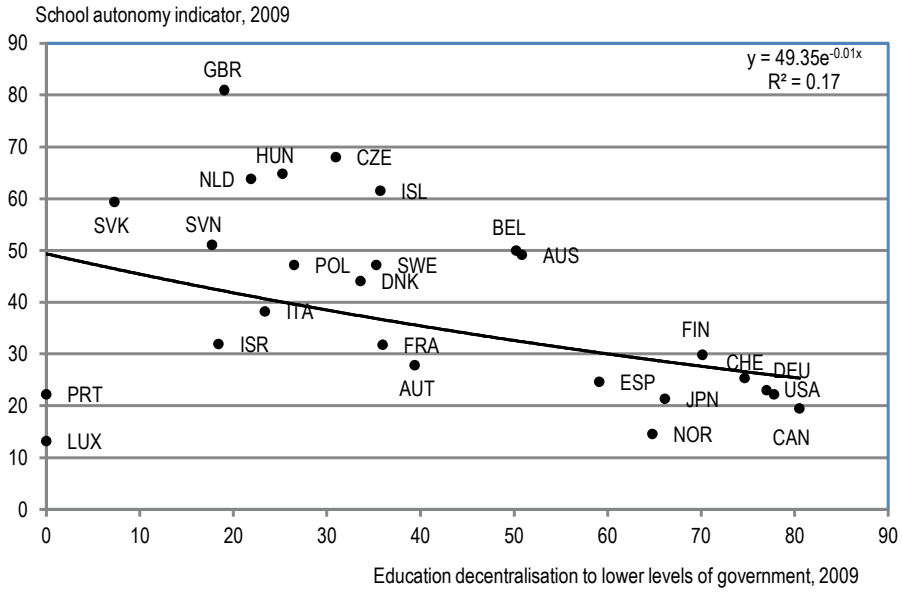
Unbalanced panel, time fixed effects, all OECD countries

Dependent variable: National PISA results																
	All countries						Federal countries					Unitary countries				
	Educ dec1	Educ dec2	Exp	Rev	Taxrev	Taxaut	Educ dec1	Exp	Rev	Taxrev	Taxaut	Educ dec1	Exp	Rev	Taxrev	Taxaut
Student characteristics	40.14***	23.13	41.29***	40.98***	47.25***	46.78***	59.34***	58.80***	53.98***	59.48***	58.32***	1.40**	2.81***	6.68	31.45***	33.53*
Education spending/GDP	1.42***	-1.07	0.90*	0.87*	1.19***	1.31***	1.02	1.36***	1.03**	0.95**	1.00	1.41**	1.42***	-0.08	1.28*	2.17
Decentralisation	0.40***	0.13	0.19	0.10	0.10	0.13	0.14	0.40*	0.26	0.14	0.31	0.65***	0.64***	0.72*	0.32	0.31
R2 adjusted	*0.45*	*0.35*	*0.38*	*0.37*	*0.51*	*0.51*	*0.84*	*0.79*	*0.82*	*0.84*	*0.89*	*0.44*	*0.10*	*0.04*	*0.24*	*0.30*
No observation	*84*	*41*	*100*	*100*	*115*	*32*	*25*	*33*	*34*	*39*	*10*	*59*	*66*	*67*	*76*	*22*

Note: *** means significance at the 1% level, ** means significance at 5% level and * means significance at 10% level. Coefficients derive from linear multivariate regressions using time fixed effects. Decentralisation indicators are inserted sequentially into the equations in order to avoid multicollinearity. Coefficients are point elasticities and therefore represent percentage point changes. *E.g.* 0.40 means that a 10% point decentralisation increase is associated with an increase of 4 PISA points. Educ dec1 is the institutional education decentralisation indicator from the OECD Education at a Glance database and educ dec2 is the education decentralisation indicator based on COFOG data.

Source: *OECD Fiscal Decentralisation Database*, *OECD Education at a Glance Database* and OECD National Accounts.

Figure 8. Decentralisation and school autonomy are substitutes rather than complements



Source: OECD Education at a Glance Database.

6. Bringing the threads together

This paper presented some evidence for a positive relationship between the decentralisation of fiscal power and economic activity. The impulse for higher activity stems mainly from higher productivity (total or multi-factor productivity) and a better educated workforce. Additional evidence on the "intermediate channels" – i.e. the link from decentralisation on the *determinants* of growth, i.e. selected policy areas – tends to confirm that decentralised public finance is associated with a higher share of spending on physical investment and on education. Decentralisation is also associated with higher student performance (as measured by the internationally comparable PISA outcomes), and this also holds if the higher spending levels in decentralised countries are taken into account. On the other hand, decentralisation has no discernible impact on private investment.

The various estimation results together could be interpreted as follows: Decentralisation of fiscal and regulatory power fosters competition between sub-central governments. In order to attract firms and residents, SCGs will try to raise productivity levels of their public sector. The empirical findings indeed suggest that the spending items likely to increase public sector productivity – such as capital spending and spending on education – are typically higher in a more decentralised setting. Moreover, the performance of educational systems, measured in the form of the PISA indicators, is higher in more decentralised countries. Decentralisation hence offers a double educational dividend: it provides for more spending in the education sector compared to spending on other budget items, and it provides for a better use of that education spending. It hardly matters whether educational responsibilities are delegated to sub-central jurisdictions or whether they are directly assigned to schools; the most important is that a part of educational responsibility is delegated to administrations on the ground and close to the citizens and providers.

The double education dividend shown above is likely to materialise in two ways: it results in a better educated workforce, and it is likely to increase the overall productivity, e.g. through more innovation. Both the quantity effect – more education – and the quality effect – higher total factor productivity – are the

main components of the production function, prompting a stronger economic performance. The empirical findings indeed suggest that the impulse for higher GDP stems from both educational attainment and higher overall productivity. Both effects are about equally strong, i.e. higher GDP seems to be equally driven by a higher educational attainment and higher overall productivity. On the other hand, the empirical findings suggest that while public investment spending is higher in decentralised settings, it has relatively little effect on private investment, and that its contribution to higher GDP is relatively weak. Investment in soft infrastructure appears to be more productive than investment in hard infrastructure. Summarising these findings, the main results from this paper suggests that the channel from decentralisation to growth runs through education policy and how it is organised across governments. Appropriate assignment of education responsibilities and functions across government levels and between administrations and schools appears to be key to foster prosperity.

ANNEX A1. THE IMPACT ON PRODUCTIVITY, INVESTMENT AND GROWTH

1. Introduction

This annex describes the empirical work carried out to establish the link between intergovernmental fiscal frameworks ("decentralisation", for short) and economic activity. Such frameworks are usually based on the constitutional principles of a country, and these are not necessarily geared towards contributing to economic policy objectives. However, like most institutional arrangements, the organisation of the public sector across government levels affects firms, households and public entities, and the way they save, invest, spend or innovate. This in turn may have considerable consequences for the long-term growth potential of a country. This annex describes the empirical methods to establish this link for a sample of OECD countries and reports the estimation results.

The annex is organised as follows. Section two summarises previous research on decentralisation and growth, focussing on explanations why the empirical results vary across studies. Section three describes the underlying growth model, and provides details on data selection, especially on the various indicators that measure the degree of decentralisation and are useful in assessing intergovernmental fiscal frameworks. Section four presents the results of two empirical specifications: one using spending, revenue and tax revenue decentralisation indicators and another specification which also includes an indicator of tax autonomy, but which covers a shorter time span.

2. Previous research

The set of empirical studies that have established a link between intergovernmental fiscal frameworks and economic activity has generated every possible answer, from a clear positive to a clear negative relationship, with several studies concluding that there is no relationship at all. Averaging over all studies leads to the conclusion that decentralisation and growth are unrelated. The results, however, depend on the type of study, what was examined, what countries and time periods were covered and the empirical approach that was selected. Results also much depended on whether a study examined a single country (i.e. local and/or regional governments in one country) or covered the sub-central level in a cross-country setting. One of the most contentious topics in the empirical analysis is the choice of the variable capturing "decentralisation" with authors being faced with a plethora of fiscal, political or administrative variables reflecting the intergovernmental set-up. Since empirical results often depend on the choice of the decentralisation variable, academics and policymakers have recently turned towards the question on how to improve the measurement of decentralisation (Kim, et al., 2013).

A summary table of the empirical studies can be found in Table A1.9. Decentralisation appears to have a more beneficial effect in high than in low-income countries, pointing at particular problems of fiscal decentralisation and local capture in developing or transition economies (Yakovlev and Zhuravskaya, 2004). Using a revenue decentralisation measure has a slightly stronger effect than using a spending decentralisation measure, but the effect is small. Using the tax autonomy indicator, which measures the extent to which SCGs have the power to set the base and rates of their own taxes, delivers sometimes very significant results. Differences are also due to the estimation technique: Cross-sectional analyses tend to provide more positive results than panel analyses. Finally, the studies focusing on a single country usually

deliver a clearer and more positive picture than cross-country studies, probably owing to the strong institutional differences and measurement problems when dealing with several countries. A meta-analysis by Feld and Schnellenbach (2009) provides similar results, suggesting that decentralising fiscal frameworks in the OECD context would be beneficial but will hardly trigger a large jump in economic activity.

3. Modelling decentralisation and growth

3.1. Model and estimation issues

GDP estimations

The starting point is the neoclassical growth model in which output (Y) depends on the stock of physical and human capital (K and H respectively) and total factor productivity (A).

$$Y_{(t)}) = K_{(t)}^{a} H_{(t)}^{b} A_{(t)}^{1-a-b} \quad (1)$$

where K and H are physical and human capital, A denotes technology, and a and b are the partial elasticities of K and A with respect to output. The model is augmented by adding decentralisation, which, as part of a set of institutions and public policies, are supposed to have a positive impact on the technology variable A. The overall long-term impact of decentralisation on output is estimated within a framework of an error correction model, along the lines of Bouis et al. (2011):

$$dY_t = a+b*(Y_{t-1}+c_1*K_{t-1}+c_2*H_{t-1}+c_3*DEC_{t-1})+d_1*dK_t+d_2*dH_t +d_3*dDEC_t+e_t \quad (2)$$

where Y is per capita income, and is a function of physical capital accumulation, measured as the investment to GDP ratio (K), human capital accumulation (H), captured by average years of schooling, the degree of fiscal decentralisation (DEC) and e is the error term. The term d denotes growth rates. The terms a, b and the vectors c and d are the estimated coefficients. The error correction term provides a test for cointegration. Kremers et al. (1992) argue that in a time series context it is more powerful than the residual-based cointegration tests in testing for co-integration. If the error correction term is negative and statistically significant the variables are connected through a long-term co-integration vector. In this case, the long-term coefficients can be obtained by a normalisation through the coefficient b:

$$Y_t=c_1/b*K_t+c_2/b*H_t+c_3/b*dPOP_t+c_4/b*DEC_t+e_t \quad (3)$$

The estimation of the error correction model including the short-term dynamics is compromised by relatively few degrees of freedom, given that most data do not go back further than around 1995. Therefore a truncated version of Equation [2] is estimated:

$$dY_t=a+b*(Y_{t-1}+c_1*K_{t-1}+c_2*H_{t-1}+ c_3*DEC_{t-1})+e_t \quad (4)$$

The long-term coefficients can be computed as in [3]. Equation [4] is estimated on pooled data but also includes country fixed effects alone and country and time fixed effects at the same time. Given that the decentralisation indicators, in particular the tax autonomy indicator, change little over time and thus can be viewed as a country fixed effect, Equation [4] is also run including only time fixed effects.

Transfers to sub-central governments can interact and influence overall fiscal autonomy as well as the structure of sub-central public spending. Therefore, transfers to lower level governments are used as a control. Alternatively, the fiscal autonomy variables are interacted with the transfer variable. In addition to these variables, the size of government, measured as tax revenues over GDP, and the tax structure (recurrent property and consumption taxes as a share of total tax revenues) are added as control variables. For some specifications, a set of conventional control variables thought to affect growth such as inflation, the openness ratio (export and imports of goods and services over GDP) and population growth are added.

TFP and business investment estimations

The degree of decentralisation is expected to influence per capita income through its effect on TFP. But the literature also found fiscal decentralisation to influence per capita income via higher business investment, in turn the result of higher returns on such investment (or, correspondingly, lower user cost of capital) due to SCG competition to attract mobile production factors (Zodrow and Mieszowski, 1986; Keen and Marchand, 1997; Keen and Kotsogiannis, 2004; Vartia, 2008). Therefore, both the relationship between decentralisation and TFP as well as the relationship between the business investment rate and decentralisation is assessed. The baseline equation for TFP growth is as follows:

$$dA_t=a+ b*dA_{t-1}+c*K_{t-1}+ d*DEC_{t-1}+e_t \quad (5)$$

where TFP growth depends on its past value, lagged government investment and the decentralisation indicator lagged one period. The control variables that are added to (5) are transfers, the size of government, and the tax structure. For some specifications, inflation and the openness ratio are added. The above equation is also estimated for the log level of TFP. The business investment equation incorporates the investment to GDP ratio (K) as a function of its lagged value, the lagged real interest rate (CPI-deflated long-term nominal interest rate) and fiscal decentralization indicators:[14]

$$K_t=a+ b*K_{t-1}+c*r_{t-1}+ d*DEC_{t-1}+e_t \quad (6)$$

Equations 4 to 6 are estimated on a dataset comprising all OECD countries and covering the period from 1970 to 2010 for the annual dataset and 1995 to 2010 for the data based on multi-year averages. A subset of the annual dataset covering 1995-2010 is also analysed to check whether the effect of decentralisation has changed over time (trend breaks) and to ensure comparability of the results obtained for the two datasets. The data sample is also split along the cross-sectional dimension: the estimations are run separately for federal and non-federal countries. Finally, the robustness of the results for outliers is checked by performing a jackknifing exercise, in which Equations 4 to 6 are estimated, excluding one country at a time. For each specification, this implies a subset of results corresponding to the number of countries included in the initial dataset. The idea behind jackknifing is that if some countries are driving the overall results, their exclusion from the sample will have a strong influence on the estimation results.

3.2. Testing non-linear effects

Decentralisation might have a non-linear impact on per capita income. The negative effects of decentralisation mentioned above – diseconomies of scale and scope, internal trade barriers, rent seeking – may become relatively more important than its advantages, leading to decreasing marginal returns of growing decentralisation. Some authors even argue that the relationship is hump-shaped with an "optimal" degree of decentralisation beyond which additional sub-central fiscal powers would have negative implications for economic activity (e.g. Thiessen, 2003 using a quadratic estimation term). We therefore test, whether a non-linear relationship between per capita income and decentralisation exists. Threshold models are estimated, in which the effect of fiscal decentralisation on per capita income, TFP growth and investment depends on the level of fiscal decentralisation. The testing procedure developed by Hansen (1999) is used, in which the threshold values are determined endogenously through a grid search, and in which the linear specification is tested against a two-regime model. If the null hypothesis of the linear model can be rejected against the alternative of a two-regime model, the null of a two-regime model is tested against the alternative of a three-regime model. The linear, two-regime and three-regime models can be written as follows.

14. Business investment data are not available for all OECD countries. This is why total investment is used. It is highly correlated with the business investment variable for countries where the latter is available.

$$Y_t = \alpha + \beta \cdot DEC_t + \varepsilon_t$$

$$Y_t = \begin{cases} \alpha_1 + \beta_1 \cdot DEC_t + \varepsilon_t & if \quad DEC_t < T \\ \alpha_2 + \beta_2 \cdot DEC_t + \varepsilon_t & if \quad DEC_t \geq T \end{cases} \tag{7}$$

$$Y_t = \begin{cases} \alpha_1 + \beta_1 DEC_t + \varepsilon_t & if \quad DEC_t < T_1 \\ \alpha_2 + \beta_2 DEC_t + \varepsilon_t & if \quad T_2 > DEC_t \geq T_1 \\ \alpha_3 + \beta_3 DEC_t + \varepsilon_t & if \quad DEC_t \geq T_2 \end{cases}$$

where T is the value of the threshold of fiscal decentralisation in the two-regime model and T_1 and T_2 are the lower and upper threshold values of fiscal decentralisation in the three-regime model. Once the threshold values are identified, the null hypothesis of $\beta_1 = \beta_2$ can be tested using a likelihood ratio test, where the test statistic is obtained through bootstrapping with random draws with replacement using 500 replications. If the likelihood ratio test statistic rejects the null hypothesis of the linear model against the two-regime model, then in a next step the two-regime model is tested against a model of three regimes.

3.3. Data

Decentralisation data are taken from the OECD fiscal decentralisation database. Since one of the main objectives of the analysis is to compare different definitions of decentralisation and their relationship with economic activity, care is taken to select adequate decentralisation indicators. Four different indicators were finally selected to enter *alternatively* into otherwise identical equations: spending decentralisation (the share of sub-central spending in general government spending), revenue decentralisation (the share of sub-central revenue – taxes, user fees and other revenue – in general government revenue), tax decentralisation (the share of sub-central tax revenue in general government tax revenue) and tax autonomy (taxes for which SCGs have some power to set the base and/or rate as a share of general government tax revenue). While total revenue and tax revenue decentralisation are similar in highly decentralised countries, they are not so in countries with little sub-central tax revenue and where SCGs often depend heavily on user fees and other non-tax own revenues (excluding grants). Spending, revenue and tax decentralisation indicators are available for the period 1970 to 2011 for few OECD countries, for the period 1985 to 2011 for around half of the countries, and for the period 1995 to 2011 for most countries. This allows testing for different panels, both balanced and unbalanced. The tax autonomy indicator is available for 1995, 2002, 2005 and 2008 only.

Given the different availability and periodicity of the four decentralisation indicators, two different model specifications are run: a panel regression using annual data for spending, revenue and tax revenue decentralisation (*annual specification*), and a panel regression using all decentralisation indicators for the four years noted above (*selected years specification*). Finally, intergovernmental transfers reflecting the wider fiscal framework enter the model in two ways: either as the share of transfer spending in general government spending, or as an interaction terms whereby each decentralisation indicator is replaced by the product of the decentralisation indicator times the share of transfer spending in general government spending. The latter specification gauges the possible negative effect of transfers on the supposed positive effect of decentralising other fiscal variables such as spending or tax revenue. The remaining control variables are taken from various OECD databases. Human capital is measured in terms of average years of schooling and is obtained from Bouis et al. (2011).

4. Results

4.1. Bivariate regressions

As a starting point, we first look at the bivariate relationship between per capita income and the various measures of fiscal decentralisation, and the possible channels through which fiscal decentralisation may affect per capita income: *i)* the TFP – fiscal decentralisation channel, *ii)* the investment – fiscal decentralisation channel, and *iii)* the human capital – fiscal decentralisation channel. The results suggest a positive relationship between decentralisation and economic activity and human capital, while the relationship between decentralisation and productivity is weaker. Decentralisation and investment appear to be unrelated (Table A1.1). The results are similar for the annual specification, which does not include the tax autonomy indicator. Results are similar for federal and unitary countries, except for TFP where some relationships are negative. Coefficients are higher for the revenue variables than for the expenditure variables. Human capital is particularly strongly correlated with all decentralisation variables, suggesting that decentralised fiscal policy making does not only affect economic activity through the technology channel but also more directly *via* a better human capital stock. Overall these results tend to suggest that decentralisation has a "broad band impact" and that one can pinpoint which sub-channels are important and which are not.

Table A1.1. Decentralisation and GDP, TFP, investment and human capital

Bivariate estimations, time fixed effects, unbalanced panel, selected years specification

	All countries				Federal countries				Unitary countries			
	Tax autonomy	Spending	Revenue	Tax revenue	Tax autonomy	Spending	Revenue	Tax revenue	Tax autonomy	Spending	Revenue	Tax revenue
GDP(-1)	0.01*	0.01*	0.01*	0.02*	0.01*	0.01*	0.01*	0.01*	0.02*	0.00*	0.01*	0.02*
TFP(-1)	0.004*	0.006**	0.004	0.004*	-0.003	-0.005*	-0.003	-0.002	0.008**	0.002	0.002	0.005
INV(-1)	-0.01	-0.03	-0.04	-0.02	0.04	0.01	-0.01	0.00	-0.05	-0.05	-0.08	-0.02
EDU(-1)	0.07*	0.05*	0.07*	0.08*	0.07*	0.09*	0.10*	0.10*	0.08*	0.03*	0.05*	0.06*
	r^2adj											
GDP(-1)	0.22	0.10	0.14	0.20	0.15	-0.03	0.34	0.31	0.22	0.02	0.04	0.13
TFP(-1)	0.02	0.05	0.01	0.02	0.01	0.04	0.01	0.00	0.04	-0.01	-0.01	0.00
INV(-1)	-0.01	0.01	0.01	-0.01	-0.05	-0.11	-0.11	-0.08	0.01	0.03	0.03	-0.02
EDU(-1)	0.18	0.16	0.25	0.25	0.15	0.14	0.62	0.45	0.15	0.05	0.06	0.12
No. of obs.	111	106	106	130	36	34	34	40	79	75	75	96

Note: The table shows the long run bi-variate correlations between decentralisation variables (columns) and lagged output variables (rows): GDP, TFP, investment and human capital. The coefficients provide estimates of elasticities or per cent changes. Short-run coefficients are not reported. ***, **, * indicate significance of the coefficients at the 1%, 5%, and 10% level, respectively. Adjusted R squared for each correlation are shown in the lower section of the table.

4.2. Annual specification

Results for the simple GDP specification using only the production function variables plus alternatively the decentralisation variables suggest a positive relationship between decentralisation and GDP. The relationship becomes stronger once additional controls are included (Table A1.2). In the extended version, all decentralisation variables are significant, with the coefficients for the revenue side being somewhat higher than those for the spending side. A 10% decentralisation increase is associated with a GDP per capita increase of around 0.3%. Results for the sub-categories of federal and unitary countries are less significant, suggesting that fiscal frameworks vary more within the two sub-categories than across them, although a smaller sample size might also affect significance. The control variables have mostly the expected sign but are often not significant: the size of the transfer system has a negative impact, government size has an insignificant impact, and the share of property and consumption taxes is, against expectations, negative. The production function variables (education and investment) are sometimes significant with the wrong sign. Adding population growth, inflation and openness produces better results

for the education and investment variables (both become positive and sometimes significant), but reduces the significance of the decentralisation variables. Using only data since 1995 raises the decentralisation coefficients somewhat, suggesting that fiscal federal frameworks have become more important for economic activity over time (not shown). Jackknifing countries – i.e. eliminating single countries one by one to test for their impact on the results – reveals small changes in the results, suggesting that the country panel yields robust results. Using a pooled instead of a time fixed effects specification changes the results only slightly, suggesting that decentralisation variables as a whole are trending little. Using country fixed effects dramatically increases r squared but in general reduces the significance of most coefficients and lowers their robustness, suggesting that the differences in fiscal federal arrangements across countries are to a large extent captured by the country fixed effects and that the results are driven by a few countries.

Table A1.2. Annual times series results: decentralisation and GDP

Panel A. Basic version, time fixed effects, unbalanced panel, all OECD countries

	All countries			Federal countries			Unitary countries		
	exp	rev	taxrev	exp	Rev	taxrev	exp	rev	taxrev
c	-12.487**	-12.324**	-10.652**	-228.213	-47.125	-2.697	-11.887**	-12.118**	-10.174**
lgcapp(-1)	1**	1**	1**	1	1	1	1**	1**	1**
inv(-1)	0.021	0.021	-0.016	4.599**	0.736**	-0.094	-0.016	-0.013	-0.037
edu(-1)	0.027	-0.004	-0.099**	6.613**	1.142*	0.465	0.028	0.009	-0.12*
decentral	0.003	0.01**	0.015**	-0.361	-0.05	0.102**	-0.008	0.006	0.01
r^2adj	*0.51*	*0.51*	*0.35*	*0.74*	*0.74*	*0.45*	*0.45*	*0.45*	*0.30*

Table A1.2. Annual times series results: decentralisation and GDP (*cont.*)

Panel B. Extended version, time fixed effects, unbalanced panel, all OECD countries

	All countries			Federal countries			Unitary countries		
	exp	rev	taxrev	exp	Rev	taxrev	exp	Rev	taxrev
c	-9.651*	-9.182	-9.443	-2.529	-6.328	-8.669	-11.292**	-11.403**	-11.437*
lgcapp(-1)	1**	1**	1**	1	1	1	1**	1**	1**
inv(-1)	0.002	0.003	0.018	-0.188**	-0.096	-0.042	-0.022	-0.015	-0.003
edu((-1)	-0.165*	-0.209**	-0.179*	-0.293	-0.13	-0.026	-0.069	-0.076	-0.064
govsize(-1)	-0.005	-0.01	-0.013	0.034	0.014	-0.001	-0.015	-0.017	-0.023
taxstruc(-1)	-0.039*	-0.039*	-0.041**	0.046	0.038	0.031	0.027	0.028	0.026
transfers(-1)	-0.044*	-0.01	-0.008	0.009	0.017	0.024	-0.066**	-0.029	-0.029
decentral	0.03**	0.032**	0.033**	0.01	-0.003	-0.01	0.027*	0.031**	0.033**
r^2adj	*0.52*	*0.53*	*0.54*	*0.74*	*0.74*	*0.73*	*0.49*	*0.49*	*0.50*

Note: The table shows the long-run coefficients between a set of decentralisation variables and GDP per capita. Variables are in logarithms, so that the coefficients provide estimates of elasticities. Short-run coefficients are not reported. ***, **, * indicate significance of the coefficients at the 1%, 5%, and 10% level, respectively.

Results for the simple TFP specification using only the production function variables plus alternatively the decentralisation variables suggest a positive relationship between decentralisation and TFP (Table A1.3), which becomes a little weaker once additional control variables are added. All three decentralisation variables have a positive and significant sign, with the coefficients for revenue decentralisation being again larger and more significant than spending decentralisation. Results for the two constitutional sub-groups – federal versus unitary – are however not significant, again owing probably to smaller sample size. Adding more controls changes the decentralisation coefficients little, with all three decentralisation variables remaining significant and again with revenue decentralisation having a stronger impact than spending decentralisation. However, an increase of the decentralisation ratio by 10% increases productivity by less than 0.1%. Jack-knifing countries changes results somewhat. Excluding Slovakia, Portugal and the United Kingdom increases the significance of the decentralisation variables in some cases. The influence of the size of the transfer system is, unexpectedly, positive, while the share of property taxes has an insignificant influence. Also government size has no significant impact. Again using a pooled mean group estimation instead of time fixed effects hardly changes the results, while the results of the country-fixed effects estimation suggest that intergovernmental fiscal frameworks are idiosyncratic and time-invariant.

Table A1.3. Annual times series results: decentralisation and TFP

Panel A. Basic version, time fixed effects, unbalanced panel, all OECD countries

	All countries			Federal countries			Unitary countries		
	exp	rev	taxrev	exp	rev	taxrev	exp	rev	taxrev
c	-10.55**	-10.512**	-10.622**	-12.809*	-13.098	-10.67**	-10.383**	-10.349**	-10.525**
logtfp(-1)	1**	1**	1**	1	1	1*	1**	1**	1**
inv(-1)	0.039**	0.04**	0.046**	0.173**	0.199**	0.062	0.034**	0.034**	0.043**
decentral	0.004**	0.004**	0.006**	-0.004	-0.012	-0.003	0.002	0.003	0.006**
r^2adj	*0.49*	*0.49*	*0.3351*	*0.60*	*0.60*	*0.35*	*0.48*	*0.48*	*0.33*

Table A1.3. Annual times series results: decentralisation and TFP (*cont.*)

Panel B. Extended version, time fixed effects, unbalanced panel, all OECD countries

	All countries			Federal countries			Unitary countries		
	exp	rev	taxrev	exp	rev	taxrev	exp	rev	taxrev
C	-10.486**	-10.543**	-10.573**	-11.466**	-11.648**	-11.486**	-10.499**	-10.592**	-10.552**
logtfp(-1)	1**	1**	1**	1**	1**	1**	1**	1**	1**
inv(-1)	0.033**	0.034**	0.036**	0.126**	0.126**	0.115**	0.027**	0.03**	0.031**
govsize(-1)	-0.001	-0.001	-0.002	-0.033**	-0.031*	-0.031*	-0.002	-0.003	-0.004
taxstruc(-1)	0.003	0.003	0.004	0.03	0.029	0.022	0.008	0.009	0.009
transfer	0.004	0.009*	0.008*	0.022	0.013	0.022	-0.002	0.005	0.005
auton	0.004*	0.005**	0.006**	-0.011	-0.008	-0.002	0.005	0.008	0.008*
r^2adj	*0.51*	*0.51*	*0.52*	*0.62*	*0.62*	*0.61*	*0.50*	*0.51*	*0.52*

Note: The table shows the long-run coefficients between a set of decentralisation variables and total factor productivity. Variables are in logarithms, so that the coefficients provide estimates of elasticities. Short-run coefficients are not reported. ***, **, * indicate significance of the coefficients at the 1%, 5%, and 10% level, respectively.

Finally, results for the channel running from decentralisation to business investment are shown in Table A1.4. Business investment – here proxied by total investment since business investment is available only for a subsample of countries and since the correlation between business and total investment is above 85% – has no clear relationship with intergovernmental fiscal frameworks. This holds true for both the simple specification with only the real interest rate as control variable as well as including the size of the transfer system. Also the control variables are mostly insignificant.

Table A1.4. Annual time series results: decentralisation and investment

Time fixed effects, unbalanced panel, all OECD countries

	All countries			Federal countries			Unitary countries		
	exp	rev	taxrev	exp	rev	taxrev	exp	rev	taxrev
C	1.666**	1.705**	1.722**	0.885	0.894	0.746	1.674*	1.744*	1.857**
inv(-1)	1**	1**	1**	1**	1**	1**	1**	1**	1**
Rir	-0.071	-0.071	-0.073	0.072	0.072	0.061	-0.114	-0.111	-0.105
transfer	0.019	0.021	0.021	0.017	0.015	0.021*	0.011	0.019	0.017
decentral	0.002	0.001	0	-0.001	-0.001	0.001	0.006	0.001	-0.001
r^2adj	*0.87*	*0.87*	*0.90*	*0.91*	*0.91*	*0.92*	*0.86*	*0.86*	*0.89*

Note: The table shows the long-run coefficients between a set of decentralisation variables and investment. Variables are in logarithms, so that the coefficients provide estimates of elasticities. Short-run coefficients are not reported. ***, **, * indicate significance of the coefficients at the 1%, 5%, and 10% level, respectively.

4.3. Selected years specification

The selected years specification with four variables – tax autonomy, revenue share, tax revenue share and spending share – delivers similar results, but the coefficients of the decentralisation indicators are less significant (Table A1.5). In the basic version the four decentralisation variables are positively related to GDP per capita, with revenue and tax revenue decentralisation having a slightly higher impact than spending decentralisation, but none of the coefficients is significant. Results do not vary much across country types, except for spending decentralisation having a negative influence in federal countries. In an alternative specification using the period 2005 and 2008 only in federal countries tax autonomy becomes significantly positive while the other variables remain insignificant, suggesting that the active use of tax autonomy has become a more important tool in local and regional economic policy during the last decade. Adding more controls changes the results little, with coefficients becoming even smaller and remaining insignificant. Eliminating alternatively single countries to test for their impact on the results does not change the results. Many control variables behave erratically; the human capital variable is sometimes significantly negative. The size of the transfer system has almost no influence on GDP. Estimating a pooled mean group instead of time fixed effects does hardly change the results, except that tax autonomy becomes (again) a significant growth determinant in federal countries in 2005 and 2008. Using country fixed effects dramatically increases r squared but in general lowers the coefficients, suggesting that the differences in fiscal federal arrangements across countries are to a large extent captured by the country fixed effects.

Table A1.5. Selected years results: decentralisation and GDP

Panel A. Basic version, time fixed effects, unbalanced panel, all OECD countries

	All countries				Federal countries				Unitary countries			
	auton	exp	rev	taxrev	auton	exp	rev	taxrev	auton	exp	Rev	taxrev
c	-9.64**	-9.934**	-9.808**	-9.979**	-9.218*	-11.652*	-12.64**	-9.248*	-9.778**	-9.764**	-9.763**	-10.225**
lgcapp(-1)	1**	1**	1**	1**	1	1	1	1	1**	1**	1**	1**
inv(-1)	-0.005	-0.003	-0.004	0	-0.001	0.069	0.068	0.015	-0.001	-0.01	-0.01	0.002
edu(-1)	-0.092**	-0.099**	-0.108**	-0.085**	-0.151	-0.06	0.064	-0.196*	-0.093**	-0.115*	-0.12*	-0.078
dpop(-1)	0.119	0.245**	0.242**	0.159*	-0.078	0.118	0.345	-0.16	0.16	0.334**	0.348**	0.234**
decentral	0.003	0.004	0.006	0.004	0.011	-0.005	-0.023	0.014	0.003	0.003	0.007	0.003
r^2adj	*0.66*	*0.66*	*0.66*	*0.66*	*0.71*	*0.75*	*0.76*	*0.74*	*0.65*	*0.65*	*0.65*	*0.65*

Panel B. Extended version, time fixed effects, unbalanced panel, all OECD countries

	All countries				Federal countries				Unitary countries			
	auton	exp	rev	taxrev	auton	exp	rev	taxrev	auton	exp	rev	taxrev
c	-9.598**	-9.898**	-9.889**	-10.077**	-13.435	-11.358	-11.832	-11.589	-9.713**	-10.359**	-10.403**	-10.742**
Lgcapp(-1)	1**	1**	1**	1**	1	1	1	1	1**	1**	1**	1**
inv(-1)	-0.007	0.002	0.002	0.005	0.224	0.066	0.073*	0.12	-0.012	-0.003	-0.002	0.001
edu(-1)	-0.096**	-0.103**	-0.107**	-0.088*	0.125	0.041	0.082	0.063	-0.096	-0.084	-0.082	-0.052
govsize(-1)	0.003	0.006	0.005	0.005	-0.07	-0.027	-0.027	-0.049	0.001	0.003	0.003	0.004
taxstruc(-1)	0.000	-0.002	-0.001	-0.001	-0.119	-0.01	-0.009	-0.058	0.009	0.014	0.014	0.014
transfers	0.009	-0.003	0.004	0.005	0.138	0.049	0.037	0.074	0.006	-0.01	-0.003	-0.001
decentral	0.003	0.006	0.006	0.005	-0.009	-0.012	-0.015	-0.011	0.002	0.005	0.005	0.001
r^2adj	*0.68*	*0.66*	*0.66*	*0.63*	*0.73*	*0.76*	*0.76*	*0.75*	*0.67*	*0.64*	*0.64*	*0.63*

Note: The table shows the long-run coefficients between a set of decentralisation variables and GDP per capita, using the selected years specification. Variables are in logarithms, so that the coefficients provide estimates of elasticities. Short-run coefficients are not reported. ***, **, * indicate significance of the coefficients at the 1%, 5%, and 10% level, respectively.

The TFP specification delivers hardly different results from the GDP specification (Table A1.6). In the basic variant with only investment as a control variable, most decentralisation variables remain insignificant, and those being significant are negative (revenue and tax revenue in federal countries). The investment variable is significantly positive. Adding more controls changes the results little, with the tax autonomy indicator showing consistently higher values than the other decentralisation variables, but the coefficients remain insignificant. Eliminating Ireland, Portugal and the United Kingdom makes the revenue variables (tax autonomy, tax revenue, revenue) significant, suggesting that these (partially) high-growth, highly-centralised countries "spoil" the empirical relationship in the full panel. Most controls have the expected sign but are mostly insignificant.

Table A1.6. Selected years results: decentralisation and TFP

Panel A. Basic version, time fixed effects, unbalanced panel, all OECD countries

	All countries				Federal countries				Unitary countries			
	auton	exp	rev	taxrev	auton	exp	rev	taxrev	auton	exp	Rev	taxrev
C	-9.878**	-10.048**	-10.004**	-9.935**	-9.557	-8.523	-7.587	-8.935	-9.964**	-10.188**	-10.152**	-9.995**
Logtfp(-1)	1**	1**	1**	1**	1	1	1	1	1**	1**	1**	1**
Inv(-1)	0.022	0.027*	0.026*	0.024**	0.05	0.07	0.058	0.049	0.027	0.032**	0.032*	0.027**
decentral	0.002	0.002	0.001	0	-0.012	-0.039	-0.069**	-0.038**	0.001	0.003	0.003	0.001
r^2adj	*0.32*	*0.29*	*0.29*	*0.33*	*0.31*	*0.35*	*0.47*	*0.44*	*0.38*	*0.33*	*0.33*	*0.38*

Panel B. Extended version, time fixed effects, unbalanced panel, all OECD countries

	All countries				Federal countries				Unitary countries			
	auton	exp	rev	taxrev	auton	exp	rev	taxrev	auton	Exp	rev	taxrev
C	-10.224**	-10.295**	-10.332**	-10.332*	-9.925	-8.805	-8.484	-8.933	-10.378**	-10.532**	-10.58**	-10.485**
Logdtfp(-1)	1**	1**	1**	1**	1	1	1	1	1**	1**	1**	1**
Inv(-1)	0.019	0.024	0.024	0.025	0.032	0.058	0.062	0.061	0.028*	0.031**	0.033**	0.032**
govsize(-1)	0.000	0.002	0.002	0.002	-0.023	-0.041	-0.045	-0.047	0	0.001	0	0
taxstruc(-1)	0.008	0.004	0.005	0.005	0.019	0.015	0.013	0.009	0.008	0.007	0.008	0.007
transfer	0.01	0.007	0.009	0.009	0.038	0.063**	0.041	0.053	0.009	-0.001	0.005	0.006
decentral	0.003	0.002	0.002	0.003	0	-0.027	-0.029	-0.019	0.001	0.005	0.006	0.004
r^2adj	*0.56*	*0.58*	*0.579195*	*0.59*	*0.35*	*0.44*	*0.45*	*0.42*	*0.62*	*0.64*	*0.64*	*0.65*

Note: The table shows the long-run coefficients between a set of decentralisation variables and total factor productivity, using the selected years specification. Variables are in logarithms, so that the coefficients provide estimates of elasticities. Short-run coefficients are not reported. ***, **, * indicate significance of the coefficients at the 1%, 5%, and 10% level, respectively.

Finally, testing for the relationship between decentralisation and the investment rate delivers few significant results, both for the basic and the extended version (Table A1.7). In the basic version, none of the coefficients are significant, and half of them are negative. In the extend version, most coefficients become positive, with tax autonomy having a larger (positive) impact than the other variables, but all coefficients remain insignificant. Jackknifing changes the results little, except that excluding Norway from the sample makes the tax revenue indicator significant. The real interest rate has the expected negative sign, while the impact of the size of the transfer system oscillates between positive and negative, with only some of the positive impacts being significant. Reducing the estimation period to 2005 and 2008 makes most decentralisation indicators significantly positive (not shown). The fact that tax autonomy has the highest indicator value of all decentralisation variables, especially in the federal country sample, suggests again that tax autonomy has become an important policy device for SCGs in promoting investment and economic activity. Estimating investment in growth terms rather than in relation to GDP increases the significance of the revenue side indicators, especially in the federal country panel (not shown).

Table A1.7. Selected years results: decentralisation and investment

Time fixed effects, unbalanced panel, all OECD countries

	All countries				Federal countries				Unitary countries			
	auton	exp	rev	taxrev	auton	exp	rev	taxrev	auton	exp	rev	taxrev
c	6.126**	7.59**	8.114**	7.545**	8.56*	6.652	8.68	8.314	6.599**	7.646**	7.891**	7.928**
inv(-1)	1**	1**	1**	1**	1**	1**	1**	1**	1**	1**	1**	1**
rir	-0.226	-0.454	-0.449	-0.312	-1.679*	-1.504*	-1.682*	-1.643*	-0.143	-0.384	-0.362	-0.253
transfer	-0.038	-0.016	0	-0.007	0.177**	0.163**	0.174**	0.176**	-0.06	-0.075	-0.02	-0.025
decentral	0.018	0.012	-0.004	0	-0.001	0.022	-0.002	0.002	0.016	0.041	0.027	0.012
r^2adj	*0.46*	*0.51*	*0.51*	*0.48*	*0.72*	*0.66*	*0.66*	*0.68*	*0.45*	*0.51*	*0.51*	*0.47*

Note: The table shows the long run-coefficients between a set of decentralisation variables and the investment rate (investment to GDP), using the selected years specification. Variables are in logarithms, so that the coefficients provide estimates of elasticities. Short-run coefficients are not reported. ***, **, * indicate significance of the coefficients at the 1%, 5%, and 10% level, respectively.

4.4. Non-linearities

The non-linear estimation results obtained for the multi-year dataset suggest the presence of some non-linear effects of fiscal decentralisation on the level of per capita income: the positive influence of fiscal decentralisation on per capita income declines with a higher degree of fiscal decentralisation (Table A1.8). Nevertheless, the results are somewhat sensitive to the use of alternative measures of fiscal decentralisation. The tax autonomy indicator, the most pertinent indicator of fiscal decentralisation, is found to have no significant impact on the level of per capita income at very low levels of fiscal autonomy. But the effect becomes strongly positive for mid-range values of decentralisation and declines for a high level of decentralisation. A somewhat different pattern is found using tax decentralisation: the effect is strongly positive, when decentralisation is weak, there is no relationship as the degree of decentralisation increases and finally there is a small positive impact for a high degree of decentralisation. Results obtained on the basis of expenditure and revenue decentralisation are less robust. For the former, a two–regime model is selected with the coefficients being statistically insignificant. For the latter, the three-regime model suggests no robust relationship between decentralisation and per capita income when decentralisation is low and the link becomes positive for the upper regime. Tax revenue indicators tend to provide more reliable results than the other decentralisation indicators. Overall, the impact appears to decrease with a rising degree of decentralisation, which suggests decreasing returns to decentralisation.

Table A1.8. The non-linear effect of fiscal decentralisation on the level of per capita income

Multi-year averages, 1995-2010

Dependent variable: GDP per capita Non-linear explanatory variable: fiscal decentralisation Threshold variable: fiscal decentralisation								
	Tax autonomy		Spending ratio		Revenue ratio		Tax revenue ratio	
Test of non-linearity	P-value		P-value		P-value		P-value	
Linear vs. 2 regime	**0.000**		**0.002**		**0.024**		**0.000**	
2 vs. 3regimes	**0.000**		0.174		**0.018**		**0.072**	
	Coefficient	Threshold	Coefficient	Threshold	Coefficient	Threshold	Coefficient	Threshold
Linear model								
DEC	0.015**		0.007**		0.009**		0.013**	
2-regime model								
Low DEC	0.059**	T: 13.13	-0.010	T: 27.40	-0.004	18.64	0.077**	6.37
High DEC	0.019**		0.002		0.006		0.018**	
3regime								
3-regime model								
Low DEC	-0.048	T1: 3.51	-0.007	T1: 27.40	0.009	T1: 10.53	0.059**	T1: 6.33
Middle DEC	0.047**	T2: 13.13	0.005	T2: 38.69	0.000	T2: 18.46	0.002	T2: 13.70
High DEC	0.015**		0.003		0.008**		0.016**	
No. of observations	111		106		106		130	
No. of countries	33		33		33		33	

Note: * and ** denote statistical significance at the 10% and 5% levels, respectively. . The p-values show the bootstrapped p-value for the test of non-linearity. P-values lower than 0.1 (in bold) imply that the null hypothesis of the linear model (the null hypothesis of the two-regime model) can be rejected against the alternative of the two-regime model (alternative of the three-regime model) at the 10% level.

Table A1.9. Literature review

Cross-country studies					
Study	**Country coverage**	**Time period**	**Fiscal decentralisation indicator**	**Results**[1]	
Asatryan (2011) "Fiscal decentralization and economic growth in OECD countries: A Bayesian model averaging approach".	23 OECD countries	1975-2001	Revenue share and tax discretion ratio.	**(-)**	Negative impact of fiscal decentralisation on per capita GDP growth rate. Results using the revenue-share indicator are less conclusive. Cross-country data show a significant positive correlation, whereas on panel data the effect is negative, but of limited significance.
Baskaran, Feld (2009) "Fiscal decentralization and economic growth in OECD countries: Is there a relationship?".	23 OECD countries	1975-2001	Tax discretion indicators.[2]	**No relation-ship**	No relationship found between fiscal decentralisation and growth. Initial results show negative relationship, but these results are not robust to alternative specifications of the model.
Rodriguez-Pose and Kroijer (2009) "Fiscal decentralization and economic growth in Central and Eastern Europe".	16 Central and Eastern European countries	1990-2004	Expenditure share, share of own revenue in total sub-central revenues, grant ratio.	**(-)**	Fiscal decentralisation has negative impact on growth. Although over time the effect varies according to the type of decentralisation considered. The effect of expenditure decentralisation and transfers remain negative, but revenue decentralisation goes from having a significant negative to a significant positive effect on the national growth rate.
Thornton (2007) "Fiscal decentralization and economic growth reconsidered".	19 OECD countries	1980-2000	Indicator of tax discretion (depends on size of own revenues, and discretionary power for setting taxes).	**No effect**	No significant relationship between fiscal decentralisation and growth.
Bodman, Ford (2006) "Fiscal decentralization and economic growth in the OECD".	21 high-income OECD countries	Around 2000	Expenditure and revenue shares. Own revenue and non-tax revenue shares. Quadratic indicator.	**No effect/ (Non-linear)**	Little/no evidence of direct link between fiscal decentralisation and growth. However, when looking for an indirect link, some evidence is found that a medium level of fiscal decentralisation is best for human capital accumulation, whereas the results for the effect of decentralisation on TFP depend largely on the sample.
Martinez-Vasquez, McNab (2005) "Fiscal decentralization, macrostability and growth".	52 developing and developed countries	1972-97	Expenditure share, revenue share.	**No effect/+**	No direct link between fiscal decentralisation and growth. Indirect link through the positive impact of revenue decentralisation on macroeconomic stability (1% increase in revenue decentralisation decreases the growth in CPI by 0.3%).
Vo (2005) "Fiscal decentralization in Vietnam: A preliminary investigation".	17 OECD and 5 ASEAN countries	1990-2001	Geometric mean of expenditure share and own revenue share adjusted for autonomy on spending decisions, possibility to set tax rates and bases, access to credit markets, and size of intergovernmental transfers.	**+**	Positive relationship between fiscal decentralisation and growth (solely based on observations, no regression analysis was done).
Eller (2004) "The determinants of fiscal decentralization and its impact on economic growth: Empirical evidence from a panel of OECD countries".	22 OECD countries	1972-96	Expenditure share net of intergovernmental transfers, revenue-share.	**(Non-linear)**	Converging to a medium degree of expenditure decentralisation yields the best outcome for growth. Revenue decentralisation has no significant effect on growth.
Ghafar, Ismail, Hamzah, Ritonga (2004) "Fiscal decentralization and economic growth: Evidence from selected Muslim countries".	Indonesia, Kazakhstan, Kyrgyzstan, Malaysia	1976-2000 (Ind.), 1996-2000 (Kaz.), 1996-2000 (Kyr.), 1973-2000 (Mal.)	Revenue share, expenditure share, average of the two.	**-**	Fiscal decentralisation is detrimental for growth.

Cross-country studies (*cont.*)					
Study	**Country coverage**	**Time period**	**Fiscal decentralisation indicator**	**Results**[1]	
Iimi (2004) "Decentralization and economic growth revisited: An empirical note".	51 countries (7 low income, 10 lower-middle income, 12 upper-middle income, and 22 high income)	1997-2001	Expenditure share.	**+**	Fiscal decentralisation is growth-enhancing. Estimated coefficient=0.067 (with OLS) and 0.037 (with IV).
Enikolopov, Zhuravskaya (2003) "Decentralization and political institutions".	21 developed and 70 developing and transition countries	1975-2000	Revenue share. Robustness check with expenditure share.	**No direct relation-ship**	No direct significant effect. Negative effect when interacted with variables representing features of the political system. In particular, the strength of the national party system (age of main parties, and fragmentation of government parties), and subordination (whether local and state executives are appointed or elected) matter.
Thiessen (2003) "Fiscal decentralization and economic growth in high income OECD countries".	High income OECD excl. Luxemburg	1973-98	Expenditure share, revenue share, un-weighted average of the two, quadratic indicator.	**Non-linear**	Hump-shaped, non-linear relationship between fiscal decentralisation and growth. "Medium" level of fiscal decentralisation appears to be best.
Wescott, Porter (2003) "Fiscal decentralization and citizen participation in East Asia".	Thailand, Cambodia, the Philippines, Indonesia and China	From 1980s	-	**No relation-ship**	Fiscal decentralisation does not matter much for the growth performance of the region. The results are however not based on a formal econometric framework.
Ebel, Yilmaz (2002) "On the measurement and impact of fiscal decentralization".	19 OECD countries	1997-99	Own revenue share, own non-tax revenue share, fiscal dependency and tax sharing ratios.	**?**	Revenue autonomy is positive for growth. Fiscal dependency has a positive, but insignificant impact. Tax sharing has a negative impact on growth. Substantial differences in results based on the more traditional expenditure share and revenue share indicators.
Yilmaz (2000) "The Impact of Fiscal decentralization on macroeconomic performance".	17 unitary states and 23 federal states, both developed and developing countries	1970-90	Expenditure share.	**(+)**	Decentralisation of expenditure at the local level increases GDP growth in unitary states, while the results for federal states are less clear-cut.
Davoodi, Zou (1998) "Fiscal decentralization and economic growth: A cross-country study".	46 countries	1970-89	Expenditure share less grants.	**(-)**	Fiscal decentralisation has negative effect on growth in whole sample and in developing countries; 10% increase in fiscal decentralisation reduces growth rate by 0.7-0.8 percentage points. No significant impact in developed countries.
Woller and Phillips (1998) "Fiscal decentralization and LDC economic growth: An empirical investigation".	23 developing countries	1974-91	Revenue share, own revenue share, expenditure share, and expenditure share of total government expenditure less defense and social security.	**No effect**	No significant effect of fiscal decentralisation (neither spending nor revenue side) on economic growth.

National studies					
Study	**Country coverage**	**Time period**	**Fiscal decentralisation indicator**	**Results[1]**	
Hammond, Tosun (2009) "The impact of local decentralization on economic growth: Evidence from US counties".	United States	1970-2000	Several measures of local government as well as measures of local government fragmentation on a per capita and per square mile basis. Ratio of county revenue to total local and county revenue.	**(+)**	Local government organisation matters for local economic growth but impact varies following the government unit considered and also differs for metropolitan vs. non-metropolitan areas. Revenue decentralisation is positive for income growth in metropolitan areas (10% increase in centralisation decreases growth by 0.28%), but has no effect overall.
Carrion-i-Silvestre et al. (2008) "Fiscal decentralization and economic growth in Spain"	Spain	1980-98	Revenue share and expenditure share net o intergovernmental transfers.	**+**	Fiscal decentralisation has a positive effect both on regional and national economic growth. The effect of the expenditure side is stronger than the revenue side.
Qiao et al. (2008) "The trade-off between growth and equity in decentralization policy: China's experience".	China	1985-98	Expenditure share. Quadratic indicator.	**+**	Fiscal decentralisation has enhanced growth, but the relationship between the two variables is non-linear.
Ákai, Nishimura, Sakata (2007) "Complementarity, fiscal decentralization and economic growth".	United States	1992-97	Expenditure share, own revenue share, quadratic indicator.	**Non-linear**	Non linear, humped-shaped relationship between fiscal federalism and growth. The optimal degree of fiscal decentralisation is higher than what is observed for the revenue-share, hence the US would gain in terms of growth from more fiscal decentralisation on the revenue side.
Hammond, Tosun (2006) "Local decentralization and economic growth: Evidence from US metropolitan and non-metropolitan regions".	United States	1970-2000	Number of counties, municipalities, and township governments relative to the region's population.	**?**	Relatively weak or negative relationship in non-metropolitan areas as opposed to positive impact in metropolitan areas.
Solle-Olle, Esteller-More (2006) "Decentralized provision of public inputs, government responsiveness to local needs, and regional growth. Evidence from Spain".	Spain	1977-98	Dummy variable for legal responsibility of service production.	**+**	Fiscal decentralisation is positive for road and educational investment and capital stock, and should therefore be beneficial to growth.
Cantarero, Perez Gonzales (2009) "Fiscal decentralization and economic growth: Evidence from Spanish regions".	Spain	1985-2004	Revenue and expenditure share.	**(+)**	No relationship between expenditure decentralisation and growth. Positive relationship between revenue decentralisation and growth. 10% increase in revenue decentralisation adds 0.5% to GDP per capita growth. No evidence of non-linearities.
Huang, Cheng (2005) "The role of fiscal decentralization in regional economic growth in China".	China	1996-2004	Sub-national retained revenue-share and ratio between retained revenue and total sub-central revenue, quadratic indicator.	**-**	The direct effect of fiscal decentralisation on growth has been negative. But squared terms suggest non-linear, U-shaped relationship. In highly centralised countries, fiscal decentralisation decreases growth; however this effect becomes smaller with higher decentralisation; and above a certain threshold additional decentralisation is beneficial for regional growth.
Malik, Hassan, Hussain (2006) "Fiscal decentralization and economic growth in Pakistan".	Pakistan	1971-2005	Expenditure share, expenditure share less defence and interest payments, revenue share, own revenue share.	**+**	Both the expenditure share and the own revenues share have a positive and significant effect on growth (estimated coefficients are 0.54 and 0.62 respectively. When grants are included in SCG revenues the effect of revenue decentralisation is however found to be negative (-0.17) but insignificant.
Jin, Zou (2005) "Fiscal decentralization and economic growth in China".	China	1979-93 and 1994-99	Expenditure share, extra budgetary expenditure share, revenue share, non tax revenue share.	**(-)**	From 1979-93: Expenditure decentralisation is negative for growth (-2.98), revenue decentralisation is positive for growth (0.54). From 1994-99: Expenditure decentralisation has no effect on growth, revenue decentralisation has negative effect on growth (-0.51).

National studies					
Study	**Country coverage**	**Time period**	**Fiscal decentralisation indicators**	**Results**[1]	
Feld et al. (2004) "Fiscal federalism and economic performance: evidence from Swiss Cantons".	Switzerland	1980-98	Revenue share and expenditure share, as well as grant share. Tax competition (difference between the tax rate in a canton and the average tax rate in neighbouring cantons), fragmentation (number of communes/ population), and urbanisation (share of people living in urban areas).	**(+)**	Spending and revenue decentralisation have no effect on growth. Matching grants are negatively correlated with economic performance. Tax competition is positive for GDP per capita. Fragmentation has a marginal negative impact, whereas urbanisation has none.
Desai et al. (2003) "Fiscal federalism and regional growth: Evidence from the Russian Federation in the 1990s".	Russia	1996-99	Share of locally generated revenues kept by a region.	**+**	Positive impact on cumulative output recovery of Russian regions. The positive impact is smaller with higher "rents": revenues from natural resource production and grants from the central government.
Akai, Sakata (2002) "Fiscal decentralization contributes to economic growth: Evidence from state-level cross-section data for the United States".	United States	1992-96	Revenue share, expenditure share, mean of the two, own revenue share.	**+**	Decentralisation has a positive impact on state gross product. Increase in expenditure decentralisation by 10% increases growth by 1.6-3.2 percentage points.
Akai, Nishimura, Sakata (2002) "Fiscal decentralization, economic growth and economic volatility. Theory and evidence from state-level cross-section data for the United States".	United States	1992-97	Expenditure share, own revenue share.	**+**	Fiscal decentralisation has positive effect on economic growth; and negative effect on economic volatility.
Behnisch, Buttner, Stegarescu (2002) "Public sector centralization and productivity growth: Reviewing the German experience".	Germany	1950-90	Expenditure share.	**+**	Increased centralisation has been positive for Germany's productivity growth (though not in the case of education and science sectors nor transport and communication).
Qiao, Martinez, Vazquez, Y. Xu (2002) "Growth and equity trade-off in decentralization policy: China's experience".	China	1985-98	Expenditure share, quadratic indicator.	**Non-linear**	Fiscal decentralisation leads to growth, but the relationship appears to be non-linear.
Lin, Liu (2000) "Fiscal decentralization and economic growth in China".	China	1970-93	Marginal retention rate.	**+**	Fiscal decentralisation is positive for economic growth. Raising the fiscal decentralisation indicator from 0% to 100% increases GDP growth rate by 3.62 percentage points.
Xie, Zou, Davoodi (1998) "Fiscal decentralization and economic growth in the United States".	United States	1948-94	Expenditure share for each level of government.	**?**	The existing level of fiscal federalism has been consistent with growth maximisation. Changing the current level could therefore be harmful for growth.
Zhang, Zou (1998) "Fiscal decentralization, public spending, and economic growth in China".	China	1980-92	Expenditure share, calculated both in total, per capita and relative to income.	**-**	Fiscal decentralisation is detrimental to growth. Coefficient estimate=-0.054.
Feld, Schnellenbach (2009) "Fiscal federalism, decentralization and economic growth: A meta-analysis".	Both cross-country and within-country			**No effect**	

1. Parentheses indicate that the estimated effect is either very uncertain, or varies with the indicator chosen or other parameters of the study.
2. Share of sub-federal tax revenues for which local governments can decide either rates, bases or both in total government tax revenue and share of revenue from shared taxes for which local governments may co-determine revenue distribution and/or other allocation details in total government tax revenue.

ANNEX A2. DECENTRALISATION, PUBLIC INVESTMENT AND EDUCATIONAL PERFORMANCE

1. Introduction

This annex contains the empirical work that assesses the impact of fiscal decentralisation on the share of public investment spending as well as on educational performance. It complements and corroborates the findings on the relationship between decentralisation and growth (see Annex A1). Since attempts to establish a link between fiscal decentralisation and economic growth deliver sometimes mixed results or are questioned on methodological grounds this annex focuses on the underlying channels through which decentralisation might affect activity. Testing the channels between fiscal decentralisation and outcomes that are more directly linked to underlying fiscal frameworks are likely to deliver more robust results. In this annex, the link between decentralisation and public investment, and the link between decentralisation and educational performance, are tested.

The annex is organised as follows: Section 2 summarises the results of previous studies examining the effects of decentralisation on the composition of public spending and educational performance. Section 3 lays out the model, data and estimation method used for the empirical work. To our knowledge, this is the first thorough cross-country analysis linking fiscal and regulatory autonomy of sub-central governments (SCGs) to educational performance at the national level. Sections 4 and 5 present the results.

2. Previous research

2.1. Public investment

There are different ways of conceptualising the link between fiscal decentralisation and the share of public investment. Keen and Marchand (1997) put forward the role of fiscal competition. At the heart of their model lies the assumption that local governments adjust the composition of their spending in order to attract capital. Fiscal decentralisation would therefore lead to more spending, and could even lead to over-investment in public infrastructure (roads, sewers, etc.) and an under-investment in other public goods and services such as recreational facilities and social services. Under the efficiency hypothesis which claims that local governments produce goods and services more in line with individual preferences, the impact of fiscal decentralisation is *a priori* undetermined. It might be different across time and countries depending on whether the local population wants more or less public investment than is provided. The link between fiscal decentralisation and the share of public capital investment can also be influenced by budgetary procedures or the tax structure. If SCGs receive large capital grants or face a weak budget constraint on their capital expenditure, then fiscal decentralisation is more likely to favour public investment. SCGs relying on personal income taxes are likely to spend on residential rather than corporate services.

The findings by Bénassy-Quéré, et al. (2007) and Kappeler and Välilä (2007) suggest that fiscal decentralisation boosts capital spending. The former finds a shift in spending away from social expenditure towards production inputs and the latter finds that decentralisation increases economically productive investment and reduces spending on redistribution. Two separate studies conclude that decentralisation boosts spending on education. Busenmeyer (2008) finds that fiscal decentralisation affects education

spending positively and public pension spending negatively, while Arze del Granado et al. (2005) find that both spending on education and health is higher at the expense of spending on pure public goods. On the other hand, Rodriguez-Pose et al. (2009), Gonzalez Alegre (2010) as well as Grisorio and Prota (2011) all find that decentralisation increases current at the expense of capital expenditure. Faguet (2004) finds that fiscal decentralisation increases investment in more socially-oriented sectors and particularly in social services and urban development. Moreover, he notes that these changes are correlated with objective indicators of need.

It is not surprising that the existing empirical literature on the impact of fiscal decentralisation on the share of public investment spending is inconclusive, given the theoretical ambiguities. The lessons that can be drawn from previous research are also limited, because there are only a few studies available. While much work has been done to evaluate the effect of fiscal decentralisation on the *level* of public spending, fewer tackle the implications for its *composition*. A last drawback is that existing studies often do not consider the same spending categories.

2.2. Education performance

Proponents of decentralisation argue that lower-level governments are better informed of the local population's preferences and demands for schooling and can therefore better tailor the supply of educational services. Moreover, inter-jurisdictional competition and benchmarking might put schools under some pressure to adapt to local demands and to improve the quality of teaching. The smaller distance between those who decide on education policies and those who benefit from them is also thought to increase accountability giving lower-level governments stronger incentives to be efficient producers. Several local providers as opposed to a central one allow pupils and parents to compare school performance and demand changes if the quality of their school is deemed insufficient. On the other hand, sceptics would fear a possible loss in economies of scale from decentralisation leading to worse performance for a given input. It has also been argued that the risk of capture is greater under a decentralised scheme, and resourceful parents can lobby for policies that are beneficial for their children yet undermine average performance. It is also not clear that parents always have the necessary information to make use of broader school choice, nor that they always give priority to the quality of schools when choosing them, which undermines the competition effect from decentralisation (OECD, 2010). Lastly, decentralisation can cause harmful segregation between schools.[15]

Most empirical studies find a positive effect of fiscal decentralisation on educational performance. Using a panel of data on Swiss cantons (states) Barankay and Lockwood (2006) find that decentralisation in the education sector has had a positive impact on student performance. A 10% point increase in education decentralisation increases the fraction of 19-year-olds that obtain the *Maturité* (certificate necessary to access university) by 3.5% points. Freinkman and Plekhanov (2009) conclude that fiscal decentralisation has a positive effect on student performance but no impact on what is generally thought to be key inputs in the education production function.[16] Decentralisation thus increases productivity and this illustrates the shortcomings of only looking at effects of inputs such as teacher salaries or class size. Habibi et al. (2003) look at decentralisation and human capital development in Argentina and conclude that fiscal decentralisation has a positive effect on educational output. Sutherland and Price (2007) find that giving greater decision making autonomy to schools increases efficiency.

Previous findings also point to various factors that influence the relationship between decentralisation and performance. Barankay and Lockwood (2006) find evidence that decentralisation is more beneficial

15. Using the PISA survey, OECD (2010) finds that more school competition leads to a stronger relationship between a school's average socio-economic background and average performance.

16. Availability of computers and pre-schooling, for instance.

when central governments are less competent where competence is measured by the capacity to run budgetary surpluses. Using school data instead of country data the results in Sutherland and Price (2007) suggest that the final impact depends on which powers are decentralised. OECD (2010) finds that while granting schools autonomy over curricula and student assessments increases performance, this is not the case for greater responsibility in managing financial resources.[17] Also, the positive effect of school autonomy appears to depend on the existence of accountability mechanisms requiring schools to publish results. Burki et al. (1999) summarise a number of studies that evaluate the effect of education decentralisation policies in Latin-America and the United States. Generally, decentralisation is found to decrease teacher absenteeism, increase attendance and reduce age-grade gaps, yet is not found to have had a consistent impact on student performance. The authors conclude that: "Taken together evaluations provide strong evidence that decentralisation can improve learning […] those cases demonstrating the largest positive gains have emphasised school autonomy with pedagogical reform". Akai et al. (2007) differentiate between the effects of decentralisation on performance in primary and secondary education and find positive effects for secondary education while the effects for primary education are mixed.

3. The model and the data

3.1. Public investment

The analysis will focus on the spending *composition* rather than spending *levels* since the latter is partially a question of societal choice. Both investment and consumption spending increase overall output (at least in the short run) and thereby contribute to economic activity. However, investment, both in physical and human capital, also increases GDP growth through a supply effect. More and better capital and labour input increases the productive capacity of the economy and successful R&D investment results in higher total factor productivity. For a given level of public expenditure, most studies find that shifting public spending away from current towards investment spending is beneficial for growth (e.g. Aschauer 1989), although recent OECD research provides mixed results (Égert et al., 2009).

The empirical work is based on a model inspired by among others Busenmeyer (2008)[18] where a particular type of spending is expressed as a function of a matrix of control variables and the institutional variable of interest:

$$Y_{i,t} = \alpha_i + \beta dec_{i,t} + \delta X_{i,t} + \varepsilon_{i,t}$$

The dependent variable is the share of public physical and human capital investment spending in total public spending and the data are from the OECD National Accounts Database. The yearly observations are five-year moving averages in order to purge the data of cyclical effects. The control matrix consists of government size, calculated as total government tax revenue in relation to GDP from the OECD Revenue Statistics, and population (in 1 000s) from the same database. Both controls are expected to have a negative impact on the share of investment spending. As an economy develops and the public sector grows, governments have tended to spend a higher fraction on social spending. Also, the size of the population will have a negative impact on the ratio of capital to current spending if economies of scale are larger for investment spending.

17. Selecting teachers for hire, establishing salaries, setting the school budget and deciding on budget allocations within the school.

18. However, contrary to his study, the lagged dependent variable is not included in our specification. This choice was made since institutional variables change slowly and therefore including their past values would absorb much of the variation in the data.

Finding appropriate measures for fiscal decentralisation is challenging. For this reason several indicators are used. Previous studies on decentralisation frequently use SCG shares of total government expenditure and/or revenues. While these indicators have the advantage of longer cross-country time series availability, they only measure the funds that transit through local budgets which need not necessarily reflect the actual decision power of SCGs. This is why the three indicators of SCG share in total government expenditure, total revenue and tax revenue are here supplemented with the more recently developed OECD indicator on SCG tax autonomy. All indicators are taken from the OECD Fiscal Decentralisation Database. To avoid multi-collinearity, they are entered *sequentially* into four separate regressions. The final equations to be estimated are:

$$INV_{i,t} = \alpha_i + \beta GVTSIZE_{i,t} + \delta POP_{i,t} + \gamma EXPSHARE_{i,t} + \varepsilon_{i,t} \quad (1)$$

$$INV_{i,t} = \alpha_i + \beta GVTSIZE_{i,t} + \delta POP_{i,t} + \gamma REVSHARE_{i,t} + \varepsilon_{i,t} \quad (2)$$

$$INV_{i,t} = \alpha_i + \beta GVTSIZE_{i,t} + \delta POP_{i,t} + \gamma TAXREVSHARE_{i,t} + \varepsilon_{i,t} \quad (3)$$

$$INV_{i,t} = \alpha_i + \beta GVTSIZE_{i,t} + \delta POP_{i,t} + \gamma TAXAUT_{i,t} + \varepsilon_{i,t} \quad (4)$$

An agnostic view is taken to the estimation technique and the pooled OLS estimator as well as the fixed effects estimator is used. Both country and time fixed effects are included, separately and simultaneously. Also, estimations are made on unbalanced panel datasets as well as time-averaged cross-sectional datasets. The estimation period is from 1970 to 2010 which in reality means 1972 to 2008 for all other variables than the dependent variable because of time averaging. However, for most countries data on public investment only start around 1995. The tax autonomy variable is only available for the years 1995, 2002, 2005 and 2008; the time dimension for the estimations involving this variable is therefore reduced to only four observations for all variables. In addition to the baseline regressions, a number of extensions shed further light on the underlying relationship:

- Estimations were made for sub-samples of unitary and federal countries to ascertain differences in the effects of decentralisation between the two groups of countries.
- The jack-knife method is used to make sure that the results are robust to country outliers.
- In separate regressions, human capital spending and physical capital were separated. While much of human capital spending can be seen as an investment since effects of better schooling are likely to prevail throughout most of an individual's working life, the norm in the national accounts is to classify education spending as current expenditure.

3.2. Education performance

Better education performance improves the quality of the stock of human capital, which in turn affects economic output. Comparable cross-country data on education performance is available through the Education at a Glance dataset. This dataset includes data on inputs, access to and participation in education as well as on the organisation of the school sector. It is constructed from the PISA surveys that were conducted in 2000, 2003, 2006 and 2009 and answered by school children at age 15 and school administrations in all OECD countries.

Empirical work on education performance typically starts from an education production function where student achievement is modelled as a function of student characteristics, school resources and institutional variables. The average national PISA score is here taken as a measure of student

achievement.[19] Student characteristics (IND) are measured by the Economic, Social and Cultural Status (ESCS) indicator which is normalised and ranges between -1 and 1. The literature consistently finds that academic results are positively and strongly correlated with a student's socio-economic background, and it is therefore expected that the estimated coefficient for this variable will be large and highly significant. Also, the ESCS indicator is highly correlated with GDP per capita. School resources (SCH) are captured by spending per student in secondary schooling in per cent of GDP.[20] The literature is less conclusive on the effect of spending on student performance. These data are taken from the OECD Education at a Glance dataset.

Several indicators are used to measure decentralisation (DEC): The institutional indicator of education decentralisation taken from the OECD Education at a Glance dataset shows the percentage of decisions related to the production of educational services taken at the non-central government level. Another indicator for education decentralisation is obtained the from the Classification of Functions of Government (COFOG) database. Finally, the four traditional indicators measuring fiscal decentralisation (SCG spending share; SCG revenue share; SCG tax revenue share and the indicator for SCG tax autonomy) are taken from the OECD Fiscal Network database. The final equation to be estimated is:

$$PISA_{i,t} = \alpha_i + \beta IND_{i,t} + \delta SCH_{i,t} + \gamma DEC_{i,t} + \varepsilon_{i,t} \quad (5)$$

The econometric approach is analogous to the case of public investment. Both the pooled OLS estimator as well as the fixed effects estimator is used and for the latter both with country and time fixed effects used separately and simultaneously. Estimations are done both on unbalanced and balanced panel[21] data as well as with cross-section data. However, using a balanced panel and particularly a cross-section time average imply a loss in the number of observations which is already quite small for some of the education estimations. While PISA surveys cover all OECD countries in the cross-country dimension, the time dimension is rather small with observations available only for four years. For most variables these years are 2000, 2003, 2006 and 2009. Unfortunately, neither the institutional indicator of education decentralisation nor the OECD tax autonomy indicator is available for exactly the same years. However, it is deemed justifiable not to make any corrections for this since the observations are not too far apart. Also, educational performance at the age of 15 is determined by educational inputs during the previous years of schooling and institutional variables typically do not vary much over time.[22]

The following extensions of the basic approach are made:

- Similar to the regressions on public spending composition, estimations are made for federal and unitary countries separately.

19. Average score = 1/3 score in mathematics + 1/3 score in sciences + 1/3 score in reading.

20. The ideal would be to have cumulative spending data for each student over a school career, but such data are not available. Secondary school spending is therefore considered a second-best option. Some studies add primary and secondary school expenditure but this is also a second-best option since current spending in primary schools can be very different from spending when the pupils answering the PISA questionnaires went to (pre) primary school.

21. Countries with less than three observations in the time dimension for any one of the variables were excluded.

22. The first observation for the tax autonomy indicator is a special case as it is for 1995, which is some time earlier than that of the other variables, and the largest changes in the indicator happened between 1995 and 2002. To address this, a linear approximation between the two first observations for this variable is assumed meaning that the value in 2000 equals the value in 1995 to which is added 1/7th of the change between 1995 and 2002.

- The jack-knife method is again used to make sure that the results are robust to country outliers.

- The effects of decentralisation are differentiated according to whether decision-making power is given to the SCG administration or directly to the school. This allows evaluating potential differences in the effect of school autonomy versus decentralisation to lower levels of government. The latter is the sum of powers of all levels of government but the central government. Because this variable turns out not to be strongly correlated with school autonomy, both variables can enter simultaneously into the same regression.

- The effects of decentralisation are also estimated for different education functions. The Education at a Glance data distinguish between four types of functions: Organisation of instruction (instruction time, choice of textbooks, curriculum content and teaching methods), personnel management (hiring and firing of school director and teachers, teacher pay and responsibilities for and provision of in-service training), planning and structures (creating/closing down schools, school programme selection, defining course content and monitoring school performance) and financial resources (allocation of personnel and non-personnel budget, development of school improvement plans). Countries may rank differently according to which of the functions are considered, reflecting that education decentralisation can take many forms. Since there is a high correlation between the ranks, separate regressions are run.

4. The impact of fiscal decentralisation on the composition of public spending

4.1. Fiscal decentralisation is associated with higher physical and human capital spending

The results indicate that fiscal decentralisation is associated with a higher share of public resources devoted to physical and human capital spending. Table A2.1 presents results for the unbalanced panel specification using time fixed effects. All four decentralisation indicators yield positive and highly significant effects and the size of the effects are not negligible. Jack-knifing reveals that the results are robust to sample outliers. Using the pooled OLS estimator yields very similar results indicating that the data do not contain a strong time trend. Estimations in the cross-sectional specification (not presented) are all insignificant. Including country fixed effects also yields only insignificant estimates. This can occur when variables, such as institutional variables, vary across countries but change little over time and as a result the country fixed effects absorb all the variation in the data. As such, the fact that results with country fixed effects are insignificant does not discredit the other results. It is, however, unfortunate as country fixed effects are convenient tools to capture potential omitted variables. Control variables are mostly significant and with the expected sign.

The results are significant for both the federal and unitary sub-samples. The SCG revenue share sparks the most capital spending in unitary countries (while the tax autonomy indicator is less significant) whereas the effect of expenditure decentralisation and tax autonomy is larger in federal countries. There seems to be no intuitive reason for these differences in results and considering the smaller number of observations when working with sub-samples, one should be careful in placing too much faith in these results.

Most of the effect of decentralisation on the share of capital spending seems to be due to education spending. The effects of decentralisation on education spending alone are found to be significant which is in line with the literature and almost of the same magnitude as the effects on physical and human capital combined (Table A2.2). The evidence for a link between decentralisation and the share of public physical capital spending only is not compelling. Estimating an unbalanced panel specification including fixed effects still yields positive and significant coefficients for the SCG expenditure and tax revenue share, but the size of the effect is very modest (Table A2.3). The estimates for the two remaining decentralisation

indicators are insignificant. Control variables remain mostly significant and with the expected sign. The effect of government size is larger than the size of the population and also more consistently significant. Again, the pooled OLS estimator yields similar results to the time fixed effects estimator, while using cross-sectional data yield again only insignificant results for all decentralisation variables, as does introducing country fixed effects.

Table A2.1. Decentralisation and the share of public capital and education spending[1]

Unbalanced panel, time fixed effects, all OECD countries

Dependent variable: Share of public physical and human capital spending												
	All countries				Federal countries				Unitary countries			
	Exp	Rev	Taxrev	Taxaut	Exp	Rev	Taxrev	Taxaut	Exp	Rev	Taxrev	Taxaut
Government size	-0.61***	-0.60***	-0.61***	-0.60***	0.01	-0.39***	-0.37***	0.00	-0.58***	-0.77***	-0.77***	-0.52***
Population	-0.03***	-0.03***	-0.03***	-0.03**	0.01***	-0.04	0.02	0.02**	-0.03**	-0.02	-0.02	-0.04
Decentralisation	0.11***	0.11***	0.15***	0.16**	0.35***	0.13***	0.12***	0.32***	0.13***	0.33***	0.33***	0.10*
R^2 adjusted	*0.42*	*0.40*	*0.44*	*0.44*	*0.85*	*0.61*	*0.60*	*0.85*	*0.45*	*0.53*	*0.53*	*0.36*
No observation	*329*	*329*	*335*	*75*	*126*	*126*	*125*	*22*	*205*	*205*	*205*	*54*

Note: *** means significance at the 1% level, ** means significance at 5% level and * means significance at 10% level.

1. Coefficients derive from linear multivariate regressions using time fixed effects. Decentralisation indicators are inserted sequentially into the equations in order to avoid multicollinearity. Coefficients are point elasticities and therefore represent percentage point changes. *E.g.* 0.11 means that a 10% point decentralisation increase is associated with a capital spending share increase of 1.1% points.

Source: *OECD Fiscal Decentralisation Database; OECD National Accounts*.

Table A2.2. Decentralisation and the share of education spending[1]

Unbalanced panel, time fixed effects, all OECD countries

Dependent variable: Share of education spending												
	All countries				Federal countries				Unitary countries			
	Exp	Rev	Taxrev	Taxaut	Exp	Rev	Taxrev	Taxaut	Exp	Rev	Taxrev	Taxaut
Government size	-0.24***	-0.24***	-0.24***	-0.19***	0.40***	0.15	0.10	0.25*	-0.19***	-0.30***	-0.29***	0.05
Population	-0.01***	-0.01***	-0.01***	-0.01	0.02***	0.01**	0.01**	0.02***	-0.02**	-0.03	-0.03***	-0.03**
Decentralisation	0.09***	0.11***	0.11***	0.09**	0.34***	0.19***	0.15***	0.23***	0.08***	0.19***	0.18***	0.04***
R^2 adjusted	*0.31*	*0.32*	*0.33*	*0.41*	*0.86*	*0.56*	*0.44*	*0.07*	*0.25*	*0.35*	*0.41*	*0.15*
No observation	*329*	*329*	*335*	*80*	*124*	*124*	*123*	*27*	*205*	*205*	*212*	*54*

Note: *** means significance at the 1% level, ** means significance at 5% level and * means significance at 10% level.

1. Coefficients derive from linear multivariate regressions using time fixed effects. Decentralisation indicators are inserted alternatively into the equations in order to avoid multicollinearity. Coefficients are point elasticities and therefore represent percentage point changes. *E.g.* 0.11 means that a 10% point decentralisation increase is associated with a capital spending share increase of 1.1% points.

Source: *OECD Fiscal Decentralisation Database; OECD National Accounts*.

Table A2.3. Decentralisation and the share of public capital spending[1]

Unbalanced panel, time fixed effects, all OECD countries

Dependent variable: Share of public physical capital spending												
	All countries				Federal countries				Unitary countries			
	Exp	Rev	Taxrev	Taxaut	Exp	Rev	Taxrev	Taxaut	Exp	Rev	Taxrev	Taxaut
Government size	-0.39***	-0.37***	-0.53***	-0.39***	-0.16***	-0.25***	-0.17***	-0.16	-0.39***	-0.46***	-0.58***	-0.33
Population	-0.02***	-0.02***	-0.03***	-0.02***	0.00	0.00	0.00	0.00	-0.02*	-0.01	-0.03***	-0.02
Decentralisation	0.02*	0.00	0.05***	0.04	0.01	-0.03**	0.00	0.00	0.07***	0.14***	0.19***	0.04***
R^2 adjusted	*0.39*	*0.38*	*0.54*	*0.41*	*0.34*	*0.37*	*0.34*	*0.07*	*0.45*	*0.47*	*0.55*	*0.38*
No observations	*345*	*345*	*362*	*80*	*152*	*152*	*157*	*27*	*264*	*264*	*308*	*68*

Note: *** means significance at the 1% level, ** means significance at 5% level and * means significance at 10% level.

1. Coefficients derive from linear multivariate regressions using time fixed effects. Decentralisation indicators are inserted alternatively into the equations in order to avoid multicollinearity. Coefficients are point elasticities and therefore represent percentage point changes e.g. 0.11 means that a 10% point decentralisation increase is associated with a capital spending share increase of 1.1% points.

Source: *OECD Fiscal Decentralisation Database; OECD National Accounts*.

5. The impact of fiscal decentralisation on student performance

5.1. Education decentralisation improves student performance

Virtually all specifications indicate a positive and significant relationship between the institutional indicator of education decentralisation and student performance. Again, jack-knifing does not alter much the significance of the results. A time fixed effects regression on unbalanced panel data yields an estimated coefficient of 0.4 (Table A2.4), meaning that a move from the least to the most decentralised country would increase the national PISA score by 28 points which is non-negligible considering that the variable is normalised around 500.[23] A 10% point increase in education decentralisation improves the PISA ranking by around four points, corresponding to an improvement of the position by about four countries. The same results are obtained with the pooled OLS estimator. Estimations on balanced panel data as well as a cross-section time average result in equally significant and somewhat more sizeable effects. The coefficient is also positive for the education decentralisation indicator based on the Classification of Functions of Government (COFOG) data, but insignificant. The country coverage of this indicator is, however, very limited.

The traditional fiscal decentralisation indicators only yield insignificant results for the whole sample. This may seem surprising given the significantly positive impact of education decentralisation. However, while the indicator measuring education decentralisation is indeed positively related to the various fiscal decentralisation indicators, the correlation is not very strong. It ranges from 0.45 between the expenditure share of SCGs and education decentralisation to as low as 0.26 between tax autonomy and education decentralisation (Table A2.5). This illustrates the importance of using disaggregated variables to capture the effects of decentralisation in a particular policy area.

As was the case when looking at public investment, the effects are stronger for unitary countries. While in federal countries education decentralisation does not significantly affect student performance, the effect in unitary countries is highly significant and stronger than for the whole sample. Again, because of the small sample size one should refrain from putting too much faith in these results. The sample for federal countries is particularly small. Control variables in all regressions are mostly significant and have the expected sign. Unsurprisingly, the effect of students' socio-economic background is found to be particularly large and significant.

23. In 2009, the average value of national PISA scores ranged from 420 to 541, but most observations are comprised in a range from 480 to 520.

Table A2.4. Education decentralisation and PISA score[1]

Unbalanced panel, time fixed effects, all OECD countries

Dependent variable: National PISA results																
	All countries						Federal countries					Unitary countries				
	Educ dec1[2]	Educ dec22	Exp	Rev	Taxrev	Taxaut	Educ dec1[2]	Exp	Rev	Taxrev	Taxaut	Educ dec1[2]	Exp	Rev	Taxrev	Taxaut
Student characteristics	40.14***	23.13	41.29***	40.98***	47.25***	46.78***	59.34***	58.80***	53.98***	59.48***	58.32***	1.40**	2.81***	6.68	31.45***	33.53*
Education spending/GDP	1.42***	-1.07	0.90*	0.87*	1.19***	1.31***	1.02	1.36***	1.03**	0.95**	1.00	1.41**	1.42***	-0.08	1.28*	2.17
Decentralisation	0.40***	0.13	0.19	0.10	0.10	0.13	0.14	0.40*	0.26	0.14	0.31	0.65***	0.64***	0.72*	0.32	0.31
R^2 adjusted	*0.45*	*0.35*	*0.38*	*0.37*	*0.51*	*0.51*	*0.84*	*0.79*	*0.82*	*0.84*	*0.89*	*0.44*	*0.10*	*0.04*	*0.24*	*0.30*
No observation	*84*	*41*	*100*	*100*	*115*	*32*	*25*	*33*	*34*	*39*	*10*	*59*	*66*	*67*	*76*	*22*

Note: *** means significance at the 1% level, ** means significance at 5% level and * means significance at 10% level.

1. Coefficients derive from linear multivariate regressions using time fixed effects. Decentralisation indicators are inserted alternatively into the equations in order to avoid multicollinearity. Coefficients are point elasticities and therefore represent percentage point changes. *E.g.* 0.40 means that a 10% point decentralisation increase is associated with an increase of 4 PISA points.
2. Educ dec1 is the institutional education decentralisation indicator from the OECD Education at a Glance data and educ dec2 is the education decentralisation indicator based on COFOG data.

Source: *OECD Fiscal Decentralisation Database; OECD Education at a Glance Database; OECD National Accounts*.

A2.5. Education decentralisation versus fiscal decentralisation

Correlation matrix

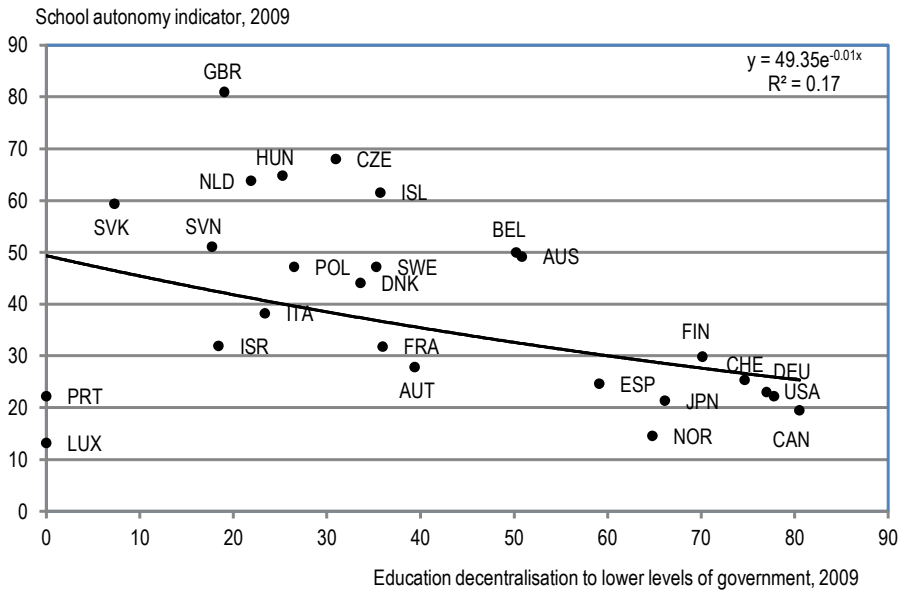
	Education decentralisation	Expenditure decentralisation	Revenue decentralisation	Tax autonomy
Education decentralisation	1			
Expenditure decentralisation	0.45	1		
Revenue decentralisation	0.43	0.76	1	
Tax autonomy	0.26	0.71	0.77	1

Source: *OECD Education at a Glance Database; OECD Fiscal Decentralisation Database*.

5.2. Both empowering schools and lower levels of government are beneficial

Decentralisation to local governments and school autonomy can co-exist and countries may adopt some elements of both policies. Indeed one might expect that countries that have devolved many powers to local governments would have experienced pressure for providing even more autonomy to the school level. However, the data paint the opposite picture. There is a clear negative correlation between the extent of decentralisation to lower level governments and the extent of decentralisation to schools (school autonomy) (Figure A2.1).

Figure A2.1. Correlation between lower level government decentralisation and school autonomy



Source: *OECD Education at a Glance Database*.

Burki et al. (1999) note that the objectives behind the two kinds of decentralisation are usually different. Decentralisation of educational powers to local governments is generally undertaken as part of a larger, more general decentralisation reform, whereas school autonomy tends to be motivated by specific concerns about school performance. Indeed, the correlation matrix suggests that school autonomy is actually negatively correlated with economy-wide decentralisation, meaning that more decentralised countries tend to have less autonomous schools (Table A2.6).

Table A2.6. Overall decentralisation, decentralisation to lower level of government and school autonomy

Correlation matrix

	Education decentralisation			All sector decentralisation
	Aggregate decentralisation	Lower level government	School autonomy	Tax revenue share
Education decentralisation	1			
Lower level government	0.67	1		
School autonomy	0.28	-0.52	1	
Tax revenue share	0.47	0.77	-0.43	1

Source: *OECD Education at a Glance Database*.

Even though countries may choose different approaches to education decentralisation, it appears to yield the same positive effects on performance. Dividing the overall decentralisation indicator in decentralisation to lower level governments and school autonomy, it is found that both types of decentralisation are equally beneficial for student results (Table A2.7). When federal and unitary countries are treated apart, the effect (i.e. the size of the coefficients) of empowering local governments is stronger than the effect of empowering schools for both sub-samples. On the contrary, when cross-section data as opposed to panel data with time-fixed effects are used, the results (not presented) suggest a somewhat larger effect from granting school autonomy as opposed to decentralisation to SCGs.

Table A2.7. Education decentralisation, school autonomy and PISA score[1]

Unbalanced panel, time fixed effects, all OECD countries

Dependent variable: National PISA results						
	All countries		Federal countries		Unitary countries	
	School autonomy	SCG power	School autonomy	SCG power	School autonomy	SCG power
Student characteristics	37.81***	37.81***	54.13***	54.13***	13.42	13.42
Education spending/ GDP	1.57***	1.57***	1.39*	1.39*	1.30*	1.30*
Decentralisation	0.51***	0.49***	0.37	0.54**	0.49***	0.76***
R^2 adjusted	*0.48*	*0.48*	*0.84*	*0.84*	*0.40*	*0.40*
No. observation	*83*	*83*	*25*	*25*	*58*	*58*

Note: *** means significance at the 1% level, ** means significance at 5% level and * means significance at 10% level.

1. Coefficients derive from linear multivariate regressions using time fixed effects. Decentralisation indicators are inserted simultaneously since they are not highly correlated. Coefficients are point elasticities and therefore represent percentage point changes. *E.g.*= 0.49 means that a 10% point decentralisation increase is associated with a 4.9 PISA point increase.

Source: *Fiscal Decentralisation Database*.

5.3. The size of effects varies according to the type of responsibility

Finally, countries may also choose to devolve different functions within the domain of education. Education consists of a variety of functions such as financing, educational content and staff policy. On average, local units appear to have more power when it comes to organising instruction (e.g. class size, timetables, etc.) and in matters of financial resources. Power to decide overall pedagogical content of schools and monitoring their performance are to a greater extent kept at the central level. This is at least partially in line with Mons (2004) who notes that countries appear to have privileged the decentralisation of financing and day-to-day operational responsibility, leaving broader matters of curriculum at a more centralised level.

It might be more advantageous to decentralise some decision powers than others. Although decentralisation is conducive to student performance regardless of the particular responsibility considered, the estimated coefficient using panel data is very small and close to insignificant for financial resources (Table A2.8). This is in line with the findings in OECD (2010). This might also be due to fewer observations for this sub-indicator. A more favourable finding is that decentralising the organisation of instruction is indeed found to yield the best result on PISA scores with a significant estimated coefficient often over twice the size as compared to the remaining three functions. The same conclusion holds when the sample is divided into the federal and unitary country sub-samples.

Table A2.8. Education decentralisation according to function and PISA score[1]

Unbalanced panel, time fixed effects, all OECD countries

Dependent variable: National PISA results												
	All countries				Federal countries				Unitary countries			
	Instruction	Personnel	Structure	Resources	Instruction	Personnel	Structure	Resources	Instruction	Personnel	Structure	Resources
Student characteristics	18.90**	15.27	25.73***	18.96*	50.74***	60.15***	57.29***	60.03***	20.59	2.04	31.85***	23.63*
Education spending /GDP	-1.06	-0.49	-0.13	-0.86	1.09	1.40	1.41	1.52	1.34	2.36*	1.79	1.67
Decentralisation	0.50***	0.24**	0.21***	0.20*	0.67	0.01	0.08	0.51	1.19***	0.63***	0.56***	0.57***
R^2 adjusted	*0.31*	*0.27*	*0.31*	*0.21*	*0.92*	*0.90*	*0.90*	*0.91*	*0.40*	*0.55*	*0.58*	*0.43*
No observation	*45*	*49*	*50*	*39*	*9*	*9*	*9*	*9*	*22*	*22*	*31*	*31*

Note: *** means significance at the 1% level, ** means significance at 5% level and * means significance at 10% level.

1. Coefficients derive from linear multivariate regressions using time fixed effects. Decentralisation indicators are inserted alternatively into the equations in order to avoid multicollinearity. Coefficients are point elasticities and therefore represent percentage point changes. *E.g.* 0.24 means that a 10% point decentralisation increase is associated with a 2.4 PISA point increase.

Source: *Fiscal Decentralisation Database*; *OECD Education at a Glance Database*.

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