Fiscal Decentralisation and Economic Growth in High-Income OECD Countries

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Abstract

Among the majority of high-income OECD countries, the degree of fiscal decentralisation has converged over the last 30 years towards an intermediate level. The theoretical arguments for and against fiscal decentralisation point to explanations for this tendency, because both extreme decentralisation and extreme centralisation are associated with disadvantages for economic growth. Hence, the observed trend of convergence would be growth-promoting. The paper analyses the long-run empirical relationship between per capita economic growth, capital formation and total factor productivity growth, and fiscal decentralisation for the high-income OECD countries. The evidence supports the view that the relationship is positive when fiscal decentralisation is increasing from low levels, but then reaches a peak and turns negative. A policy implication is that policy-makers in several countries with relatively low degrees of fiscal decentralisation could possibly mobilise growth reserves by increasing it.

JEL classification: C33, H77, O47.

I. INTRODUCTION

For the past three decades, there has been a tendency for the degree of fiscal decentralisation (FD) in the majority of high-income OECD countries to converge towards an intermediate level: countries that in the past had a relatively high degree of FD tended to reduce it (for example, Canada, Germany,

Scandinavian countries and Switzerland) and several countries that formerly had a relatively low degree of FD tended to raise it, in some cases dramatically (for example, Italy, Portugal and Spain). The theoretical arguments for and against fiscal decentralisation suggest that both extreme decentralisation and extreme centralisation have disadvantages for economic growth in developed high-income countries. Hence, the tendency for the degree of FD to converge towards a medium level in these countries would be growth-promoting. However, the empirical studies on the subject have yielded conflicting results, all of them having tested the existence of a linear relationship between per capita growth and FD. This paper attempts to contribute a new perspective to this empirical research by studying the experience of high-income OECD countries that vary widely in their degrees of FD. The analysis differs from the approach employed in other studies in three main ways: first, indicators of fiscal decentralisation other than the commonly used share of expenditures of lower government levels in total government expenditures are tested; secondly, the possibility of a non-linear relationship between fiscal decentralisation and growth is examined; and thirdly, two potentially important channels are looked at by which decentralisation might affect growth: total investment and total factor productivity (TFP). In addition, this study concentrates on cross-sectional data using long-run averages as opposed to panel data.

The paper is organised as follows. Section II briefly reviews the recent empirical literature on the subject. Section III summarises the main theoretical growth advantages and disadvantages of FD. Section IV discusses the analytical background and indicators of FD. Sections V, VI and VII present the empirical analysis regarding direct growth effects of FD and effects of FD on capital formation and TFP, respectively, and Section VIII concludes.

II. BRIEF REVIEW OF THE EMPIRICAL LITERATURE ON FISCAL DECENTRALISATION

There have been relatively few empirical studies of the relationship between FD and economic growth, and the studies that have been undertaken tend to be inconclusive. There are only three cross-country studies and several on particular states. All but one concentrate on the share of subnational government expenditures in consolidated government expenditures as the indicator of fiscal decentralisation. The exception is a study on China (Lin and Liu, 2000), which uses the marginal rate of government revenues retained by provincial governments as the indicator of fiscal decentralisation.

For 46 developed and developing countries, using average data and covering the period 1970–89, Davoodi and Zou (1998) found a negative effect of fiscal decentralisation on economic growth for the developing countries, albeit not significant, and no clear relationship for the developed countries. For a panel of developing countries, Woller and Phillips (1998) concurred with Davoodi and

Zou (1998) in finding no significant and robust relationship. Yilmaz (2000) did not use average data but a panel data-set of 46 countries as well, for the period 1971–90. He did not separate developed from developing countries but emphasised that cross-country studies should distinguish between federal and unitary states, because in the former, the division of power between central government and lower levels is defined in the constitution, whereas in unitary states, this relationship is often not well defined. Thus, in his view, the two systems cannot be compared. For unitary countries, he found a positive impact of fiscal decentralisation on per capita growth, significant at the 5 per cent level. For federal countries, the results are inconclusive.

The studies on individual countries do not arrive at clear results either. For instance, there have been two analyses on China, one of which found that the fiscal decentralisation efforts since the 1980s did not promote economic growth (Zhang and Zou, 1998). The other attempted to control adequately for the different liberalisation reforms undertaken simultaneously and concluded that these policies raised the overall growth rate mainly by improving the efficiency of resource allocation rather than by inducing more investment (Lin and Liu, 2000). For the USA, Xie, Zou and Davoodi (1999) covered the period since 1949 and found a highly insignificant effect of fiscal decentralisation on economic growth. They argued that the degree of fiscal decentralisation in the USA may be at an optimal level, such that benefits from a further increase in fiscal decentralisation are unlikely. Finally, the *Hitotsubashi Journal of Economics* (2000) devoted an entire issue to the analysis of the relationship between fiscal decentralisation and growth for several Asian countries. But the views were mixed and unanimity appears to exist merely regarding the conclusion that 'the decentralization process in the region is one of the most important factors, which determine the future of a country'.

III. FISCAL DECENTRALISATION AND ECONOMIC GROWTH

In this paper, fiscal decentralisation connotes the (legal) power of subnational governments to raise tax revenues and decide on spending programmes on their own initiative within legal criteria.

A first argument favouring FD is the 'diversification hypothesis' (or 'decentralisation theorem'). It maintains that uniform levels of public goods and services across jurisdictions will generally be inefficient (Oates, 1972 and 1977). In a simple model of only two communities, each of which has a different demand for a single public service being offered, immobile individuals, no economies of scale in the production of the public service and no spillover effects from one community to the other, a uniform level of public services offered in each community is inefficient. This is because marginal benefits of the public service differ due to the different demand schedules in each community. Resources can be saved without detriment to anyone involved by diversifying

government outputs in accordance with local demands. Thus, decentralised expenditures may cause greater 'consumer efficiency' (Vazquez and Mc Nab, 2003). The potential welfare gain from this diversification may be relatively large because, *ceteris paribus*, it depends negatively on the price elasticity of demand for public goods, and empirical studies find that this demand is highly price-inelastic (see Oates (1996) for an overview). Hence, 'Pareto' efficiency can be raised through fiscal decentralisation. According to this model, the larger the variance in people's demands for public goods, the larger the benefits of decentralisation tend to be. In other words, local government outputs need to be differentiated according to local tastes and circumstances, but this requires discretion of local governments over spending programmes, i.e. fiscal decentralisation.

Introducing mobility of people into this model creates incentives for individuals to move to the community that is perceived as supplying the best combination of public service and local tax rate. By so doing, individuals contribute to efficient resource allocation. This is also the main thrust of the seminal Tiebout (1956) model. However, freedom for local communities to decide on public spending and taxation themselves inevitably results in inequities. In addition, relaxing the restrictive assumptions of the above models, such as no spillover effects and no economies of scale, highlights the need for central government intervention. This very intervention erodes fiscal decentralisation (Prud'homme, 1994 and 1995), making clear a basic conflict inherent in fiscal decentralisation: the more one decentralises, the more reasons may be generated for interventions at the national level.

But even if individuals have identical preferences and are relatively immobile, fiscal decentralisation may still offer efficiency advantages if decisions by subnational governments better reflect the priorities of taxpayers. For instance, it could be that central governments have a greater tendency to spend on national defence rather than on education, childcare and other local infrastructure.

Oates (1993) argued that the thrust of the basic case for fiscal decentralisation (greater allocative efficiency) should also apply to a dynamic framework of economic growth. It could be expected that centrally determined policies do not consider regional and local conditions in the provision of public goods and services as well as locally determined policies — for instance, regarding infrastructure and education. Economic development and growth might therefore be promoted if local authorities have input into such policy decisions.

A second argument calling for fiscal decentralisation is the 'Leviathan restraint hypothesis': Brennan and Buchanan (1980) argued that governments may behave as revenue-maximisers to the detriment of taxpayers. Horizontal and vertical competition among different levels of government may prevent this revenue maximisation. Competing governments may concentrate on objectives other than revenue maximisation, such as maintaining stable, or even lowering,

tax rates and efficient production of public goods and services under certain revenue constraints. Hence, FD may contribute to containing the size of their budgets and thus restrain the overall size of the public sector.[1] This may prevent an oversupply of public goods and services and/or 'x-inefficiency' in the public sector. Thus, FD should, *ceteris paribus*, have a positive impact on per capita growth due to more efficient use of resources.

A third argument supporting the view that FD promotes economic growth is the 'productivity enhancement hypothesis': FD implies a transfer of responsibility associated with accountability to subnational governments. This may provide incentives for them not only to consider local residents' preferences but also to search actively for innovations in the production and supply of public goods and services. Production costs and prices of public goods and services could thus be lower and their quality better than in a uniform approach to providing public goods and services, i.e. fiscal decentralisation may result in greater 'producer efficiency' (Vazquez and Mc Nab, 2003). In addition, fiscal decentralisation relieves the central government from many tasks. Thus, it may be able to concentrate better on efficient production of those public goods and services for which it still bears responsibility (ideally, goods and services with large spillovers among communities and/or substantial economies of scale in production).

Fourthly, there are also political arguments for fiscal decentralisation, such as the view that it lessens concentration of political power and weakens the influence of vested interests on public policy thus promoting democracy, development and long-term economic growth.

On the other hand, there are significant arguments cautioning against fiscal decentralisation. First, FD can reinforce regional inequalities, which may hinder economic growth. The simple model described at the beginning of this section showed that FD breeds social inequity: incomes and tax bases are unevenly distributed among jurisdictions and regions. Wealthier communities and regions attempt to fend off low-income households and may offer better public services. Such inequities and differences in the supply of public goods with possibly large spillovers across jurisdictions can inhibit per capita growth. This is because pronounced regional differences in infrastructure, education, healthcare and other public services may prevent full use of production factors including human capital.

Secondly, FD may result in a lower quality of government decisions, more corruption and increased influence of interest groups. Some authors argue that

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[1]Ehdaie (1994) and Yilmaz (2000) presented evidence supporting this hypothesis. For a sample of 30 industrial and developing countries that covered the period 1977–87, Ehdaie (1994) found that fiscal decentralisation, proxied by subnational own-source revenues over total government expenditures, yields a negative influence on the overall size of the public sector. The influence appears to be stronger if not only expenditure decisions are decentralised but also taxing decisions. The panel analysis of Yilmaz (2000) for 46 countries and the period 1971–90 also found a significant negative relationship between fiscal decentralisation and public sector size.

central governments can, in general, achieve higher quality levels: they can attract more qualified people because of better career opportunities and salaries (Prud'homme, 1994). In addition, there may be cases where local democracies may offer less effective control by elected officials than occurs at the central level, because officials at the local level are closer to people and therefore possibly more susceptible to personal influence and corruption. If the quality of government declines with the level of government, then decentralisation could increase inefficiencies. If the quality at all government levels is high, the case for decentralisation may be weakened because it could be argued that the central government may be able to collect and process the information necessary to achieve the efficient results that are expected from decentralisation.

Thirdly, there are arguments cautioning against fiscal decentralisation in low-income and small countries, which are mentioned only briefly, given the focus of this study on high-income countries. Fixed costs could consume such a large share of the total funds available that decentralisation might seem difficult to justify (Prud'homme, 1995). Bahl and Linn (1992) argued that there is a relatively high threshold level of economic development at which fiscal decentralisation becomes attractive. This level exists not only because of fixed costs of FD but also because at a relatively low per capita income level, the demands for public goods and services may be concentrated on very few goods and the outlooks of all inhabitants may be relatively homogeneous (i.e. differences in individual preferences for public goods and services may not be pronounced and have a small variance) so that the central government has all information necessary to provide for consumer and producer efficiency.

Fourthly, FD may hinder long-run economic growth by making the task of stabilisation more difficult when we interpret stabilisation to mean not only countercyclical actions but especially the fiscal adjustments needed to eliminate structural (chronic) imbalances. FD may even create perverse incentives and worsen structural imbalances (Tanzi, 1995): one extreme example is when one government level grants a tax exemption, the original revenue from which was in large part received by another level of government. FD may even contribute to predatory and unpredictable taxation (such as in Russia; see Zhuravskaya (2000)), promoting shadow economic activities. Furthermore, effective and timely coordination among the different government levels may be difficult to implement, possibly also leading to long-run adverse growth effects.

Thus, the benefits of FD for society and its relationship with economic growth are theoretically ambiguous. FD causes shortcomings, which require central government intervention. It could thus follow that in advanced countries, whose citizens have pronounced heterogeneous demand preferences, neither a highly decentralised nor a highly centralised system promotes long-run per capita growth best, but a decentralised system with 'adequate' central government interventions would. This adequacy refers to avoiding negative effects from 'too much' regional autonomy and inequality, on the one hand, and

from 'too limited' fiscal autonomy, responsibility and accountability of subnational governments, on the other. Assuming a satisfactory indicator of fiscal decentralisation were available, the conclusion would be that on a macroeconomic level, a medium degree of decentralisation promotes growth better than either a relatively high or a relatively low degree. Nevertheless, all empirical studies on fiscal decentralisation test exclusively for a linear relationship.

IV. EMPIRICAL ANALYSIS: ANALYTICAL BACKGROUND, DATA AND INDICATORS OF FISCAL DECENTRALISATION

1. Analytical Background

Theoretical endogenous growth models can account for the potentially powerful effects of government policies on economic growth. However, there is no consensus theoretical model to guide empirical work on growth, and the formal theoretical models on growth effects from fiscal decentralisation are inadequate (Vazquez and Mc Nab, 2003). They typically assume only one representative agent with utility dependent on government expenditures at all levels of government and private consumption, and that all levels of government produce the same amount or quality of public goods with a given amount of public expenditure. The first assumption leaves out growth effects caused by higher consumer efficiency, because its consideration would require us to assume several agents whose preferences concerning public goods differ. The second assumption leaves out growth effects from higher producer efficiency, whose consideration requires us to assume that the different government levels produce different levels of public goods with a given amount of government expenditure.

The estimation approach of this paper is to measure the long-run direct effect of fiscal decentralisation on growth[2] by augmenting a well-established empirical growth model. In addition, we examine the associations between FD and basic components of economic growth — namely, the total investment share in GDP (I/GDP) and total factor productivity growth (TFPG) — to shed light on the channels by which fiscal decentralisation may affect economic growth.[3] TFPG was estimated for each country as explained in the Appendix.

Some of the empirical studies on the effects of FD on growth use panel data (pooled cross-section data) and, due to their relatively large number of observations, may be more appealing at first sight than purely cross-sectional

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[2]Estimations of the direct growth effects of fiscal decentralisation are sometimes criticised because more efficient provision of public services (higher consumer and producer efficiency) is not recorded in the national income accounts. However, long-run growth regressions may capture these potential effects because if they exist, there will eventually be a positive impact on income and measured GDP.

[3]See also Fischer (1993), who used a similar approach in his analysis of the impact of inflation on economic growth.

studies. However, it is difficult to identify a long-run impact on growth using time-series annual data, because of the suspicion that results are often driven by short-run movements.[4] Therefore, despite the limited number of observations, the analysis focuses on cross-section regressions, based on averages of annual data over the longest period possible: 1973–98. However, pooled cross-section regressions were also performed and are available, together with all time series, from the author on request.[5] Cross-section and panel regressions yielded similar results but they cannot be easily compared: the former capture purely long-run effects and the latter reflect complicated interactions between short- and long-run effects.

2. Country Sample

The sample includes all high-income OECD countries, although Luxembourg is excluded from the regressions due to its very small population (see Table 1).[6] This selection was made for reasons of homogeneity and thus comparability as well as data reliability and availability, although even for some of these advanced countries, there are considerable gaps in the International Monetary Fund's (IMF's) *Government Finance Statistics* time series used to calculate the fiscal decentralisation indicators.[7]

Since fiscal decentralisation indicators change only slowly over the years, it was judged justifiable in several cases to fill gaps, as explained in the Appendix. The suggestion by Yilmaz (2000) to separate unitary countries from federal ones was considered. Regarding the cross-section regressions, a dummy variable for unitary countries was used and subsamples for the 14 high-income unitary countries were estimated. The group of seven high-income federal countries is too small for a subgroup. Only in the panel regressions are subsamples for both governmental systems possible.

In an attempt to examine how the results are influenced by the impact of countries with relatively similar formal institutional structures but much lower income, a small additional 'control group' is considered. In order to limit the data needs, this group comprises only four countries with reliable data (Argentina, Brazil, Korea and South Africa, also in Table 1). But high-income countries are the focus of this study, and thus this sample enlargement serves merely as additional sensitivity analysis.

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[4]This was emphasised by an anonymous referee.

[5]Panel regression results from an earlier version of this paper can be found in Thießen (2001).

[6]Hence, the Eastern European member countries of the OECD — the Czech Republic, Hungary and Poland — are excluded, as are Mexico and Turkey.

[7]This refers to Greece, Italy, Japan, New Zealand, Portugal, Spain and Switzerland. It is difficult to understand why the IMF publishes statistics with such considerable gaps concerning data, which may be available from the authorities.

TABLE 1
Income Level, Growth Performance and Indicators of Fiscal Decentralisation in High-Income OECD Countries and Selected Other Countries

High-income European OECD countries

	(1) Income level[a]	(2) Growth performance, 1973–98[b]	(3) Governmental system	Indicators of fiscal decentralisation				(8) SR (self-reliance)[g]	Memo item (9) CHSR (change of self-reliance)[h]
				(4) A (expenditure share)[c]	(5) B (revenue share)[d]	(6) C (simple average of indicators A and B)[e]	(7) D (transformed indicator A)[f]		
Luxembourg[i]	43,093	1.89	unitary	16.5	6.4	11.4	5	56.9	1.0
Norway	36,021	3.04	unitary	38.3	20.6	29.4	12	65.6	-1.0
Switzerland	33,393	1.01	federal	58.2	38.5	48.3	2	76.4	-0.1
Denmark	30,424	1.93	unitary	57.4	30.3	43.8	3	53.9	0.4
Sweden	25,631	1.42	unitary	41.8	31.0	36.4	9	76.8	0.4
Ireland	24,740	4.01	unitary	30.1	3.1	16.6	10	27.5	-2.4
UK	23,679	2.01	unitary	29.5	8.6	19.1	9	45.0	-2.1
Finland	23,463	2.23	unitary	43.2	25.8	34.5	7	66.8	2.6
Austria	23,307	2.20	federal	33.6	21.3	27.5	12	72.5	-0.5
Netherlands	22,914	1.82	unitary	36.4	2.3	19.3	13	21.4	3.8
Germany	22,800	1.44	federal	46.3	29.8	38.0	6	76.6	-0.1
Belgium	22,108	1.96	unitary	12.9	4.9	8.9	4	41.5	0.8
France	21,977	1.71	unitary	17.5	8.8	13.1	6	61.9	0.5
Italy	18,616	2.28	unitary	25.0	5.2	15.1	8	23.5	4.3
Spain	14,153	2.15	federal	23.7	10.5	17.1	7	54.0	-0.4
Greece	10,667	1.63	unitary	4.2	1.0	2.5	1	72.1	-4.2
Portugal	10,497	2.85	unitary	8.4	3.4	5.9	2	52.5	7.9

TABLE 1 continued

Other high-income OECD countries

	(1) Income level[a]	(2) Growth performance, 1973–98[b]	(3) Governmental system	Indicators of fiscal decentralisation					Memo item
				(4) A (expenditure share)[c]	(5) B (revenue share)[d]	(6) C (simple average of indicators A and B)[e]	(7) D (transformed indicator A)[f]	(8) SR (self-reliance)[g]	(9) CHSR (change of self-reliance)[h]
Japan	38,162	2.63	unitary	40.5	39.6	40.0	10	n.a.	n.a.
USA	34,940	2.12	federal	51.9	32.1	42.0	4	69.2	0.3
Canada	22,370	1.84	federal	68.0	49.0	58.5	1	72.5	0.5
Australia	20,337	1.98	federal	50.6	20.7	35.7	5	53.0	1.2
New Zealand	13,027	0.96	unitary	11.6	6.6	9.1	3	85.1	0.4

'Control group' (selected, relatively advanced, middle-income countries)

	(1) Income level[a]	(2) Growth performance, 1973–98[b]	(3) Governmental system	Indicators of fiscal decentralisation					Memo item
				(4) A (expenditure share)[c]	(5) B (revenue share)[d]	(6) C (simple average of indicators A and B)[e]	(7) D (transformed indicator A)[f]	(8) SR (self-reliance)[g]	(9) CHSR (change of self-reliance)[h]
Korea, Republic of	9,671	6.02	unitary	41.8	10.5	26.1	8	35.9	–0.7
Argentina	7,695	0.73	federal	38.2	31.9	35.0	13	95.6	–0.6
Brazil	3,494	2.13	federal	39.0	27.7	33.4	11	68.3	–0.4
South Africa	2,941	–0.10	federal	33.3	6.4	19.9	11	43.6	–3.0

3. Indicators of Fiscal Decentralisation

It is well recognised that fiscal decentralisation has many dimensions and thus may differ from country to country. Therefore several indicators representing FD were considered:

- The share of subnational government expenditures in consolidated government expenditures is the best-known indicator of fiscal decentralisation, denoted A in Table 1, column 4. It is available on an annual basis since the early 1970s.[8]
- The share of subnational government revenues in consolidated government revenues is denoted B in Table 1, column 5.
- An unweighted average of indicators A and B is denoted C in Table 1, column 6.
- A quadratic of indicator A, denoted Asq in the regressions, was used to test for the hypothesis of a non-linear, hump-shaped relationship between fiscal decentralisation and growth.[9]
- To test this hypothesis, an additional, admittedly simple and restrictive, indicator, D, was constructed for the cross-sectional regressions: low and

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[8]Averages of A for use in the pure cross-sectional equations were constructed for all sample countries. Annual time series of A for use in the panel regressions could be constructed for all high-income sample countries except Greece, Japan and Portugal, and for the countries of the control group except Korea.
[9]Assuming that the relationship between economic growth, y, and fiscal decentralisation, A, is characterised by the quadratic functional form $y = \alpha A + \beta A^2$, then this relationship would be hump-shaped if α is positive and β is negative. The quadratic of indicators B and C to test for a hump-shaped relationship were also used but almost always less significant than the quadratic of indicator A.

high values of indicator A were transformed into low values, whereas medium values became high ones (see Table 2).[10]

TABLE 2

Derivation of Indicator D of Fiscal Decentralisation

	Indicator A	*Ranking*	*Indicator* D^a
Canada	68.0	1	1
Switzerland	58.2	2	2
Denmark	57.4	3	3
USA	51.9	4	4
Australia	50.6	5	5
Germany	46.3	6	6
Finland	43.2	7	7
Korea	41.8	8	8
Sweden	41.8	9	9
Japan	40.5	10	10
Brazil	39.0	11	11
Norway	38.3	12	12
Argentina	38.2	13	13
Netherlands	36.4	14	13
Austria	33.6	15	12
South Africa	33.3	16	11
Ireland	30.1	17	10
UK	29.5	18	9
Italy	25.0	19	8
Spain	23.7	20	7
France	17.5	21	6
Luxembourg	16.5	22	5
Belgium	12.9	23	4
New Zealand	11.6	24	3
Portugal	8.4	25	2
Greece	4.2	26	1

[a]Starting with the lowest and highest values of indicator A, these are given the value 1. The next lowest and highest values of indicator A are given the value 2 and so on, up to the medium-range values of indicator A, which receive the highest values. This transformation of indicator A allows testing for a hump-shaped relationship between economic growth and fiscal decentralisation, as explained in the text.
Source: Author's calculations.

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[10]This approach is borrowed from Calmfors and Driffill (1988), who tested whether a hump-shaped relation may exist between economic performance and the degree of centralisation of wage bargaining. They found supporting evidence for this hypothesis.

- Spline functions of indicators *A* and *C* were used.[11] The function of indicator *A* breaks at shares of 30 per cent and 45 per cent of subnational government expenditures in consolidated expenditures. The resulting three indicators (dummies) are denoted *AL* for 'low degree of fiscal decentralisation' according to indicator *A*, *AM* for 'medium degree of fiscal decentralisation' and *AH* for 'high degree of fiscal decentralisation'. The function of indicator *C* (simple average of indicators *A* and *B*) breaks at values of 18 per cent and 35 per cent. Dummies *CL*, *CM* and *CH* were constructed analogously. The breaks for the splines were chosen so as to obtain three country groups of similar strengths.
- A measure of the self-reliance of subnational governments, i.e. their own revenues as a share of their total revenues (denoted *SR*), is also considered, to test whether self-reliance of subnational governments has effects on economic growth and on its major components as suggested by Oates (1995). Averages of the self-reliance ratio for the period 1973–98 are available for all sample countries except Japan. The ratio is also available as a time series covering the same period for the sample countries with a few exceptions (Greece, Japan, Korea and Portugal). As a memorandum item, Table 1 also provides the average annual change of this ratio in the last column.[12] However, interpreting the self-reliance ratio as an indicator of the degree of fiscal decentralisation can be criticised: some countries with a relatively low share of subnational government expenditures in total government expenditures (Greece, New Zealand, Portugal and France) have relatively high self-reliance ratios. Hence, the measure of self-reliance indicates the extent to which subnational governments are allowed to cover their expenditures by own taxes and fees *given* a certain ceiling for their expenditures, which they cannot determine themselves and which may be quite low.

Admittedly, none of these indicators reflects all of the many dimensions of fiscal decentralisation, but obviously the collection of information on the exact nature of fiscal relations between the different government levels in each country, required to construct an adequate indicator, would be very challenging. It is also questionable whether the marginal retention rate of government revenues of subnational governments (i.e. the revenue share that a subnational government may retain if it increases its revenues by one additional unit) is a better indicator of fiscal decentralisation, as suggested by Lin and Liu (2000),

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[11]See Fischer (1994), who used this approach for his panel analysis of non-linear effects of inflation on economic growth.

[12]It shows that there has been a general tendency for it to increase in high-income OECD countries with the exception of countries that started with a rather high ratio in the early 1970s and Ireland, which had a low ratio that decreased further. By contrast, the 'control group' countries show unanimously a decreasing self-reliance ratio, although the other indicators of fiscal decentralisation for them were mostly increasing.

because it is also not multidimensional. Additional difficulties with this indicator are that it would need to be calculated for each country and many years, and because the true marginal retention rate is not directly observable, its calculation would require simulations for each major revenue type.[13]

TABLE 3

Country Ranking of the Degree of Fiscal Decentralisation[a]

Indicator *A*

	Average, 1973–98[b]	*1998*	*Direction of trend since 1973*
Canada (F)	68.0	66.5	↓
Switzerland (F)	58.2	53.3	↓
Denmark (U)	57.4	55.8	↓
USA (F)	51.9	57.3	→
Australia (F)	50.6	51.2	→
Germany (F)	46.3	41.3	↓
Finland (U)	43.2	39.1	↓
Korea (U)	41.8	n.a.	n.a.
Sweden (U)	41.8	37.0	↓
Japan (U)	40.5	n.a.	n.a.
Brazil (F)	39.0	40.0	→
Norway (U)	38.3	38.4	↓
Argentina (F)	38.2	45.1	↑
Netherlands (U)	36.4	43.2	↑
Austria (F)	33.6	34.7	→
South Africa (F)	33.3	47.7	↑
Ireland (U)	30.1	31.2	→
UK (U)	29.5	26.2	↓
Italy (U)	25.0	26.1	↑
Spain (F)	23.7	39.0	↑
France (U)	17.5	17.7	→
Luxembourg (U)	16.5	15.8	→
Belgium (U)	12.9	11.7	↓
New Zealand (U)	11.6	10.9	→
Portugal (U)	8.4	10.2	↑
Greece (U)	4.2	n.a.	n.a.

[13]See, for instance, Baretti, Huber and Lichtblau (2000), who did this for the income tax in Germany.

TABLE 3 continued

Indicator *B*

	Average, 1973–98[b]	1998	Direction of trend since 1973
Canada (F)	49.0	48.0	→
Japan (U)	39.6	n.a.	→
Switzerland (F)	38.5	31.9	↓
USA (F)	32.1	31.7	→
Argentina (F)	31.9	39.7	↑
Sweden (U)	31.0	31.1	→
Denmark (U)	30.3	31.3	→
Germany (F)	29.8	29.3	↓
Brazil (F)	27.7	31.8	↑
Finland (U)	25.8	26.9	↑
Austria (F)	21.3	19.5	↓
Australia (F)	20.7	22.6	↑
Norway (U)	20.6	18.7	↓
Spain (F)	10.5	16.0	↑
Korea (U)	10.5	n.a.	n.a.
France (U)	8.8	10.8	↑
UK (U)	8.6	3.9	↓
New Zealand (U)	6.6	6.3	→
South Africa (F)	6.4	5.0	→
Luxembourg (U)	6.4	5.9	↓
Italy (U)	5.2	11.3	↑
Belgium (U)	4.9	4.8	→
Portugal (U)	3.4	4.1	→
Ireland (U)	3.1	0.7	↓
Netherlands (U)	2.3	4.2	↑
Greece (U)	1.0	n.a.	n.a.

Table 3 continues overleaf.

Table 3 provides a country ranking on the basis of several FD indicators. As can be seen, indicators *A* and *B*, and thus also *C*, yield relatively similar rankings. (The Spearman rank correlation between the two rankings by indicators *A* and *B* is 0.80.) The ranking according to indicator *SR* is quite different. (The Spearman rank correlation between the rankings by indicators *A* and *SR* is only 0.21, and that between *B* and *SR* is 0.48.) Perhaps it can be argued that these indicators should be combined, but to judge whether this would yield a better indicator requires a deeper understanding of intergovernmental fiscal relations in each country. Table 3 also shows the trend direction of indicators *A*

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<p style="text-align:center">TABLE 3 continued</p>

Indicator *C*

	Average, 1973–98[b]
Canada (F)	58.5
Switzerland (F)	48.3
Denmark (U)	43.8
USA (F)	42.0
Japan (U)	40.0
Germany (F)	38.0
Sweden (U)	36.4
Australia (F)	35.7
Argentina (F)	35.0
Finland (U)	34.5
Brazil (F)	33.4
Norway (U)	29.4
Austria (F)	27.5
Korea (U)	26.1
South Africa (F)	19.9
Netherlands (U)	19.3
UK (U)	19.1
Spain (F)	17.1
Ireland (U)	16.6
Italy (U)	15.1
France (U)	13.1
Luxembourg (U)	11.4
New Zealand (U)	9.1
Belgium (U)	8.9
Portugal (U)	5.9
Greece (U)	2.5

Indicator *SR*

	Average, 1973–98[b]
Argentina (F)	95.6
New Zealand (U)	85.1
Sweden (U)	76.8
Germany (F)	76.6
Switzerland (F)	76.4
Canada (F)	72.5
Austria (F)	72.5
Greece (U)	72.1
USA (F)	69.2
Brazil (F)	68.3
Finland (U)	66.8
Norway (U)	65.6
France (U)	61.9
Luxembourg (U)	56.9
Spain (F)	54.0
Denmark (U)	53.9
Australia (F)	53.0
Portugal (U)	52.5
UK (U)	45.0
South Africa (F)	43.6
Belgium (U)	41.5
Korea (U)	35.9
Ireland (U)	27.5
Italy (U)	23.5
Netherlands (U)	21.4
Japan (U)	n.a.

[a]Federal countries are denoted by (F) after their name, unitary countries by (U).
[b]For several countries, shorter periods apply due to data constraints, as explained in the Appendix.
Sources: Data for the calculation of the indicators of fiscal decentralisation from IMF's *Government Finance Statistics Yearbook*; also see explanations in the Appendix.

and *B* during the past 30 years. According to indicator *A*, there has been long-run convergence towards a medium degree of FD: countries with a relatively high degree tend to reduce it and countries with a relatively low degree tend to increase it.[14] Noteworthy exceptions are, however, Belgium, which lowered its

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[14]A relatively strong long-run decline of fiscal decentralisation (according to indicators *A* and *B*) from a very high degree occurred in Switzerland. Also, the Scandinavian countries Denmark, Norway and Sweden have had long-run declines of their still relatively high degrees of fiscal decentralisation.

relatively low degree further, and also New Zealand and the UK, where the relatively low FD degrees were not raised. Thus, with regard to government expenditures, there are forces at work that increase the relative role of the central government in those countries where subnational governments have relatively high expenditure shares. By contrast, countries with relatively low degrees of fiscal decentralisation, such as Italy, Portugal and Spain, increased the relative role of subnational governments. According to the above discussion, this interesting trend of converging levels of fiscal decentralisation towards an intermediate level could have a growth-promoting effect. This long-run process raises the question of whether it is related to or even driven by the desire of governments to promote economic growth, which cannot, however, be analysed in this paper.

Figure 1 gives a first impression of the relationship between the degree of FD and economic per capita growth. For the group of high-income OECD countries and regarding the period of about three decades since 1970, countries with a medium degree of FD (as measured by the share of expenditures of subnational governments in consolidated expenditures) achieved, on average, higher per capita growth than countries with either a relatively high or a relatively low degree of FD.

FIGURE 1

Per Capita Growth[a] and Fiscal Decentralisation in OECD High-Income Countries (average annual percentages over the period 1973–98 of 22 countries)
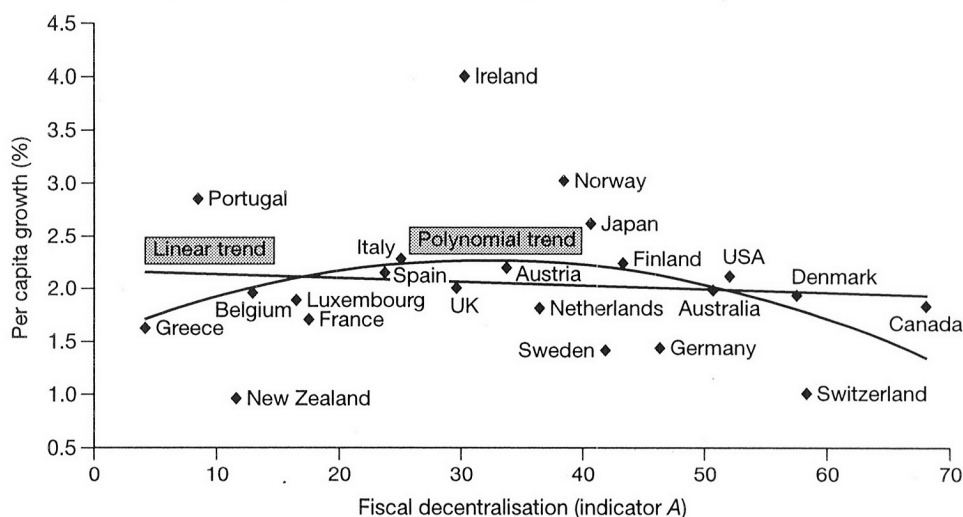
[a]Per capita growth rates are long-run averages.
Sources: Per capita growth from World Bank, *World Development Indicators*; fiscal decentralisation indicator from International Monetary Fund, *Government Finance Statistics Yearbook*.

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The graph supports the idea of a hump-shaped relationship between the degree of FD and per capita growth. There are five outlier countries — New Zealand, Portugal, Ireland, Norway and Switzerland. But even when excluding them, the graphical hump-shaped relationship persists. This hump-shaped relationship is also typical of the enlarged sample of 26 countries, and also for indicators B and C (not shown).

V. LONG-RUN ECONOMIC GROWTH

The association between long-run per capita economic growth and FD is examined on the basis of established empirical growth work. The evidence initially supports two hypotheses — namely, that economic growth and FD are positively and linearly related and also that there is a non-linear, hump-shaped relationship. However, the statistical significance of the former relationship is fragile, whereas that of the latter is relatively robust, especially when using the splines of indicator A, corroborating doubts about economic growth gains through increasingly high FD.

1. Specification

A natural starting point for the empirical analysis is the augmented Solow growth model by Mankiw, Romer and Weil (1992; in the following, MRW). MRW derived a 'convergence equation', which became a standard tool in econometric growth analyses: growth of income per working-age person (ln YP_t – ln YP_0) is a function of the natural log of initial income per worker, ln YP_0, the log of the investment to GDP ratio, ln (I/GDP), the log of human capital (proxied by a school enrolment ratio, ln $School$) and the log of the sum of working-age population growth (n), growth of the level of technology (g) and the depreciation rate of the capital stock (δ), i.e. ln $(n+g+\delta)$. Income per worker (YP) is calculated as GDP divided by the working-age population, where working age is defined as 15 to 64 years. MRW defined a particular school enrolment ratio as a proxy for human capital[15] and assumed the variables g and δ to be constant, i.e. 0.02 and 0.03, respectively, which is a reasonable assumption for high-income OECD countries (MRW, 1992, p. 413). These variable definitions were used except two: the proxy for human capital is the secondary-school enrolment ratio (from UNESCO), which has surprisingly considerable variation across the sample countries,[16] and initial income is real GDP per capita in 1970, denoted *Y70*, from

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[15]They multiplied the secondary-school enrolment rate from UNESCO by the fraction of the working-age population that is of school age.

[16]As an alternative, government educational expenditure as a share of GDP (from the World Bank's *World Development Indicators*) was also tested. This proxy was, however, in general less statistically significant, as were the overall results.

Penn World Tables.[17] The Appendix provides definitions and sources of all variables used in this paper.

The MRW model is augmented with variables representing FD. These are natural logs of averages for the period 1973–98 of indicators *A*, *B*, *C*, *D*, *SR* and the quadratic function of *A*, i.e. adding *A* and *Asq* as independent variables to the regression. In addition, there are the spline functions of indicators *A* and *C*.[18] However, these splines have three coefficients to be estimated, which causes a problem due to the limited sample size of only up to 21 high-income countries. Therefore, the splines were estimated using restricted regressions, as suggested by MRW, which reduces the number of estimated coefficients. The coefficients on ln (*I/GDP*), ln *School* and ln (*n+g+δ*) are restricted to sum to zero, which follows from the structure of the model.[19]

Following Levine and Renelt (1992), Andrés, Doménech and Molinas (1996) and Barro (1997), the robustness of the results was examined by adding variables chosen from a subset of variables and denoted *RG* (robustness of growth equations), variables that had been identified by past empirical studies (reviewed in Levine and Renelt (1992) and Barro (1997)) as potentially important explanatory variables of growth. This subset includes averages of the ratio of government consumption expenditures to GDP (*GCo/GDP*), of the ratio of the fiscal balance to GDP (*FB/GDP*), of the consumer price inflation rate (*GCPI*), of uncertainty of economic agents with regard to macroeconomic stability proxied by the standard deviation of domestic credit growth (*SDDC*)[20] and of the share of exports in GDP (*X/GDP*). They were transformed into natural logarithms when possible. An additional test of robustness and a test for differences between unitary and federal countries are the use of particular country dummies (*CD*)[21] and variation of the sample size. The unrestricted form of the estimated pure cross-sectional growth equation is thus

$$(1) \quad GYP_i = \alpha + \beta_1 \ln Y70_i + \beta_2 \ln (I/GDP)_i + \beta_3 \ln School_i$$
$$+ \beta_4 \ln (n+g+\delta)_i + \beta_5 FD_i + \beta_6 RG_i + \beta_7 CD_i + \varepsilon_i,$$

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[17]1970 was chosen and not the starting year of the sample (1973) in order to avoid the turbulences of the first oil price shock. But the results are not influenced by this choice.

[18]When using the splines, a constant cannot be included.

[19]MRW (1992, p. 410) note: 'Because the model assumes that factor shares are paid their marginal products, it predicts not only the signs but also the magnitudes of the coefficients on saving and population growth. Specifically, because capital's share in income ... is roughly one third, the model implies an elasticity of income per capita with respect to the saving rate of approximately 0.5 and an elasticity with respect to *n+g+δ* of approximately –0.5.' 0.5 + (–0.5) equals zero.

[20]The standard deviation is calculated for overlapping five-year periods, where the last three years, the current year and the following year are considered.

[21]One dummy was included for Norway and Ireland, which had exceptionally high growth, another one for the four European countries that received substantial net transfers from the European Union (Greece, Ireland, Portugal and Spain) and a third one for the two of these four countries that received the highest net transfers relative to their GDP (Ireland and Portugal).

where *GYP* is log difference GDP per working-age person for 1973–98. The independent variables, except the country dummies (*CD*), are averages over this period. *FD* represents logs of averages of indicators *A*, *B*, *C*, *D*, *SR* and the quadratic function of *A*. The subscript *i* indexes the country. The growth equations were estimated over the period 1973–98 for up to 25 countries. Following MRW, the simple ordinary least squares (OLS) method may be used on the assumption that the explanatory variables are exogenous.[22]

The expected signs of the estimated coefficients are as follows: $\beta_1 < 0$ if there is evidence for conditional convergence (i.e. countries with relatively low initial income tend to grow relatively fast after controlling for differences in the other included independent variables). The effects of investment in physical capital (β_2) and in human capital (β_3) are clearly positive. The expected effect of the sum of working-age population growth plus the constants *g* and δ on growth (β_4) is negative. The signs of the coefficients of the FD variables, β_5, are not clear due to the theoretical ambiguity of the growth impact of fiscal decentralisation. Since this relationship is, however, expected to be non-linear and hump-shaped, indicator *D* should have a positive coefficient, whereas the quadratic in indicator *A* should have a negative one.

The restricted form of the growth equation is

$$(2) \qquad GYP_i = \beta_1 \ln Y70_i + \beta_2 \{\ln (I/GDP)_i - \ln (n+g+\delta)_i\} \\ + \beta_3 \{\ln School_i - \ln (n+g+\delta)_i\} + \beta_4 FD_i + \beta_5 RG_i + \beta_6 CD_i + \varepsilon_i,$$

where *FD* represents the spline functions (the three dummies for a low, medium and high degree of FD) of indicators *A* and *C*. A Wald test shows whether or not the restriction is rejected. Due to the three dummies which represent FD, the equation must be estimated without a constant.

2. Results

Table 4 presents the pure cross-sectional per worker growth regressions for the 26-year period 1973–98.[23]

The variables included in the 'base' regression (ln *Y70*, ln (*I/GDP*), ln ($n+g+\delta$) and ln *School*) have the expected signs and are in most cases statistically significant at least at the 10 per cent level with the exception of the sum of working-age population growth, technical progress and depreciation of

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[22]Not accepting this assumption requires the use of the instrumental variables (IV) method and thus adequate instruments have to be found, which is a formidable task. There is also a growing literature that argues that IV estimation may be associated with problems that are not fully appreciated, i.e. IV estimators can be worse than the OLS estimators and, hence, the cure can be worse than the disease (see, for instance, Buse (1992) and Bound, Jaeger and Baker (1996)).

[23]For reasons of space, only selected results are presented in the following. Full results of the estimations and the raw data are available from the author.

TABLE 4

Cross-Sectional Regressions: Long-Run Growth

Dependent variable: log difference GDP per working-age person, 1973–98[a]

	Constant	$\ln(Y70)$	$\ln(I/GDP)$	$\ln(n+g+\delta)$	$\ln(School)$	DNI[b]	Indicators of fiscal decentralisation							Adj. R^2	F-stat	No. of obs.
							$\ln(A)$	$\ln(B)$	$\ln(C)$	A	Asq	$\ln(D)$	$\ln(SR)$			
21 high-income OECD countries[c]																
1a[d]	-0.79	-0.31	0.60	-0.38	0.89									0.250	2.66	21
	(-0.38)	(-2.80)**	(2.00)*	(-0.69)	(2.02)*											
1b[e]	0.60	-0.46	0.55	-0.75	0.71		0.15							0.443	4.19	21
	(0.32)	(-4.12)***	(2.16)**	(-1.53)	(1.85)*		(2.56)**									
1c[e]	-0.36	-0.39	0.52	-0.46	0.93			0.04						0.249	2.33	21
	(-0.17)	(-2.81)**	(1.72)	(-0.83)	(2.10)*			(1.00)								
1d[e]	0.44	-0.46	0.51	-0.70	0.79				0.13					0.396	3.62	21
	(0.23)	(-3.83)***	(1.89)*	(-1.36)	(1.97)*				(2.21)**							
1e[e]	1.01	-0.41	0.49	-0.43	0.58					2.17	-2.52			0.476	4.03	21
	(0.54)	(-3.78)***	(1.94)*	(-0.82)	(1.51)					(2.88)**	(-2.48)**					
1f[e]	0.72	-0.30	0.33	-0.63	0.29	0.26				1.65	-1.81			0.642	6.14	21
	(0.47)	(-3.37)***	(1.50)	(-1.45)	(0.87)	(2.73)**				(2.52)**	(-2.05)*					
1g[g]	1.12	-0.28	0.47	-0.05	0.54							0.10		0.434	4.07	21
	(0.57)	(-2.92)**	(1.80)*	(-0.09)	(1.32)							(2.50)**				
1h[e]	-0.47	-0.24	0.57	-0.26	0.72								-0.16	0.297	2.61	20
	(-0.23)	(-2.09)*	(1.55)	(-0.49)	(1.65)								(-1.67)			

Continues overleaf.

TABLE 4 continued

	Constant	$\ln$(Y70)	$\ln$(I/GDP)	$\ln$(n+g+δ)	$\ln$(School)	DNI[b]	Indicators of fiscal decentralisation							Adj. R^2	F-stat.	No. of obs.
							$\ln$(A)	$\ln$(B)	$\ln$(C)	A	Asq	$\ln$(D)	$\ln$(SR)			
14 high-income countries with unitary governmental system																
1i[e]	2.01	−0.53	0.64	−0.40	0.83		0.19							0.491	3.50	14
	(0.68)	(−3.03)**	(2.13)*	(−0.52)	(1.59)		(2.67)**									
1j[e]	0.12	−0.45	0.66	−0.59	0.82					2.69	−3.62			0.482	3.02	14
	(0.04)	(−2.61)**	(2.15)*	(−0.75)	(1.51)					(2.70)**	(−2.23)*					
1k[e]	−0.63	−0.47	0.69	−0.84	0.90							0.17		0.592	4.78	14
	(−0.28)	(−3.12)**	(2.62)**	(−1.26)	(1.94)*							(3.30)**				
Full sample (21 high-income OECD countries plus 'control group' of relatively advanced OECD middle-income countries)																
1l[e]	1.60	−0.52	0.67	−0.78	0.69		0.15							0.713	12.94	25
	(1.72)	(−5.75)***	(2.97)***	(−1.58)	(4.73)***		(2.87)***									
1m[e]	1.15	−0.49	0.66	−0.66	0.69					1.55	−1.55			0.686	9.78	25
	(1.11)	(−5.07)***	(2.80)**	(−1.23)	(4.53)***					(2.17)**	(−1.55)					
1n[e]	1.88	−0.39	0.73	−0.13	0.71							0.07		0.638	9.44	25
	(1.81)*	(−4.37)***	(2.86)**	(−0.27)	(4.31)***							(1.59)				

[a]For variable definitions, see explanations in the text and in the Appendix. The investment ratio (I/GDP), population growth rate (n) and secondary-school enrolment ratio (School) are averages for the period 1973–98. Y70 is GDP per working-age person in 1970. Definitions of country groups are given in Table 1.
[b]Dummy for Norway and Ireland, which had exceptionally high TFP growth during the period considered and a medium degree of fiscal decentralisation.
[c]Except model 1h, which comprises 20 countries due to missing data for Japan.
[d]Solow model augmented with human capital accumulation; see Mankiw, Romer and Weil (1992, p. 426).
[e]Solow model augmented with human capital accumulation and indicators of fiscal decentralisation.
Note: OLS method is used. T-statistics are given in parentheses; * indicates significance of the respective variable at the 10 per cent level; ** indicates significance at the 5 per cent level; *** indicates significance at the 1 per cent level.
Source: Author's calculations.

the capital stock and in several cases also the proxy for human capital and the investment to GDP ratio. The coefficients are elasticities of the steady-state level of income with regard to the respective independent variable. In comparison with the original results of MRW (1992), whose sample period was 1960–85, the implied convergence rate decreased slightly, the positive growth effect of investment in both physical and human capital rose considerably, the dampening effect of working-age population growth declined and the statistical significance of human capital rose. However, the portion of the total variation in economic growth that is explained by the model decreased considerably, from 65 per cent reported by MRW to 25 per cent (equation 1a in Table 4).[24] This indicates that factors other than those considered by the augmented Solow model had a larger effect on growth during the period considered here (1973–98) than during the period analysed by MRW (1960–85).

Surprisingly, when including indicators of fiscal decentralisation in the estimated equation, the explained portion almost always rises considerably and the measured positive growth effects of investment in physical and human capital decline somewhat whereas the dampening effect of population growth increases. With regard to fiscal decentralisation, it is found that indicators A, C and the two indicators that test for a non-linear, hump-shaped relationship between economic growth and FD (D and the quadratic in A) are all highly statistically significant. The two latter indicators are relatively highly significant (equations 1e and 1g). They remain so even when controlling, through a dummy variable, for the influence of the two outlier countries, Ireland and Norway (equation 1f). Indicators B and SR are never statistically significant and, surprisingly, the self-reliance ratio SR always has a negative sign. The irrelevance of indicator B (distribution of government revenues) relative to indicator A (distribution of government expenditures) can be interpreted as suggesting that for economic growth, it may be less important how the tax revenues are distributed among the government levels but more important which government level controls the expenditures.

Also, the dummy variable for unitary countries (not shown) is never significant, and when estimating a subsample for these countries (equations 1i–1k), the same results regarding the significance of FD variables are obtained as for the whole sample of high-income OECD countries.

Adding the selected four advanced developing countries with relatively low income to this sample (equations 1l–1n), the case for a linear relationship between growth and FD is strengthened and that for a non-linear, hump-shaped relationship weakened (indicator A is highly significant whereas indicators D and Asq become insignificant). This suggests that middle-income developing countries benefit, on average, from increased FD.

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[24]MRW obtained this 65 per cent ratio for the same country sample with the exception of Turkey, which was included by MRW and excluded here.

Robustness tests were performed by adding up to three policy variables of the subset RG to equations 1b–1n. These added variables were never significant at least at the 10 per cent level and their inclusion tended to reduce the significance of most or all independent variables of the base regressions and to reduce the adjusted R^2. However, the estimated signs of the coefficients of the base regression never changed and in many cases the FD indicators and other variables of the base regressions remained significant at least at the 10 per cent level. Comparing the sensitivity of the significance of indicator A and the two indicators of a hump-shaped relationship, it was found that A is more sensitive than the latter two indicators, i.e. its significance is relatively fragile.

These experiments thus suggest that the significance of the variables of the base regressions is not robust to the inclusion of additional variables, although their signs are. The smaller sensitivity of the significance of indicator D and the quadratic in A to the inclusion of additional variables compared with that of indicator A may increase confidence in the existence of a hump-shaped relationship between growth and FD.

Using the splines of indicators A and C in the restricted growth regressions provides strong support for a hump-shaped relationship:[25] Table 5 (equations 2a–2d) shows that for different sample groups of the high-income OECD countries, a medium degree of fiscal decentralisation according to indicators A and C is associated with higher long-run per-worker growth than either a low or a high degree.[26] The spline function of indicator C was consistently insignificant, and therefore only one sample regression with this indicator is shown (equation 2b). According to these equations, the ranking of the contribution of FD (measured by indicator A) to long-run growth is such that, on average, a medium degree is best for growth, followed by a high degree, whereas a relatively low degree promotes growth least.

Confirming the finding above, inclusion of the four developing countries in the sample changes this picture such that growth is promoted best the higher is the degree of FD (equation 2e).

Robustness tests through adding policy variables show that the hump-shaped relationship between growth and FD is robust, although the significance of several or all of the independent variables of the base regressions tends to decline. The significance of the FD splines is, however, affected relatively little by these experiments.

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[25]As shown by the high p-values in the last column of Table 5, the restriction was never rejected.
[26]This result holds also when including a dummy variable for the two countries with relatively high per capita growth and a medium degree of fiscal decentralisation — Ireland and Norway.

TABLE 5

Cross-Sectional Regressions: Long-Run Growth

Dependent variable: log difference GDP per working-age person, 1973–98
Solow model, restricted regression, augmented with human capital accumulation and dummies for the degree of fiscal decentralisation

	$\ln(Y70)$	$\ln(I/GDP)$ $-\ln(n+g+\delta)$	$\ln(School)$ $-\ln(n+g+\delta)$	Dummies for the degree of fiscal decentralisation						Adj. R^2	F-stat.	No. of obs.	Wald test of restriction: p-value
				Low degree, indicator A ('AL')	Medium degree, indicator A (AM)	High degree, indicator A (AH)	Low degree, indicator C (CL)	Medium degree, indicator C (CM)	High degree, indicator C (CH)				
21 high-income OECD countries													
2a	−0.33 (−3.04)**	0.54 (2.07)*	0.27 (2.55)**	1.81 (2.04)*	1.95 (2.14)**	1.88 (2.01)*				0.407	3.74	21	0.915
2b	−0.32 (−2.64)**	0.58 (2.12)*	0.27 (2.13)**				1.68 (1.48)	1.72 (1.44)	1.71 (1.42)	0.294	2.67	21	0.811
14 high-income countries with unitary governmental system													
2c	−0.46 (−2.30)*	0.66 (1.79)	0.37 (2.08)*	2.50 (1.62)	2.65 (1.69)	2.57 (1.57)				0.22	1.73	14	0.919
15 OECD countries with highest per capita income													
2d	−0.50 (−4.12)***	0.40 (1.60)	−0.14 (−1.02)	5.50 (4.24)***	5.62 (4.32)***	5.55 (4.16)***				0.712	7.91	15	0.677
Full sample (21 high-income OECD countries plus 'control group' of relatively advanced OECD middle-income countries)													
2e	−0.28 (−2.48)**	1.22 (3.90)***	0.22 (1.61)	0.63 (0.80)	0.69 (0.89)	0.74 (0.87)				0.346	3.54	25	0.815

Notes: For variable definitions, see explanations in the text and in the Appendix. Definitions of country groups are given in Table 1. OLS method is used. T-statistics are given in parentheses; * indicates significance of the respective variable at the 10 per cent level; ** indicates significance at the 5 per cent level; *** indicates significance at the 1 per cent level.
Source: Author's calculations.

VI. THE LONG-RUN INVESTMENT SHARE

The association between the long-run gross investment share in GDP and FD is also examined. All FD indicators are consistently statistically insignificant, except indicator *B* and, as in the previous section, the splines of indicator *A*. But the significance of indicator *B* is fragile, whereas that of the splines is, as in the previous section, highly robust. The estimated coefficients of the splines point to limits for improvements of investment performance through FD.

1. Specification

A 'base' regression of the long-run total investment share is specified as a function of the initial income level and three macroeconomic policy variables — namely, the ratio of the fiscal balance to GDP (*FB/GDP*), macroeconomic uncertainty as defined before (*SDDC*) and the ratio of government consumption to GDP (*GCo/GDP*). The initial income level is included due to the expectation that in the long run, countries with relatively low income are catching up with higher-income countries through higher per capita economic growth, which may require higher physical investment ratios. Other macroeconomic policy variables of the subset of *RG* variables considered above are not included in the 'base' regression because prior tests revealed that they had unexpected and highly insignificant signs: the ratio of exports to GDP consistently had a negative sign and the inflation rate had a positive one. The two measures for human capital investment — the school enrolment ratio (*School*) and the ratio of government educational expenditures to GDP (*E/GDP*) — are consistently insignificant. All these variables are used, however, for additional tests of robustness and are denoted *RI* variables (robustness of investment equations). All measures of fiscal decentralisation are used, including the splines. Variables are not transformed into natural logarithms because prior tests revealed that this improved the fit and the overall significance. Thus, the estimated equations have the general form

$$(3) \qquad I/GDP_i = \alpha + \beta_1 \, Y70_i + \beta_2 \, (FB/GDP)_i + \beta_3 \, SDDC_i + \beta_4 \, (GCo/GDP)_i \\ + \beta_5 \, FD_i + \beta_6 \, RI_i + \beta_7 \, DU_i + \varepsilon_i,$$

where *I/GDP* is the average annual investment to GDP ratio over the period 1973–98, *Y70* is initial income (real GDP per capita for 1970 from *Penn World Tables*) and *DU* is a country dummy variable for unitary countries considered in the sample of all high-income OECD countries.

The expected signs of the estimated coefficients are as follows: $\beta_1 < 0$ if countries with relatively low income tend to have a higher investment share; $\beta_2 > 0$, to the extent that the potential crowding-out effect of investment through budget deficits prevails;[27] and β_3 and $\beta_4 < 0$ if higher uncertainty with regard to

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[27]Note that an increase in *FB/GDP* represents a rise in the budget surplus.

macroeconomic stability and a higher share of government consumption in GDP inhibit investment. The expected signs of the coefficients of the FD variables, β_5, are again undetermined, except for indicator D and Asq, which are expected to be positive and negative, respectively.

2. Results

Table 6 shows the main results of the association between FD and the total investment share in GDP: high-income OECD countries with a medium degree of FD have, on average and in the long run, a slightly better investment performance (i.e. a higher investment share in GDP) than countries with either a relatively low or a relatively high degree (equation 3a).

    This finding is confirmed for the two subgroups of high-income countries, i.e. unitary countries and countries with highest income (equations 3c and 3e), and also for the sample where the four developing countries are included (equation 3g). Moreover, there is no significant difference in the long-run investment performance between countries with a low or a high degree of FD. Thus, investment decisions are apparently of importance in explaining the estimated beneficial effect of a medium degree of FD on economic growth relative to either a high or a low degree.[28] In these investment regressions, all other FD indicators are consistently statistically insignificant, except, surprisingly, indicator B (the tax revenue share of subnational governments in total government tax revenues), which is significant at least at the 10 per cent level in several subgroups (equations 3b, 3d and 3f). However, the significance of indicator B is as fragile as the significance of indicator A in the growth regressions in Section V when examining its robustness to the inclusion of successively added explanatory variables from the subset RI. Thus, the finding that increases in the tax revenue share of subnational governments in total government revenues have, on average and in the long run, a beneficial effect on the total investment share is not statistically robust. But the significance of the splines is robust to the inclusion of additional variables, variation in the sample size and inclusion of a dummy for unitary countries. As in the economic growth regressions, the dummy for unitary countries is never statistically significant.

    The other explanatory variables of the investment share are predominantly statistically significant at least at the 10 per cent significance level, with the expected signs, except the proxy for macroeconomic uncertainty (the standard deviation of domestic credit growth, $SDDC$), which is highly significant only in the regressions that include the OECD middle-income countries. These results indicate that government deficits and government consumption are, on average, not conducive to good overall investment performance.

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[28]This result holds also when controlling, through a dummy variable, for the effect of the two high-growth countries with a medium degree of fiscal decentralisation — Norway and Ireland. The dummy was, however, not statistically significant.

TABLE 6

Cross-Sectional Regressions: Long-Run Capital Formation

Dependent variable: average annual investment share in GDP (I/GDP), 1973–98

	Constant	Y70	FB/GDP	SDDC	GCo/GDP	Indicators of fiscal decentralisation				Adj. R^2	F-stat.	No. of obs.
						B	AL	AM	AH			
21 high-income OECD countries												
3a		-0.001 (-2.23)**	0.71 (2.40)**	-0.23 (-1.03)	-0.27 (-1.79)*		0.374 (8.17)***	0.384 (8.69)***	0.375 (7.65)***	0.297	2.41	21
14 high-income countries with unitary governmental system												
3b	0.40 (11.19)***	-0.01 (-3.32)**	0.59 (2.50)**	-0.33 (-1.77)	-0.34 (-2.48)**	0.13 (3.00)**				0.771	9.79	14
3c		-0.01 (-2.03)*	0.89 (2.40)**	-0.51 (-1.85)	-0.27 (-1.17)		0.430 (7.45)***	0.434 (8.07)***	0.430 (6.70)***	0.449	2.77	14
15 OECD countries with highest per capita income												
3d	0.43 (9.78)***	-0.01 (-4.41)***	0.91 (2.76)**	-0.20 (-0.95)	-0.30 (-2.36)**	0.10 (2.16)*				0.652	6.26	15
3e		-0.01 (-2.10)*	1.06 (2.65)**	-0.29 (-1.21)	-0.30 (-1.93)*		0.402 (6.85)***	0.422 (7.91)***	0.402 (6.58)***	0.517	3.50	15
Full sample (21 high-income OECD countries plus 'control group' of relatively advanced OECD middle-income countries)												
3f	0.35 (13.78)***	-0.001 (-3.89)***	0.49 (2.24)**	-0.02 (-4.04)***	-0.32 (-2.65)**	0.09 (1.98)*				0.550	6.88	25
3g		-0.01 (-2.15)**	0.63 (2.53)**	-0.02 (-3.26)***	-0.33 (-2.45)**		0.349 (11.20)***	0.358 (12.73)***	0.347 (10.32)***	0.448	4.25	25

Notes and Source: Same as for Table 5.

VII. LONG-RUN TOTAL FACTOR PRODUCTIVITY GROWTH

Examining the association between long-run total factor productivity growth (TFPG) and FD proved to be a difficult task and, despite all efforts, omitted variables could be important. Admitting this qualification, it is found that of the FD indicators, only the three splines of indicator *A* are consistently significant and robust, as in the investment analysis. Their estimated coefficients suggest that TFPG is promoted through FD, if at all, only up to a certain limit.

1. Specification

Productivity growth is calculated for the sample countries as a Solow residual, as explained in the Appendix. Empirical analyses of TFPG are notoriously difficult and this is also the case here. Therefore, the specification is very limited: in addition to initial income. which is included because it could be expected that countries with initially lower income catch up with higher-income countries through higher TFPG, only one macroeconomic policy variable is considered in the 'base' regression — namely, the proxy for macroeconomic uncertainty (the standard deviation of domestic credit growth, *SDDC*). Prior tests revealed that it was the only policy variable that was relatively significant. Thus, *TFPG* is specified as a function of initial income, *SDDC* and *FD*. Tests for robustness are carried out by adding, step by step, all other previously described macroeconomic policy variables (denoted robustness variables in TFPG regressions, *RT*). A dummy for unitary countries (*DU*) is also considered. Variables are not transformed into natural logarithms because this improves the overall goodness of the estimated equations. Thus, the general form of the estimated equations is

(4) $$TFPG_i = \alpha + \beta_1\, Y70_i + \beta_2\, SDDC_i + \beta_3\, FD_i + \beta_4\, RT_i + \beta_5\, DU_i + \varepsilon_i,$$

where *TFPG* is average annual TFP growth.

The expected signs are as follows: $\beta_1 < 0$ if countries with lower initial income tend to catch up through relatively high TFPG; $\beta_2 < 0$ if macroeconomic uncertainty inhibits TFPG; β_3 is again undetermined except when using indicator *D* and the quadratic in *A*, for which a positive and negative sign are expected, respectively.

2. Results

As expected, finding satisfactory empirical associations between TFPG and relevant macroeconomic variables is very difficult, as shown by the relatively low explained portion of the total variation in the dependent variable in the equations shown in Table 7. Particular caution is thus needed in interpreting the

TABLE 7

Cross-Sectional Regressions: Total Factor Productivity Growth

Dependent variable: average annual total factor productivity growth, 1973–98[a]

	Constant	Y70	SDDC	DNI[b]	Indicators of fiscal decentralisation				Adj. R^2	S.E. of regression	F-stat.	No. of obs.
					D	AL	AM	AH				
21 high-income OECD countries												
4a		-0.001 (-1.64)	-0.035 (-0.90)			0.0170 (3.29)***	0.0182 (3.61)***	0.0158 (2.37)**	0.076	0.00451	1.39	21
4b		-0.001 (-1.40)	-0.064 (-2.12)*	0.011 (3.72)***		0.0173 (4.49)***	0.0155 (4.06)***	0.0149 (2.99)***	0.485	0.00337	4.76	21
4c	0.015 (3.21)***	-0.001 (-2.16)**	-0.021 (-0.61)		0.00046 (1.87)*				0.245	0.00407	3.16	21
14 high-income countries with unitary governmental system												
4d		-0.001 (-1.91)*	-0.056 (-1.08)			0.0164 (2.32)**	0.0189 (2.79)**	0.0177 (1.81)	0.159	0.00485	1.54	14
4e	0.016 (2.85)**	-0.001 (-1.70)	-0.038 (-0.92)		0.00067 (2.03)*				0.206	0.00426	2.12	14
15 OECD countries with highest per capita income												
4f		-0.001 (-1.67)	-0.002 (-0.07)			0.0212 (2.69)**	0.0220 (3.11)**	0.0199 (2.18)*	0.229	0.00415	2.04	15
Full sample (21 high-income OECD countries plus 'control group' of relatively advanced OECD middle-income countries)												
4g		-0.0001 (-0.17)	-0.002 (-1.80)*			0.0110 (2.75)**	0.0110 (3.19)***	0.0079 (1.44)	0.029	0.00511	1.18	25

results. To this end, the table also reports the standard errors of the regressions to enable a sense to be gained of the amount of variation there is in TFPG.

TFPG is higher, on average, in countries with a medium degree of FD than in countries with either a relatively low or a relatively high degree. This is shown by equations that use the splines of indicator A (equations 4a, 4d and 4f) or the splines of indicator C (not shown). Also, indicator D is significant at the 10 per cent level in several samples (equations 4c and 4e), whereas all other FD indicators are consistently insignificant.[29] However, in contrast to the economic growth regressions and the investment regressions, this result is influenced considerably by two countries with a medium degree of FD and above-average per-worker growth and TFPG — Norway and Ireland — as shown by equation 4b. When controlling for the influence of these two countries, the relationship between TFPG and FD becomes linear and negative. Such a negative linear association is also obtained for the whole sample including the developing countries (equation 4g). Thus, the empirical evidence points to disadvantages of relatively high fiscal decentralisation for TFPG. One admittedly speculative explanation for this could perhaps be that TFPG, which, by definition, reflects all economic growth contributions not coming from physical investment and labour force growth (i.e. technical progress and institutional improvements) may be influenced more by central government decisions than by regional or local ones, because many institutional changes require central government decisions. Hence, when subnational governments have a strong expenditure and/or revenue power relative to the central government, the latter may have fewer incentives and/or possibilities to improve the institutional environment and therefore less TFPG may result. By contrast, if the central government has 'too much' power relative to subnational governments, the lack of competition between the two may result in little pressure on the central government to design and implement improvements that could foster TFPG.

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[29]Robustness tests of equations 4a–4g by adding policy variables confirmed the consistently high significance of the FD dummies, but not of indicator D, which is rather fragile. The other independent variables of the base regression are robust with regard to their signs. Their significance and coefficients are, however, fragile, as the different samples shown in Table 7 already show.

VIII. CONCLUDING REMARKS

Over the last 30 years, countries with a formerly low degree of fiscal decentralisation have tended to raise it and countries with a formerly high degree of FD have tended to reduce it. This convergence could have a growth-promoting effect, since the theoretical arguments for and against fiscal decentralisation suggest that promoting economic growth through FD may have limits. Perhaps one of the arguments explaining such limits may appear particularly convincing: the full use of growth-conducive spillovers across jurisdictions and regions of the supply of public goods and services (including maximisation of feedback effects) may require a significant role of the central government (and also of supranational authorities) concerning decisions about public goods supply. The estimated long-run effects of fiscal decentralisation in high-income OECD countries on economic growth and two of its major determinants, the total investment share in GDP and TFP growth, suggest that there are indeed limits for economic gains from fiscal decentralisation, although, admittedly, the findings are inevitably tentative due to the small sample size and since the FD variables could be endogenous to a wider political process that may be correlated with other growth determinants.[30] Starting at a relatively low level of fiscal decentralisation (measured either by the share of subnational government expenditures in consolidated government expenditures or by a simple average of this share and the share of revenues) and increasing it to a medium level, the total investment ratio and per-worker economic growth tend to be promoted. If fiscal decentralisation increases further, the investment ratio, TFP growth and economic growth all tend to decrease. The hypothesis for a hump-shaped relationship between economic growth and FD appears to hold also for both federal and unitary countries. This is suggested by consistent insignificance of a dummy variable for one of these groups in regressions that include both types of countries and by the results of regressions for subgroups in cross-sectional and in panel analyses. No relationship between economic performance and reliance of subnational governments on own revenue sources to finance their expenditures could be found. An additional qualification to these findings is, of course, the adequacy of the indicators used. Future research may arrive at a better indicator on the basis of an in-depth analysis of intergovernmental fiscal relations in each of the countries considered, which may make it possible to weigh the indicators presented and combine them.

The evidence in support of a hump-shaped relationship between economic growth and FD in high-income countries has a tentative policy implication: the optimal degree of FD at which economic growth would be maximised should be found. Hence, it could be interesting to examine especially the individual circumstances regarding countries that did not follow the trend of convergence

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[30]This point was emphasised by an anonymous referee.

towards an intermediate level of FD. This concerns countries with a relatively low degree of FD (Belgium, France and New Zealand). In addition, the UK, despite its good growth performance and its formerly medium degree of FD, did not follow the trend of convergence, since its long-run trend is toward declining FD (briefly interrupted at the end of the 1980s). Perhaps there are barriers to increases in FD in these countries that could be reduced to promote growth further.

APPENDIX: DEFINITIONS OF VARIABLES AND DATA SOURCES

A.1 Indicators of Fiscal Decentralisation

Indicators A (the share of subnational government expenditures in consolidated government expenditures), B (the share of subnational government tax revenues in consolidated government revenues) and SR (share of own revenues in total revenues of subnational governments, i.e. the self-reliance ratio) were taken from the International Monetary Fund's *Government Finance Statistics Yearbook*. The cross-sectional regressions use annual averages over the period 1973–98. As shown in Table A.1, there were gaps in the data needed to construct indicators A, B and SR for eight countries.

In four cases, it seemed justifiable to fill these gaps due to relatively minor variation in the indicator values that surround the missing years: for Italy, missing data were constructed by assuming that the indicators evolve linearly from 1975 to 1985 and from 1989 to 1995; for New Zealand, Spain and Switzerland, the missing years were similarly constructed. With regard to

TABLE A.1

**Missing Data for Selected Countries
in IMF's *Government Finance Statistics Yearbook***

	Indicator A		Indicator B		Indicator SR	
	Gap	Gap filled?	Gap	Gap filled?	Gap	Gap filled?
Greece	1982–98	no	1982–98	no	1982–98	no
Italy	1976–84	yes	1976–84	yes	1976–84	yes
	1990–94	yes	1990–94	yes	1990–94	yes
Japan	1978–98	no	1975–80	yes	1973–98	no
			1990–98	no		
Korea	1979–98	no	1979–98	no	1979–98	no
New Zealand	1973–77	yes	1973–77	yes	1973–77	yes
	1982–91	yes	1982–91	yes	1982–91	yes
Portugal	1973–86	no	—	—	1973–86	no
Spain	1974–79	yes	—	—	1974–79	yes
Switzerland	1985–89	yes	—	—	1985–89	yes

indicators *A*, *B* and *SR*, this procedure was, however, not deemed justifiable in the cases of Greece, Japan and Korea, so that for these countries, the indicators are not available as time series. Also, indicators *A* and *SR* are not available as time series for Portugal.

The averages of indicator *A* for these countries (Greece, Japan, Korea and Portugal) used in cross-sectional regressions had thus to be based on averages of the following shorter periods: Greece, 1973–81; Japan: 1973–77; Korea: 1973–78; and Portugal: 1987–98. The averages of indicator B for Greece, Japan and Korea were based on the following periods: Greece, 1973–81; Japan, 1973–89; and Korea, 1973–78. The averages of indicator *SR* for these countries were based on averages during the same years, except for Japan, where no data were available.

The spline functions of indicators *A* and *C* for use in the cross-sectional and panel regressions were constructed for all countries and all years in the sample. For Greece, Italy, Portugal and New Zealand, the available data on indicator *A* are substantially below a 30 per cent share of subnational government expenditures in total government expenditures. Therefore, years of missing data for these countries were classified as ones that fall in the category of a low degree of fiscal decentralisation (*AL*). In the case of Japan, it was assumed that the medium range of fiscal decentralisation (*AM*), which prevailed in the 1970s, was maintained throughout the period under consideration. For Korea, it was assumed that the relatively high degree of fiscal decentralisation (*AH*), which prevailed in the second half of the 1970s, was maintained. The splines for indicator *C* were constructed analogously. This spline function breaks at values of 18 per cent and 35 per cent, which results in three country groups of similar strengths.

A.2 Total Factor Productivity Growth

A simple growth-accounting exercise is undertaken to estimate the growth rate of total factor productivity (the Solow residual, denoted *TFPG*), assuming a constant labour share of 0.65:

$$(A.1) \quad TFPG_{it} = GDPR_{it} - 0.35 \, GKAP_{it} - 0.65 \, GLAFO_{it},$$

where *GDPR* represents the growth rate of real GDP, *GKAP* denotes the growth rate of real capital (using the growth rate of real gross fixed capital formation) and *GLAFO* denotes the growth rate of the labour force. The subscript *i* indexes the country ($i = 1, \ldots, 25$) and the subscript *t* indexes time ($t = 1973$ to 1998). Admittedly, this estimation has well-known limitations since it abstracts from the quality of factor inputs and time-varying factor shares, due to data constraints.

A.3 Data

In the following alphabetical list of variables used and sources, the data are annual unless otherwise noted.

δ	Rate of depreciation of capital, assumed to be a constant of 0.03.
A	Ratio of subnational government expenditures to consolidated government expenditures, from IMF's *Government Finance Statistics Yearbook*.
AH	Dummy variable ('high degree of fiscal decentralisation according to indicator A') that attains the value 1 for years during which indicator A is above 45 per cent.
AL	Dummy variable ('low degree of fiscal decentralisation according to indicator A') that attains the value 1 for years during which indicator A is below 30 per cent.
AM	Dummy variable ('medium degree of fiscal decentralisation according to indicator A') that attains the value 1 for years during which indicator A is between 30 and 45 per cent.
Asq	Indicator A squared.
B	Ratio of subnational government tax revenues to consolidated government tax revenues, from IMF's *Government Finance Statistics Yearbook*.
C	Arithmetic average of indicators A and B.
CH	Dummy variable ('high degree of fiscal decentralisation according to indicator C') that attains the value 1 for years during which indicator C is above 35 per cent.
CL	Dummy variable ('low degree of fiscal decentralisation according to indicator C') that attains the value 1 for years during which indicator C is below 18 per cent.
CM	Dummy variable ('medium degree of fiscal decentralisation according to indicator C') that attains the value 1 for years during which indicator C is between 18 and 35 per cent.
D	Transformed indicator A to test for a hump-shaped relationship, as explained in Table 2.
DNI	Dummy variable for Norway and Ireland.
E/GDP	Government expenditures for education (from World Bank's *World Development Indicators*) as a ratio to GDP, where GDP is from IMF's *International Financial Statistics*.
FB/GDP	Ratio of the consolidated fiscal balance to GDP, from IMF's *International Financial Statistics* and World Bank's *World Development Indicators*.
g	Growth rate of technological progress, assumed to be a constant of 0.02.
GCo/GDP	Ratio of total government consumption expenditures to GDP, from IMF's *International Financial Statistics*.
$GCPI$	Consumer price inflation rate, from IMF's *International Financial Statistics*.
$GDPR$	Growth rate of real GDP, from IMF's *International Financial Statistics* and World Bank's *World Development Indicators*.

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GKAP	Proxy for the growth rate of the real capital stock. Since, surprisingly, neither the OECD nor the IMF nor the World Bank provides capital stock data or net fixed capital formation data for all high-income OECD countries, this proxy is simply the growth rate of real gross fixed capital formation under the assumption that it is highly positively correlated with growth of the real capital stock. Real gross fixed capital formation was obtained by deflating nominal gross fixed capital formation by the producer price index, both from IMF's *International Financial Statistics*.
GLAFO	Labour force growth rate, from IMF's *International Financial Statistics* and World Bank's *World Development Indicators*.
I/GDP	Ratio of gross fixed capital formation to GDP, from IMF's *International Financial Statistics* and World Bank's *World Development Indicators*.
n	Growth rate of working-age population (15–64 years), from World Bank's *World Development Indicators*.
School	Annual secondary-school enrolment ratio, from United Nations UNESCO's *Statistical Yearbook*.
SDDC	Uncertainty of economic agents with regard to macroeconomic stability, proxied by the standard deviation of domestic credit growth, from IMF's *International Financial Statistics*, calculated for overlapping five-year periods where the last three years, the current year and the following year are considered.
SR	Indicator of self-reliance of subnational governments (i.e. own revenues of subnational governments, excluding grants, as a share of their total revenues, including grants), from IMF's *Government Finance Statistics Yearbook*.
TFPG	Annual growth rate of total factor productivity, estimated as explained in this Appendix.
X/GDP	Exports divided by nominal GDP, from IMF's *International Financial Statistics*.
Y70	Level of real GDP per capita in 1970, from *Penn World Tables*, version 5.6.
YP	Real income per working-age person, equals GDP divided by working-age population, where working age is defined as 15–64 years. Working-age population from World Bank, *World Development Indicators*.

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