

**FISCAL DECENTRALISATION AND ECONOMIC GROWTH:
IS THERE REALLY A LINK?**

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Introduction

The relationship between fiscal decentralisation (FD) and economic growth has been analysed by a number of economists during the last three decades. Linking economic growth and FD together has mainly three reasons: firstly, growth is seen as an objective of FD and efficiency in the allocation of resources in the public sector; secondly, it is an explicit intention of governments to adopt policies that lead to a sustained increase in per capita income and thirdly, per capita growth is easier to measure and to interpret than other economic performance indicators (see Zhang and Zou 2001, 60). While theoretical examinations started with the pioneer publications of Tiebout (1956), Musgrave (1959) and Oates (1972), empirical analysis regarding the role of economic growth on FD started at the end of the 1970s (with Kee 1977 and Pommerehne 1977) and estimations concerning the direct impact of FD on economic growth have only been conducted since the end of the 1990s (starting with Oates 1995 and Davoodi and Zou 1998). Both theoretical and empirical analyses tend to be inconclusive and come up with ambiguous and differing results. One can conclude that this is the outcome of the theoretical trade-off construction, which reflects the various pros and cons of a decentralised government structure (see Breuss and Eller 2004). But we shall also consider that direct empirical estimations are still scarce and do not sufficiently involve new results of economic growth theory and empiricism. In addition, different methodological approaches and diverse designs for decentralisation have been applied. Furthermore, theoretical foundations for the direct impact of FD on economic growth have remained largely undeveloped and have therefore weakened the validity of the empirical work on this topic (see Martinez-Vazquez and McNab 2001). Nevertheless, the empirical studies on the direct impact of FD on economic growth during the last decade have not only provided the first corresponding empirical examinations, but have also elaborated meaningful insights into

various aspects of this relationship. Therefore, it is time for an evaluation (again¹). This article reviews these studies, summarises their major findings, examines the covered time horizon and region, compares the applied theoretical framework and the chosen empirical methodology, evaluates the chosen indicators for fiscal decentralisation and the specification of the dependent growth variable. In this way we would like to acknowledge this scientific focus of the last decade and contribute to a better understanding of the “real” linkage between the two variables of interest.

Survey of the Status Quo of Empirical Evidence

1.1 Data coverage

Since 1995 there have been few empirical studies, which have directly examined the impact of fiscal decentralisation on economic growth² (in total 14 studies). Table 1 provides a compact overview. Currently there are only six cross-country studies – Oates 1995; Davoodi and Zou 1998 (mixed set of developing countries and OECD countries); Woller and Phillips 1998 (set of least developed countries (LDCs)); Yilmaz 1999; Thießen 2000 and Thießen 2003 (high income OECD countries) – and several ones on particular countries: three on China (Zhang and Zou 1998; Lin and Liu 2000; Zhang and Zou 2001), two on the United States (Xie, Zou and Davoodi 1999; Akai, Nishimura and Sakata 2004), one on Germany (Behnisch, Buettner and Stegarescu 2001), one on India (Zhang and Zou 2001), and one on Russia (Desai, Freinkman and Goldberg 2003). Within the cross-country studies, the countries

¹ In January 2001, Martinez-Vazquez and McNab composed a first survey regarding this issue. Nevertheless, they did not take into account several studies published before this date: Oates (1995), Thießen (2000), or Yilmaz (2000). Until today, a number of new studies have been conducted (see Table 1).

² This survey concentrates on cross-country studies and on studies on particular (federal) states. Studies on developing or transitional countries or studies, which concentrate on the effects of centralisation instead of decentralisation, are tackled only secondarily. Furthermore, there have been elaborated empirical studies focusing the role of central government consumption in GDP for per capita income growth (e.g., Ram 1986; Aschauer 1989; Barro 1990), the impact of the composition of general public expenditures on economic growth (e.g., Devarajan, Swaroop and Zou 1996), the impact of FD on the efficiency of certain policy categories (e.g., Gupta, Honjo and Verhoeven 1997; Letelier 2001), the impact of FD on the size of the public sector (Kirchgässner (2001) surveyed the corresponding literature), the impact of FD on corruption (e.g., Fisman and Gatti 2000), the impact of corruption on growth (e.g., Mauro 1995, Tanzi and Davoodi 1997), or the impact of

are grouped into high and low income ones (Thießen 2000 and 2003), into unitary and federal ones (in order to consider the diverse constitutional structures, see Yilmaz 1999), into different geographical areas (Akai et al. 2004). They also consider the size of the jurisdictions in order to make the ratios more comparable across states and launch size variables (Zhang and Zou 2001: area of Indian states; Desai et al. 2003: size of regional Russian population) or include per capita explanatory variables (Zhang and Zou 2001; Desai et al. 2003).

1.2 Chosen Variables

Appendix A explains the chosen dependent growth and fiscal decentralisation variables in detail³ and refers to their data sources and to the tested hypotheses. Most authors choose the *budget data approach* and approximate the degree of FD using the share of sub-national government expenditures (or revenues) in general government expenditures (or revenues), net of intergovernmental transfers. The Government Finance Statistics (GFS) of the International Monetary Fund (IMF) operate as the corresponding database. As the GFS deliver data since the early 1970s, the resulting time series have a length of circa 30 years. While the revenue share is chosen only in three studies (Woller and Phillips 1998, Thießen 2003, and Akai et al. 2004), the expenditure share is built into eight examinations. Zhang and Zou (1998 and 2001) examine the cross-provincial impact of FD in China and in India and use the ratio of consolidated provincial budgetary spending (revenue) to central budgetary spending (revenue). Lin and Liu (2000) and Desai et al. (2003) use the marginal revenue retention rate or tax revenue retention rate, respectively, as a measure for FD in order to consider regional fiscal incentives and regional fiscal autonomy. A similar measure for the independence of sub-national levels is the self-reliance ratio (share of own revenues of lower levels in their total revenues), which is used by Oates (1995) and Thießen (2000 and 2003).

FD on the quality of governance (e.g., Huther and Shah 1998; Treisman 2000). These sets of studies are not included in this survey.

³ In Table 1 are stated only abbreviations.

These indicators for FD are *disaggregated by function* at different levels of government. Davoodi and Zou (1998, 254) discuss the opposing expected effects of capital and infrastructure expenditures (positive growth effects) versus current and welfare expenditures (negative growth effects). In order to consider the accurate responsibility of either level of government, Woller and Phillips (1998) construct an expenditure share subtracting defence and social security spending and a revenue share subtracting grants-in-aid. Behnisch et al. (2001) analyse different spending categories (education and science, transport and communication) at the central level. Zhang and Zou (1998 and 2001) show the most sophisticated approach respecting functional diversification and separate, on the one hand, budgetary and extra-budgetary spending and, on the other hand, different spending categories at the central and provincial level.

With respect to the *dependent variable*, the majority of the studies use the growth rate of real GDP per capita (in cross-country studies) or the growth rate of real provincial (state) income (in studies on particular countries). Exceptions are Woller and Phillips (1998), who employ the PPP-adjusted real GDP growth rate, Behnisch et al. (2001), who analyse the impact of public sector centralisation on total factor productivity growth (TFPG), Desai et al. (2003), who use a recovery index focused on regional industrial output, or Akai et al. (2004), who test the impact of FD on economic volatility. Thießen (2000) splits economic growth into its components TFPG and the growth rate of real gross fixed capital formation and estimates own regressions using these rates as dependent variables.

1.3 Conceptual Framework

Most authors use the *endogenous growth model of Barro (1990)*, where the production function has multiple inputs including private and public spending (Davoodi and Zou 1998; Zhang and Zou 1998; Xie et al. 1999; Zhang and Zou 2001; Akai et al. 2004). They split public spending into three levels of government (for the first time in Davoodi and Zou 1998) and analyse different decentralisation shares regarding their consistency with growth

maximization (see in particular Xie et al. 1999). Highest complexity is reached in Zhang and Zou (2001), who augment the aforementioned approach and develop a model that links multiple sectors of public spending by multiple levels of government to economic growth. Akai et al. (2004) refer additionally to Nishimura (2001), who developed a model, which considers differences in the quality as well as complementarities of public services. Lin and Liu (2000) and Thießen (2003) choose a different approach. They follow *Mankiw, Romer and Weil (1992)* and adapt their augmented Solow (1956) model of economic growth introducing FD as explaining variable.

1.4 Empirical Methodology

Two kinds of conventional growth regressions are employed: *pure cross-country regressions* and *panel data regressions* based on several period averages. In panels usually annual frequency data are used, but it is also possible to construct perennial average panels in order to capture the likelihood of long-run effects (see Davoodi and Zou 1998; Woller and Phillips 1998). Pro and cons of these two regression types are discussed in particular by Thießen (2000 and 2003), who finally gives priority to pure cross-sectional growth regressions based on averages of annual data. The differences between the two approaches are pronounced conspicuously in his first study, where the estimated pure cross-section regression shows that FD affects GDP growth positively (the coefficient for Western European countries is not significant). Adding the time series dimension and estimating the panel regressions, the significance of the FD indicator disappears completely and the coefficient for European countries becomes even negative. However, most authors choose the panel data method and include *country fixed and time fixed effects* in order to control for individual-specific, time invariant characteristics of the analysed countries. Besides panel and pure cross-section regressions the *growth accounting procedure* is employed (see Thießen 2000; Behnisch et al. 2001). *Ordinary least squares (OLS) estimation* predominates the studies, while general least squares (GLS) (see Zhang and Zou 1998; Thießen 2000), least squares dummy variable

(LSDV) (see Zhang and Zou 1998), or maximum likelihood (ML) estimation (see Akai et al. 2004) are applied only in particular cases. In addition, Desai et al. (2003) estimate simultaneous growth regressions and use three stage least squares (3SLS) estimators in order to correct for simultaneity and the potential endogeneity of certain explanatory variables (i.e., budgetary transfers from the central level as percentage of regional governmental revenue). Within empirical estimation most authors conduct *sensitivity analyses* following Levine and Renelt (1992), who adapt the extreme bound analysis (EBA) of Leamer (1985). Accordingly they distinguish between three groups of explaining variables: base regressors, which are always included in the regressions; the variables of interest (i.e., fiscal decentralisation); and a subset of regressors chosen from a pool of variables identified by past studies as potentially important explanatory variables for growth. In addition, they classify a variable as “robust”, “if it remains statistically significant and of the theoretically predicted sign when the conditioning set of variables in the regression changes” (Levine and Renelt 1992, 943). Only Woller and Phillips (1998) pick up the critique of Sala-i-Martin (1997) regarding the “Levine-Renelt (1992) procedure (“the test is too strong for any variable to pass it”, Sala-i-Martin 1997, 179)” and conduct additional robustness tests following his improvement advice, based mainly on the kind of the cumulative distribution of the estimates.

1.5 Major Findings

While theory indicates a *positive impact of FD on economic growth* due to efficiency gains, the empirical verifications are only in part able to support this hypothesis. Oates (1995) detects a significant and robust positive correlation between FD and growth. Lin and Liu (2000) show that China’s overall growth rate depends positively on FD – mainly via efficiency improvements of resource allocation rather than via inducing more investment. Yilmaz (1999) finds for unitary countries a significant positive impact of FD on per capita growth while his results for federal countries are inconclusive. Desai et al. (2003) conclude that tax retention as a proxy for fiscal autonomy has shown a significant positive effect on

industrial output recovery of the Russian regions since the break-up of the Soviet Union. Akai et al. (2004) demonstrate that FD affects economic growth of the US states positively and economic volatility negatively – thus, FD is conducive for providing a stable economic growth. Zhang and Zou (2001) detect a positive effect of the per capita FD shares on Indian regional economic growth, albeit the effect is only significant in the case of the per capita revenue share.

A significant and robust *negative impact* of FD on China's provincial economic growth is revealed by Zhang and Zou (1998 and 2001). Key infrastructure projects with nation-wide externalities, which are too decentralised in China, are the main reason for this result. Comparing this study with Lin and Liu (2000) it becomes clear that, interestingly, FD induces diverse growth performances at the national and at the provincial level. Davoodi and Zou (1998) find for the developing countries also a negative effect of FD on growth, albeit not significant, and for the developed countries no clear relationship. Woller and Phillips (1998) concur with Davoodi and Zou (1998) in finding no significant and robust relationship in LDCs. At best, they are able to detect a weak inverse relationship between the revenue share and growth. Xie et al. (1999) find for the US states also *insignificant coefficients* on local and state spending shares, but they argue, referring to their adopted theoretical model, that insignificant FD shares indicate consistency with growth maximization. However, the model could even be wrong and insignificance could also indicate that FD is irrelevant to growth and should have no effect.

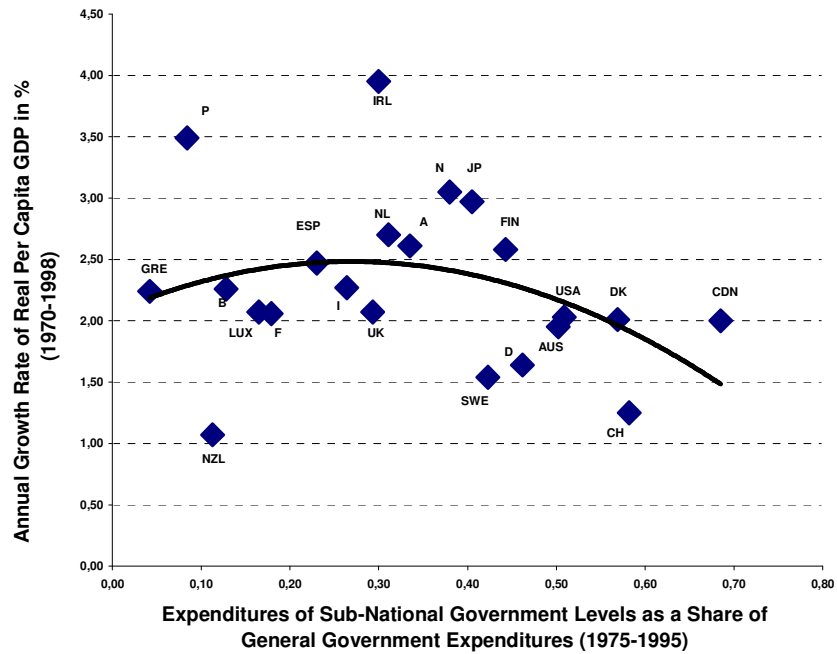
Observing the impacts on growth from the opposite point of view – namely from the *centralisation perspective* – the results are still mixed: while Behnisch et al. (2001) identify a statistically significant positive effect of overall centralisation on TFPG in Germany, Schneider and Wagner (2000) find that centralised wage bargaining shows a significant negative impact on long-term economic growth in the European Union.

Thießen (2000 and 2003) chooses a somewhat alternative approach. He tests the hypothesis of a *hump-shaped relationship* between FD and economic growth. In the case of too much decentralisation, inter-jurisdictional externalities cannot be internalised and economies of scale are not realised; negative growth effects are the consequence. The same holds for a low level of decentralisation: unconsidered preferences lead to inefficiencies in the provision of public goods, what inhibits, in turn, economic growth (see Breuss and Eller 2004). This theoretical trade-off construction indicates that the optimal degree of FD lies somewhere in between of an extremely high and an extremely low one. Thießen (2000, 30) finds that the hump-shaped relationship is particularly pronounced in the countries with highest per capita income⁴ (see Figure 1) while there is evidence that low per capita income countries grow linearly with higher decentralisation degrees⁵. Furthermore, he tests the *convergence of the FD shares towards a medium degree* implementing three dummy variables, which represent a low, medium and high degree of FD (see Appendix A). Within the sample of 21 OECD countries the low and high degree are significant at the ten percent level, while the medium degree is significant at the five percent level. The medium degree is associated with higher long-run per-worker growth than either a low or high degree. In this way, the observed trend of convergence among high-income OECD countries towards a medium degree of FD tends to promote economic growth (see Thießen 2003). Akai et al. (2004) classify their data set for FD variables also into high, medium and low degrees of FD in order to test the robustness of their estimations. All coefficients of the classified expenditure shares are highly significant at the one percent level and show positive signs. Thus, FD is conducive to growth regardless of the current degree of decentralisation. Interestingly, the group with a low degree of FD shows the highest coefficient, indicating that US states with a low degree of FD tend to grow stronger.

⁴ Australia, Belgium, Denmark, Finland, France, Germany, Luxembourg, Netherlands, Norway, Sweden, Switzerland, United States

⁵ Greece, Ireland, Portugal, Spain; Argentina, Brazil, Republic of Korea, South Africa

Figure 1: Economic Growth vs. Degree of Fiscal Decentralisation



Source: Thießen 2000; Data: IMF (IFS and GFS)

1.6 Critical Appraisal and Future Research Necessities

Despite the intense theoretical and political debate of the pros and cons of FD, systematic evidence of the impact of FD on economic growth is still scarce. Ambivalent effects are at work; clear recommendations regarding the optimal degree of decentralisation are difficult to draw. This survey showed that there is no unambiguous, automatic, relationship between decentralisation and growth. Martinez-Vazquez and McNab (2001) reviewed six empirical studies estimating the direct impact of FD on growth. Our survey is enriched by eight additional studies. Unless meaningful variations and differentiations within the budget data dimension (e.g., diversification by governmental function and level, consideration of size variables and constitutional structure, or examination of the hump-shaped and convergence hypothesis), several *deficiencies* of the respective estimations stated in Martinez-Vazquez and McNab (2001) have been removed only marginally.

- (a) There is still a *problem of possible misspecification* of the empirical estimation models. Since most authors apply the Levine-Renelt (1992) procedure and exclude some of the necessary control variables, an omitted variable bias may be the consequence. As Sala-i-Martin (1997, 180) emphasises, “missing important variables is more of a problem than introducing irrelevant variables”.
- (b) The *measurement of FD is still problematic* because of the omnipresent budget data approach, which is only in part able to account for the various dimensions of FD. The World Bank evaluates the application of the GFS on decentralisation issues and highlights various shortcomings, ranging from the lack of details on expenditure autonomy and own-source revenue to deficiencies regarding reported data for the sub-national levels and information scarcity for analysing dispersion among sub-national regions (see <http://www1.worldbank.org/publicsector/decentralization>). In order to cope with multi-level governments and with the multidimensionality of FD, the exploration of new approaches plays a crucial role (see also Ebel and Yilmaz 2002, 17). It is time for a new generation of decentralisation variables. It is necessary to examine reliable and comparable indicators for federal autonomies. In this connection the attempts of the OECD (Survey on Fiscal Design Across Levels of Government), the World Bank (Fiscal Decentralization Indicators Project), or Treisman (2000; separates five types of decentralisation: structural, decision, resource, electoral, and institutional decentralisation) have to be strongly supported.
- (c) The different channels of interference and *potential bi-directional causalities* between FD and economic growth have not been sufficiently considered within theoretical models or empirical specifications, respectively. If decentralisation is seen as a superior good (due to possible quality gains in the supply of public goods) and shows therefore a higher income elasticity, then a higher income per capita can form the basis for additional expenditures used for the constitution of a new decentralised level. In this case per capita income is

expected to have a positive effect on FD⁶. Since several studies showed that FD depends on the level of economic development, generally measured by per capita income (see Kee 1977; Pommerehne 1977; Bahl and Nath 1986; Oates 1985; for a more recent study see Letelier 2003), there arise the problem of endogeneity and spurious correlation when FD is put as explanatory variable into an economic growth regression.

Therefore, future research should intensify, firstly, the efforts to formalize the primary impact of FD on allocative efficiency, redistribution and macroeconomic stability. Then the linkage between these three branches and economic growth should be constructed. In this way the indirect impact of FD on growth can be considered. Secondly, given potential bi-directional causalities it is also necessary to address the present research regarding the impact of economic growth on FD and examine the various channels of interference. Thirdly, it is important to precise the determinants and dimensions of both FD and economic growth and clarify which exogenous variables determine simultaneously the two variables of interest (as, e.g., population growth). Implementing these three fundamental components into a theoretical model, a basis for new, more sophisticated, empirical verifications can be constructed. These, in turn, are not only led by the latest estimation procedures of economic growth empiricism (in order to overcome the problem of empirical misspecification) but resort also to a new generation of decentralisation data (in order to overcome the problem of data inaccuracy). In this way more satisfactory outcomes should be expected.

⁶ This hypothesis could particularly hold in high per capita income countries, as Austria, Switzerland, or the United States, that are able to afford the costs for the implementation of decentralisation.

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Table 1: Fiscal Decentralisation and Economic Growth – Status Quo of Empirical Analysis

AUTHORS / YEAR	SAMPLE COVERAGE REGION	SAMPLE COVERAGE TIME	DEPENDENT VARIABLE	EXPLANATORY FD VARIABLES	CONCEPTUAL FRAMEWORK / REMARKS	EMPIRICAL METHODOLOGY	MAJOR FINDINGS
Oates (1995)	40 countries (no details available)	1974-1989	GYP	FD-EXP, SR	Dissertation research performed by Sang Loh Kim and Oates (Maryland).	No details available	They found a significant and robust positive correlation between FD and per capita economic growth. The self-reliance variable is not itself statistically significant, but its first difference is.
Davoodi Zou (1998)	46 developing countries and OECD countries	1970-1989	GYP	FD-EXP	They follow Barro (1990; government spending is built into an endogenous growth model) and use a Cobb-Douglas production function with public spending (split into three federal levels) as input.	Cross-country panel regressions based on averages over five- and ten-year periods, with country fixed and time fixed effects. OLS estimation.	They find a negative – albeit not significant – relationship between FD and growth in developing countries , but none in developed countries . When the whole sample is used, this negative effect of FD on growth seems to be more significant. Interpretation: excessive spending of SNGs on the wrong expenditure items, wrong revenue assignment among various levels of government.
Woller Phillips (1998)	23 LDCs	1974-1991	GYP'	FD-EXP, FD-EXP _{DEF} , FD-REV, FD-REV _{GIA} .	They apply the robustness tests of Leamer (1985) and Sala-i-Martin (1997).	Panel regressions based on annual, three- and five-year averages, using country fixed effects. No details regarding the used estimator available.	They fail to find any strong, systematic relationship between FD and LDC economic growth. At best, a weak inverse relationship between FD-REV and GYP' can be detected examining the five-year averages.
Zhang Zou (1998)	28 provinces of China	1980-1992	GYP _{REG}	FD-CEXP, FD-CEXP _{EB} , FD-CEXP _{B+EB}	They follow Barro (1990), Levine and Renelt (1992), and Davoodi and Zou (1998). They distinguish different spending categories (at the central and provincial level) and analyse their impact on growth.	Cross-province estimations based on provincial annual data, with provincial fixed and random effects. GLS and LSDV estimation.	They find a significant and robust negative impact of FD on provincial economic growth . Interpretation: key infrastructure projects with nation-wide externalities are too decentralised in China and may have a far more significant impact on growth when assigned to the central level.
Xie Zou Davoodi (1999)	50 states of the USA	1948-1994	GYP	FD-EXP	The same theoretical framework is applied as in Davoodi and Zou (1998).	Growth regressions based on annual data (further details are not available). OLS estimation.	The insignificant coefficients on local and state spending shares may imply that the existing spending shares for state and local governments have been consistent with growth maximization . The alternative interpretation indicates that the spending shares are irrelevant to growth and should have no effect.

Table 1 (continued): Fiscal Decentralisation and Economic Growth – Status Quo of Empirical Analysis

AUTHORS/ YEAR	SAMPLE COVERAGE REGION	SAMPLE COVERAGE TIME	DEPENDENT VARIABLE	EXPLANATORY FD VARIABLES	CONCEPTUAL FRAMEWORK / REMARKS	EMPIRICAL METHODOLOGY	MAJOR FINDINGS
Yilmaz (1999)	46 countries (no details available)	1971-1990	GYP	FD-EXP	Surveyed in Thießen (2003). Distinguishes between federal and unitary countries.	No details available	He finds a significant (at the 5% level) positive impact of FD on per capita growth in unitary countries . For federal countries the results are inconclusive.
Lin Liu (2000)	China	No details available	GYP	MRR-REV	They follow Mankiw, Romer, and Weil (1992) and specify a Solow (1956) model of economic growth that assumes decreasing returns to all forms of reproducible capital.	No details available	FD efforts in China raised the overall growth rate mainly by improving the efficiency of resource allocation rather than by inducing more investment.
Thießen (2000)	EU-15, CH, NO, JP, US, CA, AU, NZ, AR, BR, KR, ZA	1975-1995	GYP, GKAP, TFPG	FD-EXP, FD-EXP ² , SR, CHSR	Reference to a theoretical endogenous growth model (further details are not available).	Pure and pooled cross-sectional growth regressions with cross-section weights; growth accounting procedure. GLS estimation.	The analysis suggests for high-income countries a hump-shaped relation between per capita economic growth and capital formation, on the one hand, and FD, on the other hand. There is empirical evidence suggesting that capital formation is positively related to increasing self-reliance .
Zhang Zou (2001)	29 provinces of China 16 major states of India	1987-1993 1970-1994	GYP _{REG}	FD-CEXP FD-CEXP, FD-CEXPpc, FD-CREV, FD-CREVpc	Following Barro (1990) and Davoodi and Zou (1998), they develop a theoretical model that links multiple sectors of public spending by multiple levels of government to economic growth.	Cross-province estimations based on provincial annual data with provincial fixed effects. Cross-state estimations with a five- year forward-moving average of the dependent variable	As in 1998, they found a significant and robust negative impact of FD on provincial economic growth in China . They found a positive relationship (significant only in the case of FD-CREVpc) between the per capita FD-shares and state economic growth in India . The shares of central government spending on several expenditure categories show a significant positive impact. The state allocation of public spending in various sectors is broadly consistent with growth maximization.

Table 1 (continued): Fiscal Decentralisation and Economic Growth – Status Quo of Empirical Analysis

AUTHORS / YEAR	SAMPLE COVERAGE REGION	SAMPLE COVERAGE TIME	DEPENDENT VARIABLE	EXPLANATORY FD VARIABLES	CONCEPTUAL FRAMEWORK / REMARKS	EMPIRICAL METHODOLOGY	MAJOR FINDINGS
Behnisch Buettner Stegarescu (2001)	Germany	1950-1990	TFPG	CEN-EXP, CEN-EXP _{ED&SC} , CEN-EXP _{TR&CO}	They analyse different spending categories (education & science [ED&SC], transport & communication [TR&CO]) at the central level.	Growth accounting procedure using linear regressions and time series analysis.	The results indicate a significant positive effect of overall centralisation on TFPG , but not for total public expenditures (insignificant, negative sign), central expenditures on ED&SC (weakly significant, negative sign), and central expenditures on TR&CO (insignificant, positive sign). Interpretation: co-ordination of policies among lower level jurisdictions is less efficient and overall central government intervention is still needed.
Desai Freinkman Goldberg (2003)	80 Russian regions	1996-1999	Y_t/Y_{1990}	RR-TAXREV	No explicit reference to a theoretical model.	Cross-regional single and simultaneous growth regressions based on 1996-1999 average data with time specific effects. OLS (with panel-corrected standard errors) and 3SLS estimation.	Tax retention (as a proxy for sub-national fiscal autonomy) has a positive effect on the cumulative output recovery of the Russian regions since the break-up of the Soviet Union. The strongest effects can be observed in regions with limited opportunities for rent-seeking .
Thießen (2003)	EU-14 (without LU), CH, NO, JP, US, CA, AU, NZ, AR, BR, KR, ZA	1973-1998	GYP, INVGDGP, TFPG	FD-EXP, FD-EXP ² , FD-EXP _{LOW} , FD-EXP _{MED} , FD-EXP _{HIGH} , FD-REV, SR	Uses the augmented Solow growth model of Mankiw, Romer, and Weil (1992).	Pure cross-sectional growth regressions based on averages of annual data. Panel regressions are not interpreted because of the problem of capturing the likelihood of long-run effects. OLS estimation.	The observed trend of convergence among high-income OECD countries towards a medium degree of fiscal decentralisation tends to promote growth .
Akai Nishimura Sakata (2004)	50 states of the USA	1992-1997	GYP _{REG} , ECVOL	FD-EXP _{REG} , FD-EXP _{REG,LOW} , FD-EXP _{REG,MED} , FD-EXP _{REG,HIGH} , FD-REV _{REG}	Referring to Barro (1990) and Nishimura (2001), they provide a theoretical model considering differences in the quality of public services due to different abilities of bureaucrats as well as complementarities of jurisdictional public services.	Panel cross-sectional growth regressions with time and state fixed effects. Explanatory variables are measured at each initial fiscal year (except GPOP). Maximum likelihood estimation.	They found a significant positive relationship between FD and economic growth, and a significant negative relationship between FD and economic volatility. Thus, FD is conducive for providing a stable economic growth .

Appendix A:

List of Variables Stated in Table 1, Data Sources and Tested Hypotheses

Dependent Variable		Data Source	Tested Hypotheses
GYP	Average growth rate of real GDP per capita	International Financial Statistics (IFS) of the International Monetary Fund (IMF); World Development Indicators (WDI) of the World Bank	
GYP'	Log first differences of real GDP (PPP-adjusted)	IFS, Summers and Heston's Penn World Tables (PWT)	
GYP _{REG}	Real per capita growth rate of provincial/state income (net provincial output)	China National Income Statistics (CNIS), China Statistical Yearbook (CSY); USA COUNTIES, USA State and Metropolitan Area Data Book	
Y _t /Y ₁₉₉₀	Regional industrial output (Y), deflated by the regional price deflator, is used as "recovery index" due to the lack of data for gross regional product before 1996	Russian Federation's State Committee for Statistics (ROSKOMSTAT)	This industry-focused recovery index reflects how much of the pre-reform level of industrial output was recovered by the second part of the 1990s. Accumulated, longer-term changes in regional development are measured in this way.
INVGD	Average gross investment share of GDP	IFS, WDI	Many variables in growth regressions may explain in a first step INVGD rather than GYP (see Levine and Renelt, 1992: 946).
GKAP	Average growth rate of real gross fixed capital formation (deflated by the producer price index)	IFS	FD affects GYP via the change in the supply of production factors
TFFG	Total factor productivity growth derived as a component of a macroeconomic production function		FD affects GYP via the change in productivity
ECVOL	Economic volatility, measured as the variance of the noise term in the regression of FD and the control variables on GYP _{REG}	Calculated by Akai et al. (2004)	FD leads to a lower economic volatility due to risk-diversification across the different levels of government

Explanatory Fiscal Decentralisation Variables		Data Source	Tested Hypotheses
FD-EXP	Share of sub-national government expenditures in general government expenditures net of intergovernmental transfers	GFS	
FD-EXP _{REG}	Ratio of local government expenditure to state and local government expenditure.		Used in studies on particular (federal) countries
FD-EXP ²	Non-linear transformation of FD-EXP	Calculation of Thießen (2000 and 2003).	Hump-shaped relationship between GYP and FD-EXP
FD-EXP _{LOW}	Dummy variable that attains the value of one for years during FD-EXP is below 30%	Akai et al. (2004) classified their panel data set into high, middle and low degree of FD-EXP _{REG} and choose the thresholds so that the number of the data within each category is equalized.	
FD-EXP _{MED}	Dummy variable that attains the value of one for years during FD-EXP is between 30% and 45%		
FD-EXP _{HIGH}	Dummy variable that attains the value of one for years during FD-EXP is above 45%		
FD-CEXP	Ratio of consolidated provincial budgetary spending to central budgetary spending		
FD-CEXP _{pc}	Ratio of per capita spending in each state to per capita central spending		Per capita ratio: consideration of the size of the jurisdiction in order to make the ratios more comparable across states
FD-CEXP _{B+EB}	Ratio of consolidated (budgetary + extra-budgetary) provincial spending to consolidated central spending (per capita terms)		
FD-CEXP _{EB}	Ratio of provincial extra-budgetary to central extra-budgetary spending (per capita terms)		
FD-EXP _{NDEF}	FD-EXP less defence and social security expenditures		Defence and social security policies are only the competence of the central level.
CEN-EXP	Share of central government expenditures in total public expenditures (without social insurance)	Deutsches Statistisches Bundesamt	
FD-REV	Ratio of sub-national government revenues to total government revenues	GFS	
FD-REV _{REG}	Ratio of local government revenue to state and local government revenue		
FD-REV _{GIA}	Ratio of local government revenues less grants-in-aid to total government revenues		Consideration of the accurate responsibility of either level of government.
FD-CREV	Ratio of state own revenue in each state to total central revenue		
FD-CREV _{pc}	Ratio of per capita revenue collection in each state to per capita central revenues		Per capita ratio: consideration of the size of the jurisdiction in order to make the ratios more comparable across states
RR-TAXREV	Tax revenue retention rate: share of locally generated taxes that are left with the regional budgets.	ROSKOMSTAT	Measure for regional fiscal incentives and regional fiscal autonomy.
MRR-REV	The marginal retention rate of government revenues of sub-national governments (i.e. the revenue share which a sub-national government may retain, if it increases its revenues by one additional unit).	Used by Lin and Liu (2000), quoted in Thießen (2003)	
SR	Self-reliance ratio: own revenues of sub-national governments as a share of their total revenues	GFS	
CHSR	Changes of the self-reliance ratio		Increasing self-reliance promotes economic growth (see Oates, 1995)

