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Regional Inequality and Decentralization – An Empirical Analysis

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Abstract

This paper analyzes the impact of political and fiscal decentralization on regional inequalities using a unique data set which covers 56 countries at different stages of economic development. Cross-section and panel data estimations show that decentralization decreases regional inequalities in general. However, estimations using an interaction variable approach imply that the effect depends on the level of economic development. While rich countries benefit from decentralization with regard to a more equal regional income distribution, decentralization may lead to higher regional inequalities in developing and emerging economies. The results are pointing in the same direction for measures of fiscal and political decentralization implying that both - autonomy in decision making and fiscal authority - are decisive in this context. Thus, when fostering decentralization in developing countries - as proposed by international development agencies - the potential negative redistributional consequences should be taken into account.

JEL-Code: H110, H770, R110.

Keywords: regional inequality, decentralization, panel data.

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1 Introduction

Income inequalities are growing in many parts of the world causing dissatisfaction and compromising political stability. The spatial dimension of inequality has attracted considerable policy interest, since regional disparities in economic activity, incomes and social indicators foster overall income inequality. Besides being a determinant of interpersonal inequality, spatial inequality matters since it is often an outcome of ethnic conflicts and a breeding ground for separatist tendencies [Kanbur and Venables (2005)]. Despite the obvious importance of regional inequality, few studies exist which analyze its causes systematically. The reason for the scarcity of research in this field is mainly driven by poor availability of regional data which is necessary to analyze spatial inequality. Regional data is rare in particular for developing and emerging economies so that the existing studies mainly focus on high developed countries. Results of those studies are important to understand the driving forces of regional inequality, but are difficult to generalize. This paper contributes to the empirical literature on the determinants of spatial inequality by using a unique data set covering countries of all continents and all levels of economic development.

One issue that has received a lot of attention in the public debate as well as in the academic literature is the role of decentralization in regional inequalities. The major argument in the still ongoing discussion is that decentralization enhances public sector efficiency [Oates (1972)], but can weaken inter-jurisdictional redistribution causing a rise in regional inequality [Prud'homme (1995)]. Thus, a conflict between efficiency and redistribution might arise from decentralization. For many countries in the world this is an essential question, since there is a global trend of public sector decentralization [Watts (2008)]. Examples include high developed countries such as Spain or Belgium as well as emerging economies such as Chile or Brazil. Decentralization and its effects are particularly relevant to developing countries, since the World Bank and other international agencies consider decentralization as an important element of their development strategy [Gopal (2008)].

The existing evidence on the redistributive consequences of decentralization is mixed. Some authors find an increasing effect of decentralization on regional inequality [see e.g. Rodríguez-Pose and Gill (2004)], some authors find a decreasing effect [see e.g. Lessmann (2009) or Ezcurra and Pascual (2008)], and some authors stress different effects for high and low income countries [see e.g. Shankar and Shah (2003) or Rodríguez-Pose and Ezcurra (2010)]. Reasons for the contradictory results are the use of different country samples and observation periods, different measures of decentralization, and different estimation techniques. Hence, there is still demand for a comprehensive empirical study which uses a broader data set including countries of all stages of development, and which uses alternative measures of political and fiscal decentralization as well as adequate empirical methods. The aim of this paper is to fill this gap in the literature.

Consequently, the paper analyzes the determinants of regional inequalities focusing on the impact of the federal structure. For this purpose, I have collected a unique data set of 56 countries at all stages of economic development covering the period from 1980 to 2009. In case of OECD coun-

tries, data collection is quite easy since the OECD Regional Statistics, EUROSTAT, or Cambridge Econometrics (CAMECON) provide regional data. In contrast, regional data for other countries is often not publicly available and was provided by national statistical offices or central banks on individual request. Most non-OECD countries in my data set are from South America and Asia. Using these regional data to calculate measures of regional inequalities, it turns out that inequalities are significantly higher in developing or emerging economics, and slightly rising within the observation period. The main finding of this analysis is, however, that political as well as fiscal decentralization decrease regional inequality. Moreover, interaction models show that the relationship between decentralization and regional inequality depends on the level of economic development. While decentralization tends to increase inequality in poorer countries, decentralization decreases regional inequality in richer ones. The findings have important implications for the design of federal systems in developed as well as developing countries. Several observers suspect increasing regional inequalities in decentralizing countries and demand the implementation of interregional transfer schemes. This study shows that this effect should not necessarily be a concern in high developed countries, since decentralization decreases regional inequalities. Decentralization initiatives in poor countries, however, should take the potential negative redistributional effects into account.

The remainder of the paper is organized as follows: Section 2 presents the unique data set on regional inequality. Section 3 discusses the theoretical framework for the impact of decentralization on regional inequality and summarizes the existing empirical studies. Section 4 presents the econometric analysis. Finally, Section 5 sums up the results and concludes.

2 Regional inequality around the world

The restricting factor for empirical research on regional inequality is to get reliable regional data. For comparative studies one needs regional economic or social accounts at a widely homogenous territorial level for countries at all levels of economic development. The OECD Regional Statistics, EUROSTAT, or CAMECON provide such data since the 1980s/1990s. However, data of developing or emerging economies is scarce and cannot be accessed through one single data base. For this study, the data was collected from several national statistical offices or central banks. But even if regional data is available, measurement of regional inequality is difficult. Three different decisions arise: (1) the choice of an appropriate economic indicator, (2) the choice of the territorial level to be applied, and (3) the choice of applicable concentration measures.[1]

(ad 1) Cross-country studies on decentralization and regional inequality use regional per capita income [Shankar and Shah (2003)], regional GDP per employee [Gil Canaleta et al. (2004)], or regional GDP per capita [Rodríguez-Pose and Gill (2004), Ezcurra and Pascual (2008), and Lessmann (2009)] as a starting point for calculating disparity measures. All these indicators have their specific advantages and drawbacks, in particular concerning the sensitivity against biases resulting

[1] See Lessmann (2009) for a detailed discussion of different measurement concepts of regional inequality.

from commuters or unequal (un-)employment. For this study, the regional GDP per capita is best suitable since data on regional employment or household income is usually not available for developing or emerging countries.

(ad 2) A further problem arises from the different sizes of the regions considered. In countries with large economic differences and an unequally distributed population, a disparity measure might be difficult to interpret. For example the wide Canadian Territories are much poorer than the regions at the East and West coast so that an inequality measure might indicate large economic differences, although very few people are affected from being poor (note that the territories are inhabited by only 100,000 people in total). Therefore, it is necessary to use a territorial classification that creates relatively homogeneous regions. I decided to use large regions (TL2) for countries covered by the OECD Regional Statistics (e.g. Australia), NUTS2 regions for countries covered by EUROSTAT and CAMECON (all EU members), and state/province level data otherwise (e.g. India, Brazil, etc.).[2] For non-OECD countries, data availability has driven the selection of the territorial levels. In most cases, the regional level is equivalent to state or province level. A complete list of countries, territorial levels, the period coverage and data sources is provided in Table A.1 in the appendix. Note that I also calculate a disparity measure that is adjusted for the different population sizes of the regions (WCV), and I control for the number of sub-national units and country size in the regression analysis to minimize a potential bias emerging from the heterogeneity of territorial levels.

(ad 3) The last concern is the application of appropriate concentration measures. Different measures of inequality do not always provide the same country ranking. Especially in a cross-country analysis, the concentration measure should be independent of the number of regions considered (spatial independence), should not be sensitive to shifts in average GDP levels (mean independence), and should satisfy the Pigou-Dalton transfer principle [Dalton (1920), Pigou (1912)]. This principle states that an arithmetical transfer from rich to poor regions reduces inequality [see Sen (1973) and Mehran (1976) for details]. All three requirements are satisfied by the coefficient of variation (CV), the adjusted Gini coefficient ($GINI$) and the population-weighted coefficient of variation (WCV):[3]

$$CV: \quad = \quad \frac{1}{\bar{y}}\left[1/n\sum_{i=1}^{n}\left(\bar{y}-y_i\right)^2\right]^{1/2}, \tag{1}$$

$$GINI: \quad = \quad \frac{2\sum_{i=1}^{n} iy_i}{n\sum_{i=1} y_i} - \frac{n+1}{n}, \tag{2}$$

$$WCV: \quad = \quad \frac{1}{\bar{y}}\left[\sum_{i=1}^{n} p_i\left(\bar{y}-y_i\right)^2\right]^{1/2}, \tag{3}$$

$\bar{y}$ is the country's average GDP p.c., y_i is the GDP p.c. of region i, p_i is the share of the country's total population in region i, and n is the number of sub-national units.[4] The new data set of

[2] NUTS - Nomenclature of Territorial Units for Statistics. Note that I have used the NUTS3 territorial level in case of Latvia, Lithuania, and Malta, since NUTS2 level data is not provided.

[3] See Bendel et al. (1989) for a comparison of standard inequality measures.

[4] Note that the Theil-index is not applicable for cross-section analysis with large variations in the number of

regional inequalities considers 56 countries for the period 1980-2009. Note that the frequency of the data varies by country: in case of the OECD countries the underlying panel is almost balanced, but there are quite large gaps in the data of some developing economies. Table 1 presents the means of these calculations for the whole observation period. In the following, I will discuss

Table 1: Regional Inequalities in Europe and Centra Asia

Country	CV	GINI	WCV	Country	CV	GINI	WCV
Europe & Central Asia				*North America*			
Austria	0.21	0.14	0.22	Canada	0.26	0.16	0.15
Belgium	0.38	0.19	0.38	U.S. of America	0.36	0.14	0.17
Bulgaria	0.23	0.13	0.26	*Latin America & Caribbean*			
Croatia	0.21	0.18	0.21	Argentina	0.36	0.18	
Czech Republic	0.33	0.15	0.31	Bolivia	0.30	0.16	0.25
Denmark	0.11	0.09	0.09	Brazil	0.55	0.31	0.48
Finland	0.18	0.11	0.13	Chile	0.48	0.26	0.35
France	0.18	0.08	0.26	Colombia	0.65	0.31	0.43
Georgia	0.19	0.12	0.19	Mexico	0.51	0.26	0.55
Germany	0.19	0.10	0.17	Panama	0.60	0.38	0.46
Greece	0.19	0.08	0.16	Peru	0.51	0.30	0.42
Hungary	0.28	0.17	0.34	Venezuela, RB	0.26	0.15	
Ireland	0.16	0.16	0.13	Average	0.47	0.26	0.42
Italy	0.25	0.15	0.26	*East Asia & Pacific*			
Kazakhstan	0.83	0.38	0.72	Australia	0.15	0.09	0.08
Latvia	0.44	0.28	0.50	China	0.68	0.33	0.50
Lithuania	0.25	0.15	0.25	Indonesia	1.23	0.46	0.89
Netherlands	0.16	0.10	0.14	Japan	0.13	0.07	0.14
Norway	0.21	0.13	0.22	Korea, Rep. (South)	0.10	0.06	0.07
Poland	0.19	0.10	0.21	Mongolia	0.57	0.30	0.67
Portugal	0.22	0.13	0.26	New Zealand	0.09	0.08	0.07
Romania	0.34	0.17	0.32	Philippines	0.51	0.29	0.62
Russian Federation	0.39	0.23	0.36	Thailand	0.88	0.43	0.88
Slovak Republic	0.53	0.27	0.37	Average	0.48	0.23	0.44
Slovenia	0.18	0.18	0.18	*South Asia*			
Spain	0.20	0.12	0.20	India	0.52	0.22	0.37
Sweden	0.11	0.06	0.13	*Sub-Sahara Africa*			
Switzerland	0.13	0.08	0.13	South Africa	0.35	0.22	0.41
Turkey	0.40	0.25	0.42	Tanzania	0.32	0.17	0.37
Ukraine	0.51	0.24	0.58	*Middle East & North Africa*			
United Kingdom	0.28	0.12	0.33	Iran, Islamic Rep.	0.77	0.33	0.56
Uzbekistan	0.52	0.32	0.51	Malta	0.17	0.14	0.07
Average	0.28	0.17	0.29				

just the coefficient of variation CV and leave it to the reader to compare results of alternative concentration measures. Differences are not very large since the pairwise correlation coefficient between the indicators is 0.91 or higher. Let me first comment the results for Europe & Central Asia. The countries with the lowest regional inequality based on the coefficient of variation (CV)

sub-national units of the countries considered, see Hale (2003) for details.

are Denmark (0.11), Sweden (0.11) and the Netherlands (0.16); the countries with the highest level of regional inequality are Kazakhstan (0.83), Uzbekistan (0.52), and Slovak Republic (0.53). Obviously, regional inequalities are higher in less developed economies. Despite, Belgium (0.38) and the United Kingdom (0.28) are rich countries with quite high regional disparities implying that development is an important but not the only determinant. The unweighted average of countries in Europe & Central Asia is 0.28. Turning to the North American region it is noticeable that Canada and the United States of America have regional inequalities which are quite large compared to core European countries, although the level of economic development is similar. In the country groups Latin America & Caribbean and East & South Asia, the first observation is that inequality is on average much higher compared to Europe & Central Asia supporting the aforementioned development-inequality hypothesis. Within the group of East Asia & Pacific, there are large differences in regional inequality which also can also be attributed to large differences in economic development. New Zealand and Korea have an even smaller level of regional inequality than the Scandinavian countries mentioned above.

For an empirical analysis, it is also important to have data varying within countries over time. To get a first impression of the changes of regional inequality I have plotted the CV in Figure 1 for a sample of countries. I have chosen the United States of America and Canada as Anglo-American countries; the United Kingdom; Germany, Austria, and Belgium for core European countries; and India, Bolivia, and the Republic of Korea represent other parts of the world. In the U.S. and

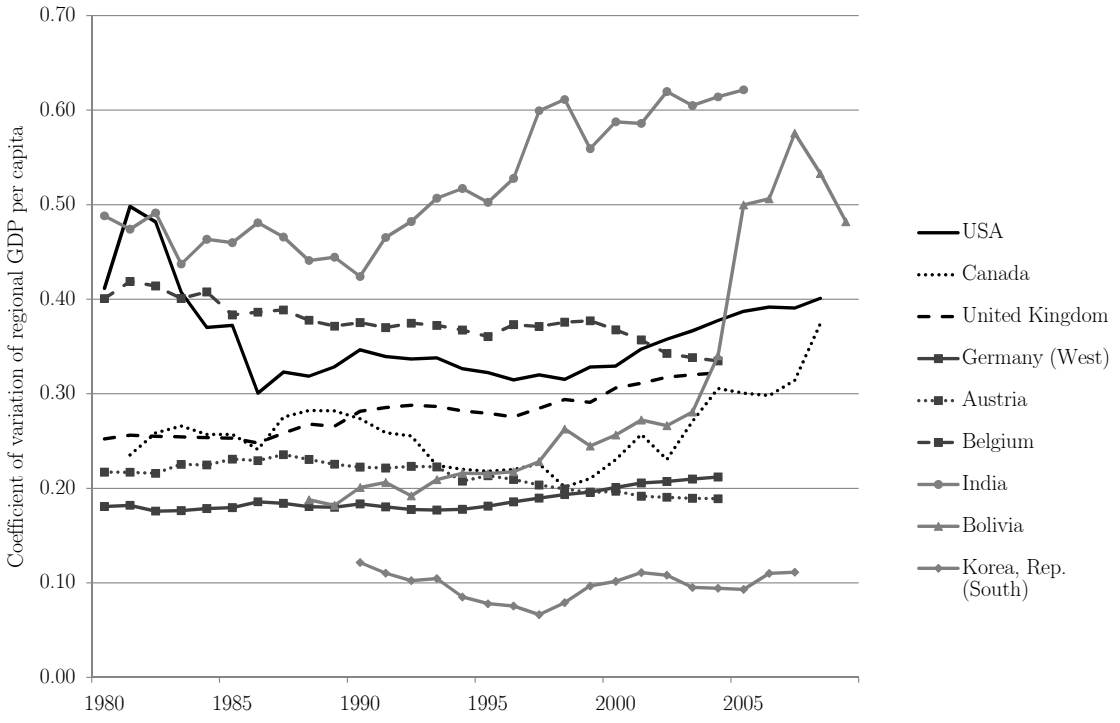

Figure 1: Trends in regional inequality 1980-2009

Canada, we observe a quite high variation over time, with high levels of regional inequality at the beginning of the observation period, followed by a decline in the 1990s, and rising inequalities since 2000. In the U.K., regional inequalities are on rise in general. Interestingly, the current level is almost identical compared with the group of Anglo-American countries suggesting that political factors might be important here. In Germany and Austria, regional inequalities are also similar, but inequalities are increasing in Germany but decreasing in Austria. Belgium faces high regional inequalities, which are almost monotonously decreasing over time. This is an interesting fact for the following discussion on decentralization and regional inequality, since Belgium faces at the same time a strong decentralization trend. India shows high and strongly increasing regional inequality as Bolivia does, while South Korean "equality" is obviously very stable over time. So far, we can say from the analysis that inequalities vary between countries as well as over time, which is important for the investigation of its determinants.

3 Decentralization and regional inequality

The previous section has given an overview on the main facts of regional inequality. As stressed in the introduction, regional inequalities are not just an outcome of geography or economic development, but also affected by state interventions. In particular, the federal design of countries may play an important role in regional inequalities. In this section I discuss the theoretical background as well as existing empirical studies.

3.1 Theoretical background

A growing share of the global population is living in federal countries reaching nowadays about 40% [Watts (2008)]. In this process, countries are not just decentralizing responsibilities and budgetary power to local levels of government, but they also shift into the direction of a political federalism by adopting (quasi) federal constitutions as in the case of Spain and Belgium. Federations are formed as a system of sub-national units with free markets and some degree of political autonomy incorporated to one national entity. This organizational form has two main advantages: on the one hand, economic and social integration guarantee free trade and factor mobility to exploit the efficiency gains from common markets. On the other hand, decentralized decision making ensures that local policies fit to the needs of a heterogeneous population with different regional tastes [Oates (1972)].

Besides these efficiency gains from decentralization, politicians and researchers are concerned about potential negative redistributive consequences, since "unfettered fiscal decentralization is likely to lead to a concentration of resources in a few geographical locations and thus increase fiscal disparities across sub-national governments" [Martinez-Vazquez and McNab (2003), p. 1605]. Several arguments are important here. Following Prud'homme (1995), fiscal decentralization weakens the budgetary power of the central government thereby reducing the scope to redistribute resources from the richer to the poorer regions. At the same time, decentralization often involves fiscal

competition, which may be at the cost of poor regions. Prud'homme argues, that richer regions will have a larger tax base than poorer regions and will therefore either collect more taxes and provide more local public goods or they provide the same quantity and quality of public goods at lower tax rates. In any case, mobile factors will prefer richer jurisdictions, "enlarging the tax base and increasing the gap in income between regions" [Prud'homme (1995), p. 203]. Prud'homme concludes from his analysis that "decentralization can be the mother of segregation". Another issue concerning the relationship between decentralization and regional inequalities is the redistribution aspect. According to Oates (1972) sub-national governments have no suitable redistributive instruments. If sub-national governments raise taxes in order to equalize – say between individuals or regions– , such programms are not likely to succeed because mobile factors can easily move to other jurisdictions undermining the goals of such programs [Pauly (1973)]. Hence, if governments aim to equalize living standards across regions, the tax-transfer-scheme should be implemented at a higher centralized government level [Musgrave (1959)]. Regional inequality might also be a direct consequence of decentralization. In a standard Tiebout framework, decentralization implies that public goods provision is stratified due to the different preferences of a heterogeneous population [Tiebout (1956)]. Thus, "there is clearly a tension between pursuing goals of equality in service provision and greater decentralization and choice" [Besley and Ghatak (2003), p. 245].

Besides the potential negative redistributional effects of decentralization, there are also arguments for equity promoting consequences, most of them related to enhanced efficiency of local public policies. Following the decentralization theorem, sub-national authorities can better provide the economically efficient quantity and quality of local public goods, since they are better informed about local needs [Oates (1972)]. This greater public efficiency at the local level might stimulate regional growth and convergence [Oates (1993)]. Moreover, decentralization gives sub-national governments the opportunity to actively pursue economic development policies, which better fit to the strengths and weaknesses of their regions than central government policies. With a certain degree of sub-national autonomy, local officials get the opportunity to attract mobile capital to their particular regions, e.g., by granting tax privileges or offering other forms of assistance [Martinez-Vazquez and McNab (2003)]. Decentralization is also accompanied by inter-jurisdictional competition forcing governments to represent citizen interests and to preserve markets, since competition acts as a disciplinary device to punish sub-national government officials for inappropriate market intervention [Weingast (1995), Qian and Weingast (1997)]. For example, local governments could be removed if they fail to achieve standards of wealth and growth comparable with those of the rest of the country, or people "vote with their feet" instead. Following Qian and Weingast (1997) decentralization gives less developed regions an important instrument to compete with richer ones by providing more attractive investment conditions, e.g., by means of more flexible labor markets or a less generous welfare state. "Jurisdictional competition can therefore reduce regional inequality without centrally-mandated redistribution"[Qian & Weingast (1997), p. 87]. This view is supported by some anecdotal evidence of U.S. states. After the War of Secession, regional inequalities were high since the defeated South had fallen far behind the North. But local growth-enhancing policies, e.g. in terms of more flexible labor market conditions, helped the poor

South to catch up with the rich North decreasing regional inequalities [McKinnon (1997)]. The European Union as confederation of member states provides with Ireland an example showing how important autonomy is for successful regional politics which is quite similar to some extent. During the 1990s Ireland converged rapidly to core European economic prosperity, since they had the autonomy to levy much lower taxes. The Irish autonomy in decision making was a crucial factor to overcome the disadvantages caused by its peripheral location. Baldwin and Krugman (2004) conclude that centralization or harmonization would have prevented this convergence process. The discussion shows that decentralization can strengthen regional growth and contribute to a more equal factor distribution.

The existing literature discusses the efficiency enhancing effects of decentralization which might also promote equality among regions. Recent studies, however, challenge efficiency gains from decentralization in developing countries. Tanzi (1996) discusses the effects of decentralization in developing countries stressing that decentralization might cause coordination problems, excessive regulation, higher administrative costs or poor quality of local bureaucrats. Moreover, decentralization might increase corruption and cronyism in developing countries undermining potential efficiency gains [Bardhan (2002), Lessmann and Markwardt (2010)]. Hence, while many of the assumptions that link decentralization to lower regional inequality may be valid for high developed countries, this may not be the case in developing economies [Rodríguez-Pose and Ezcurra (2010)]. Another argument for development being decisive for the impact of decentralization on regional inequality is related to the higher redistributive capacity in rich countries. Rich countries may offset the negative redistributive consequences of decentralization through interregional redistribution policies, for which a high fiscal capacity is important.

Based on the theoretical discussion, the overall effect of decentralization on regional inequality is ambiguous, since negative redistributional consequences may be offset by efficiency gains at the local level. Thus, the aim of the following sections is to investigate the relationship between decentralization and regional inequalities empirically. Moreover, the discussion shows that the development stage might be important, since efficiency gains from decentralization are less likely in developing countries compared to industrial economies. The empirical analysis aims at testing this issue using interaction variables of decentralization and income.

3.2 Related empirical studies

Empirical literature on the relationship between decentralization and regional inequality is scarce and inconclusive. Existing studies can be grouped by single-country case studies, cross-country studies of high developed countries, and cross-country studies using data of both high and low developed countries. Single-country studies are Kanbur and Zhang (2005) for China, Kim et al. (2003) for Korea, Bonet (2006) for Colombia, and Akai and Hosio (2009) for the United States. In the Chinese case, decentralization has increased regional inequality, and a similar result emerges from the Colombian departments. In Korea the effect is ambiguous, but in the U.S., decentralization has decreased regional inequalities. Thus, country-level evidence is mixed. Gil Canaleta

et al. (2004), Ezcurra and Pascual (2008), and Lessmann (2009) study the impact of decentralization on regional inequalities based on OECD countries, finding regional inequalities decreasing in the degree of decentralization. Shankar and Shah (2003), Rodríguez-Pose and Gill (2004), and Rodríguez-Pose and Ezcurra (2010) also take developing countries into account. Shankar and Shah (2003) find lower regional inequalities in federal countries, Rodríguez-Pose and Gill (2004) found a positive relationship between rising sub-national expenditure shares and increasing regional inequalities, and Rodríguez-Pose and Ezcurra (2010) provide some evidence of decentralization to increase regional inequality in developing countries, but no robust relationship for high developed countries. See Table A.2 in the appendix for a summary of the existing literature.

The mixed evidence can be attributed to differences in country samples, decentralization measures, and estimation methods. In the cross-section studies, the number of countries varies from 11 [Rodríguez-Pose and Gill (2004)] to 26 [Rodríguez-Pose and Ezcurra (2010)], which is quite few to explain between-country-differences in regional inequalities. Most studies use the degree of expenditure decentralization – defined as the share of sub-national expenditures in total government expenditures – as decentralization measure, but only Lessmann (2009) and Rodríguez-Pose and Ezcurra (2010) take indicators into account which reflect the political autonomy of sub-national governments at least to a certain extent. Thus, some important arguments of the theoretical literature related to the political autonomy of sub-national governments have only sparsely been tested. Concerning the estimation procedures only the most recent cross-country studies by Ezcurra and Pascual (2008), Lessmann (2009), and Rodríguez-Pose and Ezcurra (2010) make use of panel data, which has several advantages. In particular the inclusion of country fixed effects allows consideration of unobserved heterogeneity between countries which is very likely to be important for regional inequalities due to geographic, political, or ethnic differences. However, also these studies suffer from a serious problem which may be caused by endogeneity [see section 4.3 for details]. (Central) governments might react with changes in the federal structure on changes in regional inequalities. Thus, decentralization has to be treated as an endogenous regressor, which is difficult in small country samples. The aforementioned panel data studies use lagged decentralization measures as instruments for contemporary levels of decentralization, which is quite problematic. The underlying data set of my analysis considers more than twice as much countries than the existing literature, so that there is much more cross-country variation in the data making it easier to find appropriate instrumental variables. To sum up, this paper aims to overcome the shortcomings of the existing literature by using a much bigger data set, various measures reflecting political and fiscal decentralization, and more appropriate econometric methods.

4 Empirical analysis

4.1 Data and methodology

Before explaining the methodology and the results of the regression analysis, let me first introduce the data. Two groups of variables are particularly important for this study: measures of regional

inequality and decentralization measures. The first have been discussed in detail in section 2 so it remains to present the decentralization variables. The theoretical discussion showed that the particular federal design matters for the relationship between decentralization and regional inequality. Several measurement concepts are used in the literature to find appropriate approximations [see e.g. Treisman (2002) and Rodden (2004)]. In general, decentralization is viewed as the devolution of authority towards sub-national governments, with total government authority over society and economy perceived as fixed. Attempts to define and measure decentralization have focused on fiscal authority rather than political autonomy. In our context, I am interested in both issues, since the degree of local autonomy should be important.

Decentralization measures reflecting fiscal authority can be approximated by using measures of fiscal decentralization, which can be calculated from the IMF Government Finance Statistics. Those measures include the degree of expenditure decentralization ($EXPDEC$) and the degree of revenue decentralization ($REVDEC$), which relate expenditures (revenues) of sub-national governments to total government expenditures (revenues). Both measures are commonly used in the decentralization literature. However, those indicators do not necessarily reflect sub-national government autonomy in decision-making, since the central government may also determine spending at the local level through central government legislation. To capture these effects, a commonly used measure based on budgetary accounts is the so called vertical imbalance ($VIMB$). This measure relates central government transfers to sub-national government expenditures, and is therefore a measure of transfer dependency of sub-national governments. Note that a high value of this measure indicates little local financial autonomy, while all other decentralization measures are defined such that a high value represents a high degree of decentralization. The vertical imbalance measure is in particular interesting in our context, since it also reflects to some extent the importance of intergovernmental transfers, which often redistribute between regions in order to equalize living standards and to reduce regional inequalities. A last measure of fiscal decentralization is the degree of tax decentralization, which relates the tax revenues of sub-national governments to total government revenues ($TAXDEC$). It represents an alternative fiscal indicator of sub-national government financial autonomy incorporating the degree of inter-jurisdictional competition. Note however, that all these measures are imperfect in so far that they do not reflect the political dimension of the underlying decision-making process. Assume for example that the central government determines the tax base and sub-national governments determine the tax rate. In this case the tax decentralization index might indicate a high degree of financial autonomy, although the central government has the major influence on sub-national revenues. Decentralization measures incorporating this problem were developed by Rodden (2004) and Stegarescu (2005), but are not applicable here since they only cover OECD countries.[5] Note that all decentralization measures are only available until 1998, since there was reorganization in the IMF statistics in 2001. More recent data is not comparable to the long time series data used for this analysis.

To capture the dimension of political decentralization I refer to decentralization measures provided

[5] See Lessmann (2009) for an empirical analysis of decentralization and regional inequality using those decentralization measures.

by Daniel Treisman [see Treisman (2008)]. A first measure of political decentralization is a dummy variable for those countries, which have a federal constitution (*FEDERAL*).[6] A decentralization measure reflecting the vertical fragmentation of governments is the number of vertical government tiers (*TIERS*), which ranges from 1 to 6. Most OECD countries have 3 or 4 levels of government according to this indicator. The theoretical literature on decentralization and regional inequality stresses sub-national government efficiency, which might increase with the degree of local autonomy. For this purpose, Treisman created several dummy variables based on the constitutions of countries. A sub-national legislature is said to have 'residual authority', if the constitution assigns the exclusive right to legislate on issues that are not specifically assigned to one level of government (*RESID*). Another measure captures the 'autonomy' of a sub-national legislature. It is said to exist if the constitution reserves exclusive decision-making power on any specific task (*AUTON*). I also sum up both measures to a joint indicator of sub-national autonomy (*AUTRES*). Treisman's data also contains data on local elections (electoral decentralization), which is important to incorporate electoral accountability arguments. One measure is a dummy variable, which becomes one, if there are elections at the lowest government level (*BOTEL*); a second measure is again a dummy variable, which is one, if there are elections at the second lowest government level (*SECEL*). I combine these measures to a new dummy variable indicating whether there are elections at any sub-national level of government or not (*BOSEC*).

Beside measures of fiscal and political decentralization, I use the share of sub-national government employment in total government employment as a further decentralization indicator (*EMPLDEC*) which cannot be assigned to one of the two categories. The data is also provided by Treisman (2008). In this case, the analysis is purely explorative, since there is no theoretical prediction concerning the impact of public sector employment decentralization on regional inequality. Table A.3 in the appendix provides pairwise correlations of the different decentralization measures based on the 56 countries considered in the empirical analysis where the number of observations varies by data availability. It turns out, that the decentralization measures indeed reflect various characteristics of the government structure which might be helpful to test different theories. Data sources and definitions of all considered variables are provided in Table A.4 in the appendix.

4.2 Estimation design

The empirical analysis of this study is carried out in three steps. The first step is to relate the decentralization measures to regional inequality in a cross-section of countries which uses long period averages from 1980-2009. The basic empirical model has the following form:

$$REGINEQ_i = \alpha + \sum_{j=1}^{k} \beta_j CONTROL_{j,i} + \gamma DEC_i + \epsilon_i. \tag{4}$$

[6] The following criteria have to be fulfilled to be counted as a federal country: Countries have at least two levels of government, which share parts of the executive and legislative authority; sub-national governments have a representation in the federal parliament (second chamber); there is a duty to obtain consent on constitutional amendments; a constitutional jurisdiction solves disputes between organs of state; institutions foster collaboration [see Watts (2008)].

$REGINEQ_i$ reflects one of the alternative measures of regional inequality (CV, $GINI$, or WCV) in country i, α is a constant, $CONTROL_{j,i}$ are k exogenous control variables affecting inequality, DEC_i represents one of the different decentralization measures, and ϵ_i is a random error term. These benchmark results provide us a first impression on how decentralization might impact disparities. Since countries might react with a change in the level of decentralization in response to increasing or decreasing disparities, I also treat decentralization as endogenous regressor to incorporate a potential endogeneity bias. Thereby, I refer to a cross-section of countries instead of panel data, since the major determinants of decentralization are time-invariant factors. The second step of the analysis is to estimate panel data models, where the estimation equation takes the form:

$$REGINEQ_{i,t} = \alpha_i + \sum_{j=1}^{k} \beta_j CONTROL_{j,i,t} + \gamma DEC_{i,t} + \mu_t + \epsilon_{i,t}. \quad (5)$$

In case of the time-varying measures of fiscal decentralization I include country fixed effects (α_i), but random effects otherwise (time indexed by t). The regressions use the original annual frequency of the data as well as 5-year period averages. The third step of the analysis is to investigate whether the level of economic development has an impact the relationship between decentralization and regional inequality. For this purpose, I estimate a panel data model using interaction variables of decentralization and the log of the GDP per capita ($GDPPC$):

$$REGINEQ_{i,t} = \alpha_i + \sum_{j=1}^{k} \beta_j CONTROL_{j,i,t} + \gamma_1 DEC_{i,t} + \gamma_2 DEC_{i,t} \times GDPPC_{i,t} + \mu_t + \epsilon_{i,t}. \quad (6)$$

Note that the GDP per capita and its squared value also enter the regression as controls therefore the interaction model is fully specified [Brambor et al. (2006)]. The estimations are again based on random effects and fixed effects models using annual data as well as period averages.

The set of control variables is the same in all specifications. One issue intruding from the look on the data in section 2 is a potential link between regional inequality and economic development. An explanation provide Kuznets (1955) and Williamson (1965). In his seminal paper, Kuznets conjectured that as countries develop from farm-based economies to industrial economies, income inequality first increases, peaks, and then decreases. Thus, the trajectory of this relationship is inverse-U-shaped – what we call the *Kuznets curve* today. Williamson has adopted this idea for the case of interregional inequality. He argues that the industrialization was driven by the discovery and utilization of natural resources such as coal or iron. Since those natural resources are normally not equally distributed within countries, economic prosperity in the industrialization process is also unequally distributed, therefore regional inequalities rise in this process. Later, the more attractive employment opportunities in the booming regions attract workers from abroad depressing wages in the settled regions but increasing wages in home regions. Thus, a natural convergence process starts in which regional inequality falls drawing again an inverse-U-shaped relationship. To test this theory, I control for the Log of the GDP per capita ($GDPPC$) as well as its squared value ($GDPPC^2$). Moreover, I control for the number of regions which has been used to calculate the inequality measures ($UNITS$), since the territorial level is not always comparable over

all countries considered. Controlling for the number of regions should incorporate a measurement error caused by heterogeneity.[7] In addition, I control for the size of a country considering the log of area in square kilometers (*AREA*). Related studies such as Lessmann (2009) have shown that the unemployment ratio (*UNEMPL*) effects regional inequalities so I also control for this. Since Gianetti (2002) and Rodriguez-Pose and Gill (2006) propose an impact of international trade on regional disparities I control for the sum of imports and exports as a share of the GDP (*OPENNESS*). A particularly important determinant of regional economic inequality may be the heterogeneity of the population living in the different parts of a country. The different regions are often inhabited by different ethnic groups. Examples include Belgium with the Dutch-speaking Flemings living in the northern part and the French-speaking Walloons in the south, or India with the Indo-Aryans in the north and Dravidians in the south. The ethnic diversity may result in ethnic discrimination or conflict promoting the divergence of regions. Thus, I control for the degree of ethnolinguistic fractionalization (*ETHNO*) as calculated by Alesina et al. (2003). To capture agglomeration effects, I also control for the share of urban living population (*URBAN*).[8]

4.3 Cross-section results

Following I present the benchmark results from OLS regressions. I use long period averages of all variables for 56 countries covering the period from 1980-2009. The results are presented in Table 2.[9] The different specifications suggest a negative impact of decentralization on regional inequality. Most decentralization variables have a negative coefficient, which is statistically significant from zero in case of the federal dummy (column 1), the measure of residual and local autonomy (column 5), the measure of elections at sub-national government tiers (column 8), the degree of expenditure decentralization (column 9), and the degree of revenue decentralization (column 10). Thus, both measures of political as well as all measures of fiscal decentralization seem to impact regional inequality in a similar direction. The regressions explain 70%-80% of the variation in regional inequalities between countries as indicated by the adjusted R-squared.

Interestingly, my selection of control variables supports the theoretical findings concerning the inverse-U-shaped relationship between regional inequality and economic development. Moreover, a higher fragmentation is positively correlated with regional inequality as is the geographical size. Countries with high levels of unemployment face lower regional inequality. A possible explanation for this somewhat counterintuitive result can be the unemployment insurance: This social insurance – as it exists in most countries considered – redistributes indirectly between rich and poor regions so that inequalities fall. A similar result find Kaufman et al. (2003) for Canadian provinces. More open economies have higher regional inequalities, and also more heterogeneous countries as reflected by the degree of ethnolinguistic fractionalization are more heterogeneous in terms of

[7] I have also experimented with average size of regions (units per area) and other indicators for fragmentation, but the number of units turned out to be the most important determinant.

[8] Following Lessmann (2009) I have also used a concentration measure of the population within countries which does not turn out to impact regional inequality significantly.

[9] Robustness tests using the weighted coefficient of variation (*WCV*) and the Gini coefficient (*GINI*) as dependent variables support the general findings. The results are available from the author upon request.

Table 2: Cross-section results

	Dependent variable: Coefficient of variation (CV)) of regional GDP p.c. 1980-2009												
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
GDPPC	0.729***	0.761***	0.445	0.514*	0.456*	0.738**	0.681**	0.696**	0.195	0.290	0.526*	0.566**	0.909***
	(2.98)	(2.80)	(1.67)	(2.00)	(1.85)	(2.37)	(2.24)	(2.38)	(0.58)	(0.93)	(1.80)	(2.05)	(3.13)
$(GDPPC)^2$	-0.044***	-0.047***	-0.029*	-0.033**	-0.029**	-0.046**	-0.042**	-0.043**	-0.014	-0.020	-0.035**	-0.037**	-0.056***
	(-3.14)	(-2.98)	(-1.88)	(-2.22)	(-2.05)	(-2.57)	(-2.45)	(-2.60)	(-0.72)	(-1.09)	(-2.07)	(-2.31)	(-3.29)
UNITS	0.009***	0.008***	0.008***	0.009***	0.009***	0.008***	0.009***	0.009***	0.008***	0.008***	0.009***	0.008***	0.009***
	(3.71)	(3.19)	(3.16)	(3.74)	(3.59)	(3.19)	(3.41)	(3.45)	(3.21)	(3.42)	(3.57)	(3.74)	(2.78)
AREA	0.053***	0.046***	0.040***	0.040**	0.042***	0.046***	0.043***	0.041***	0.053***	0.056***	0.037**	0.038**	0.047***
	(4.14)	(3.32)	(2.72)	(2.64)	(3.08)	(3.48)	(3.43)	(3.34)	(2.83)	(3.10)	(2.34)	(2.45)	(3.03)
UNEMPL	-0.014***	-0.012***	-0.013***	-0.014**	-0.012***	-0.014***	-0.012**	-0.012**	-0.011***	-0.013***	-0.013**	-0.013***	-0.017***
	(-3.19)	(-3.00)	(-2.96)	(-2.42)	(-2.83)	(-2.74)	(-2.24)	(-2.20)	(-2.84)	(-3.17)	(-2.63)	(-2.78)	(-3.30)
OPENNESS	0.003***	0.003***	0.003***	0.003***	0.003***	0.003***	0.003***	0.003***	0.003***	0.003***	0.003***	0.003***	0.004***
	(4.24)	(3.99)	(3.03)	(3.06)	(3.05)	(3.36)	(3.72)	(3.39)	(3.09)	(3.13)	(3.18)	(3.22)	(3.63)
ETHNIC	0.308***	0.251**	0.298**	0.322***	0.348***	0.168*	0.199**	0.175**	0.290***	0.304***	0.309***	0.328***	0.276**
	(2.87)	(2.69)	(2.43)	(2.73)	(3.01)	(1.91)	(2.28)	(2.03)	(3.14)	(3.24)	(2.89)	(3.09)	(2.42)
URBAN	-0.004**	-0.004**	-0.004**	-0.004***	-0.004**	-0.005**	-0.004*	-0.004*	-0.004**	-0.004**	-0.004**	-0.004**	-0.005***
	(-2.27)	(-2.55)	(-2.56)	(-2.26)	(-2.42)	(-2.44)	(-1.77)	(-1.78)	(-2.05)	(-2.14)	(-1.95)	(-2.09)	(-3.03)
FEDERAL	-0.090**												
	(-2.16)												
TIERS		0.023											
		(0.73)											
AUTON			-0.016										
			(-0.34)										
RESID				-0.063									
				(-1.42)									
AUTRES					-0.080*								
					(-1.91)								
BOTEL						-0.098							
						(-1.40)							
SECEL							-0.055						
							(-1.45)						
BOSEC								-0.055*					
								(-1.84)					
EXPDEC									-0.004*				
									(-1.93)				
REVDEC										-0.004**			
										(-2.13)			
TAXDEC											-0.001		
											(-0.72)		
VIMB												0.002	
												(1.16)	
EMPLDEC													0.001
													(0.53)
Constant	-3.318***	-3.388***	-1.845	-2.175*	-1.985*	-3.006**	-2.894**	-2.854**	-0.912	-1.354	-2.085	-2.348*	-3.898***
	(-3.03)	(-2.80)	(-1.50)	(-1.81)	(-1.78)	(-2.15)	(-2.12)	(-2.15)	(-0.62)	(-0.97)	(-1.56)	(-1.87)	(-3.05)
Obs.	56	55	52	52	53	51	49	49	48	48	48	47	46
Adj.-R^2	0.74	0.72	0.74	0.75	0.76	0.71	0.68	0.69	0.78	0.79	0.76	0.77	0.72

Note: t-values are reported in parentheses; standard errors are calculated using White correction; ***, **, and * indicate significance at 1%, 5%, and 10%, respectively.

regional economic activity. Finally, I find countries with a higher share of urban living people having lower regional inequalities.

4.4 Endogeneity

The benchmark findings are, however, just a first step of this analysis since endogeneity might bias the estimates. Different channels are important here. Assume for example a federal government faces increasing regional inequalities. This might cause the government to centralize the budget in order to have more scope for redistributive policies. Of course, also the opposite reaction might occur, if the central government believes that decentralized decisions are necessary for regional convergence. That's one possible reason for measures of fiscal decentralization being endogenous. Another reason can be a mechanical association of measures of regional inequality and measures of fiscal decentralization, which are in particular important for panel analysis focusing on within country variation. Consider a federation consisting of two jurisdictions, a rich region and a poor region. Suppose further that the sub-national governments associated with the two regions finance their expenditures mainly through flat taxes on property, but the central government has a progressive tax structure under which income in the rich region faces a higher marginal tax rate than does income in the poor region. What happens in this model if a negative technological shock harming just the rich region causes a decrease in regional inequality? Sub-national revenues are unchanged given equal tax rates on property yet federal revenues fall given that the income in the rich region is taxed at a lower rate now. If this happens we should observe an increase of the degree of revenue decentralization as an outcome of an exogenous decrease in regional inequality. Thus, decentralization – in particular measures of fiscal decentralization – have to be treated as endogenous variables.

I provide different approaches to reduce the potential endogeneity bias. The first is to use cross-country data with long period averages, since the mechanical association of regional inequality and decentralization measures is less important in regressions using between country variations in contrast to panel regressions which focus on the within country variation. This empirical strategy was not an option in the existing literature, since the underlying data sets – with a maximum number of 26 countries – are too small for reliable cross-section estimations. The findings aim at a negative impact of decentralization on regional inequality as discussed above. The second approach are instrumental variable (IV) regressions in a two stage least squares (TSLS) procedure using exogenous determinants of decentralization measures. Again this is possible due to the higher number of observations in my data set. Finally, the third approach is to apply panel estimations with long period averages considering country fixed effects (if possible).

Instrumental variable regressions are quite difficult in this context, since I need exogenous determinants of decentralization, which are independent of the level of regional inequalities. Standard instruments for decentralization as used in the literature are the size of a country or the degree of ethnolinguistic fractionalization [see e.g. Wasylenko (1987), Arikan (2004), or Lessmann and Markwardt (2010)]. However, these instruments are not applicable in my context since they are

linked to regional inequality through other channels than decentralization. Therefore, I propose several new instruments for the different measures of decentralization which are related to the institutional structure, colonial origin, and the composition of the society. Note that I use different sets of instruments for the different decentralization measures depending on the first-stage regression diagnostics.

One of the instrumental variables is the share of the population that speaks a major European language (*EURLANG*). This variable reflects the influence of Western European countries [Hall and Jones (1999)], which I expect to be positively correlated with decentralization. Historically, the federal idea dates back to the *Alte Eidgenossenschaft* in Switzerland (1291-1798) and can be seen as a European invention which diffused all over the world through colonial activities and settlers [Acemoglu et al. (2002)]. Thus, countries with a historical link to Western Europe are expected to have a higher degree of decentralization. Also the level and experience with democracy is an important determinant of the federal structure of a country. Those countries which have long democratic traditions have acknowledged more and more voice to the people over time. To get a better representation of local tastes in politics, democratic countries have organized the government in smaller units implying an increase in the degree of (political) decentralization. Therefore, I use different indicators of democracy as instrument including the number of years of democracy since 1800 (*DEMO18*), the democracy index of the Polity2 data set (*DEMOP2*), the overall Polity2 index (*POLITY2*), and the number of years of uninterrupted democracy since 1950 (*INTDEMO*). Moreover, the existence of a common or civil law system might be a useful instrument. A common law system – as it exists in the U.S. or the UK – can be seen as a kind of decentralized structure, where local courts decide on legal issues that become common law for the whole federation in the process of adjudication, whereas the civil law is developed at a central level. Therefore, I use a dummy variable for a common law (*LAW*) system as further instrument for decentralization. Related to this idea is the use of the legal origin of a country as instrument [Porta et al. (2008)]. Those countries which have a German legal origin (*LEGOR*) are expected to be more decentralized. The last instrument – that works quite good for measures of fiscal decentralization – is the share of Protestants in the total population (*PTANTS*). The Protestant Church is less hierarchically structured than other denominations, it promotes individualism, and it supports the protection of minorities [Treisman (2000)]. These values and norms are reflected by the society, and their request for decentralization, which is a well-suited government structure to realize these fundamentals. In contrast, the Catholic Church and the Islam have a hierarchical, centralized structure with one or few religious leaders at the head – the pope or the mufti. This structure carries over the society and government organization. Thus, I expect countries with a high share of Protestants to be more decentralized. The results of the instrumental variable estimations, where I make use of the different instruments case by case, are presented in Table 3.

Table 3: Cross-section results, IV estimates

	Dependent variable: Coefficient of variation of regional GDP p.c. 1980-2009 (CV)					
	(1)	(2)	(3)	(4)	(5)	(6)
Second-stage regression results						
GDPPC	0.735***	0.418	0.849**	0.185	0.301	0.604**
	(3.22)	(1.49)	(2.24)	(0.61)	(1.10)	(2.27)
$(GDPPC)^2$	-0.044***	-0.023	-0.051**	-0.013	-0.020	-0.040***
	(-3.37)	(-1.44)	(-2.43)	(-0.75)	(-1.27)	(-2.56)
UNITS	0.010***	0.011***	0.008***	0.008***	0.008***	0.008***
	(3.58)	(3.21)	(3.48)	(3.27)	(3.57)	(3.71)
AREA	0.050***	0.066***	0.035*	0.041***	0.040***	0.031**
	(2.86)	(2.69)	(1.84)	(2.97)	(3.12)	(2.07)
UNEMPL	-0.017***	-0.008	-0.012	-0.013***	-0.015***	-0.018***
	(-4.13)	(-1.45)	(-1.63)	(-3.99)	(-4.62)	(-3.88)
OPENNESS	0.003***	0.002**	0.001	0.002***	0.002***	0.002***
	(4.04)	(2.12)	(0.75)	(3.05)	(3.08)	(2.75)
ETHNIC	0.378***	0.565***	0.157	0.300***	0.322***	0.337***
	(3.19)	(3.15)	(1.26)	(3.57)	(3.76)	(3.41)
URBAN	-0.003*	-0.004*	-0.003	-0.004**	-0.004**	-0.003
	(-1.91)	(-1.92)	(-1.39)	(-2.37)	(-2.45)	(-1.63)
FEDERAL	-0.166*					
	(-1.68)					
AUTRES		-0.387**				
		(-2.18)				
BOSEC			-0.229***			
			(-2.65)			
EXPDEC				-0.004***		
				(-2.60)		
REVDEC					-0.004***	
					(-2.84)	
TAXDEC						-0.003*
						(-1.71)
Constant	-3.345***	-2.400*	-3.122*	-0.655	-1.133	-2.186
	(-3.02)	(1.80)	(-1.86)	(-0.49)	(-0.92)	(-1.82)
Obs.	48	51	48	42	42	42
Adj.-R^2	0.73	0.52	0.47	0.80	0.81	0.76
First-stage regression diagnostics						
A.P. F-statistic	5.78	4.61	4.46	12.06	15.37	3.46
Prob > F	0.01	0.04	0.02	0.00	0.00	0.02
Partial R^2	0.24	0.08	0.15	0.46	0.55	0.18
Hansen J	0.08	-	0.06	4.14	3.95	5.16
Hansen-J (p)	0.78	-	0.80	0.25	0.27	0.16
Excluded instruments						
	EURLANG	DEMOP2	LAW	PTANTS	PTANTS	PTANTS
	DEMO18		POLITY2	LEGOR	LEGOR	LEGOR
				EURLANG	EURLANG	EURLANG
				INTDEMO	INTDEMO	INTDEMO

Note: t-values are reported in parentheses; standard errors are calculated using White correction; ***, **, and * indicate significance at 1%, 5%, and 10%, respectively.

Estimates with instrumental variables are applied to those decentralization measures, that have turned out to impact significantly regional inequality in the benchmark OLS regressions above.[10] The upper part of the table presents the results of the second stage regression, the lower part reports first stage regression diagnostics and the considered instruments. Importantly, the coefficients of the different measures of political and fiscal decentralization are negative and statistically significant at conventional confidence levels implying that decentralization decreases regional inequality. The regression diagnostics indicate, however, that the instruments are only meaningful in case of the degree of expenditure decentralization (column 4), and the degree of revenue decentralization (column 5). The other regressions might suffer from a weak instrument bias. Table A.5 in the appendix reports results of OLS and TSLS regressions using the alternative measures of regional inequality ($GINI$ and WCV) as dependent variable supporting the major finding.

4.5 Panel evidence

The cross-section estimates have a major drawback, since there may exist other country-specific factors effecting regional inequality which cannot be considered by the control variables due to the limited number of degrees of freedom or unobservability. This problem may bias estimates, although the adjusted R-squares indicate a quite good fit of the empirical model. Panel data models, however, can help to overcome this problem, since they allow to investigate within country variations by including country fixed effects incorporating unobserved heterogeneity [Baltagi (2005)]. Unfortunately, the use of panel data is not a free lunch in this context, since there are no instruments for decentralization available which vary over time. Remember the instruments used in the previous section. Thus, I can deal with the problem of unobserved heterogeneity by using panel data, but it is not possible to consider a potential endogeneity problem convincingly. I refrain to instrument with lagged decentralization measures as done by previous studies, since decentralization is a persistent phenomenon so that lagged decentralization measures are not exogenous.

My empirical approach for the panel data analysis is twofold. First, I use the original annual frequency of the data set providing me with almost 800 observations between 1980 and 2009. Second, I consider potential business cycle effects building 5-year period averages. This should also help to deal with the second source of endogeneity as discussed above. In both data sets, I estimate random effects and fixed effects models. Measures of political decentralization are not varying over time, so that it is impossible to include country fixed effects. The only way to deal with this problem is to use random effects or to estimate a cross-section as in the previous section. In contrast to measures of political decentralization, the measures of fiscal decentralization vary over time so that I can include country fixed effects here. The estimation results of equation (5) are reported in Table 4 considering the annual panel.[11] Note that I just report coefficients of the decentralization measures due to space limitations; all control variables are similar to the cross-section estimations

[10] In the other cases, I was not able to find any significant effects. The results are available from the author upon request.

[11] Table A.6 in the appendix reports results considering 5-year period averages, which support the findings based on the annual panel, although significance levels are lower due to the smaller number of available degrees of freedom.

Table 4: Panel results (annual data)

	Dependent variable: Coefficient of variation of regional GDP p.c. (CV)					
	Random effects			Fixed effects		
	Coeff.	Obs.	Adj.-R^2	Coeff.	Obs.	Adj.-R^2
FEDERAL	-0.071	795 (56)	0.57	–	–	–
	(-1.44)					
TIERS	0.027	790 (55)	0.56	–	–	–
	(0.54)					
AUTON	-0.051	765 (52)	0.56	–	–	–
	(-1.29)					
RESID	-0.052	775 (52)	0.60	–	–	–
	(-1.28)					
AUTRES	-0.095**	783 (53)	0.60	–	–	–
	(-2.29)					
BOTEL	-0.135**	749 (51)	0.53	–	–	–
	(-2.25)					
SECEL	-0.080**	728 (48)	0.47	–	–	–
	(-1.98)					
BOSEC	-0.076***	728 (49)	0.49	–	–	–
	(-2.59)					
EXPDEC	-0.002***	350 (35)	0.55	-0.003***	350 (35)	0.17
	(-3.00)			(-3.86)		
REVDEC	-0.001	350 (35)	0.56	-0.003**	350 (35)	0.17
	(-1.63)			(-2.26)		
TAXDEC	0.000	353 (35)	0.59	0.000	353 (35)	0.19
	(1.32)			(0.68)		
VIMB	0.000	344 (34)	0.59	0.000	344 (34)	0.15
	(-0.01)			(0.59)		
EMPLDEC	0.000	700 (46)	0.52	–	–	–
	(-0.20)					

Note: t-values are reported in parentheses; standard errors are calculated using White correction; ***, **, and * indicate significance at 1%, 5%, and 10%, respectively.

and included in each regression. The random effects estimates based on the annual panel report a negative and significant impact of the autonomy variable ($AUTRES$), the variables of electoral decentralization ($BOTEL$, $SECEL$, and $BOSEC$), and the degree of expenditure decentralization ($EXPDEC$). Turning to the fixed effects estimates, the degree of expenditure decentralization ($EXPDEC$) as well as the degree of revenue decentralization ($REVDEC$) turn out to negatively impact regional inequality. Table A.7 in the appendix provides robustness tests using the weighted coefficient of variation (WCV) as well as the Gini coefficient ($GINI$) as dependent variable supporting the result of a negative impact of decentralization on regional inequality. Table A.8 provides a robustness test using 5-year period averages. I conclude from the panel estimations that unobserved heterogeneity is obviously not a major source of bias in the estimates so that the cross-section results are definitely meaningful.

4.6 Interaction effects – Considering the development stage

The theoretical discussion points at different effects of decentralization on regional inequalities in developing or emerging economies in contrast to high developed countries. The reason is that the efficiency enhancing effects, which may contribute to regional convergence, are more likely to occur in high developed countries due to a better institutional environment. To test this hypothesis I estimate an interaction model as given by equation (6). The regressions include the log of the GDP per capita (and its squared value) as control and I also let it interact with the different decentralization measures. The results based on the annual panel data set are reported in Table 5.[12] Again, I only report the coefficients of interest due to space limitations, but note that all control variables are included in the regressions.

The regressions show a positive and significant coefficient of the decentralization measures and a negative and significant interaction term in almost all specifications. However, I am not particularly interested in the individual statistical significance of either of these terms. Instead, I want to know their joint significance or, more correctly, the marginal effect of decentralization on regional inequality depending on the level of economic development.[13] The marginal effect can be calculated using γ_1 and γ_2 given the GDP p.c. [see equation (6) above]:

$$\frac{\partial REGINEQ}{\partial DEC_m} = \gamma_1 + \gamma_2 \cdot GDPPC \tag{7}$$

Hence, my interaction model asserts that the effect of a change of the degree of decentralization on regional inequality depends on the value of the conditioning variable GDP p.c. While it is possible to calculate the marginal effect using equation (7) and the results obtained in Table 5, it is not possible to do so for the standard errors at least in case of continuously defined decentralization measures such as the degree of expenditure decentralization. The standard error of the marginal effect is in this case:

$$\hat{\sigma}_{\frac{\partial REGINEQ}{\partial DEC}} = \sqrt{var(\gamma_1) + GDPPC^2 \cdot var(\gamma_2) + 2 \cdot GDPPC \cdot cov(\gamma_1 \gamma_2)} \tag{8}$$

The standard errors can be used to calculate confidence bands around the marginal effects. Figure 2 illustrates how the marginal effect of the degree of expenditure decentralization on regional inequality varies with the level of economic development, and it comprises confidence bands for the 10 percent significance level as calculated by equation (8). I concentrate on the degree of expenditure decentralization since this is the most common indicator in the existing literature on decentralization and regional inequality. The negative slope of the marginal effect is an outcome of the negative coefficient of the interaction variable (γ_2). For low GDP p.c. levels, the marginal effect of decentralization on regional inequality is positive, while it is negative for high GDP p.c. levels. The cutoff value of economic development is the value of the log GDP p.c. for which $\partial REGINEQ/\partial DEC_m = 0$ is 7.94 which corresponds to a GDP of approximately 2,800 US$ per capita. Countries poorer than this threshold might experience negative redistributional

[12] Table A.9 in the appendix reports results of the 5-year averaged panel data set which support the major findings as discussed below.

[13] For an excellent overview on does and don'ts in interaction models see Brambor et al. (2006).

Table 5: Panel results using interaction variables (annual data)

	Dependent variable: Coefficient of variation of regional GDP p.c. (CV)					
	Random effects			Fixed effects		
	Coeff.	Obs.	Adj.-R^2	Coeff.	Obs.	Adj.-R^2
FEDERAL	0.807***	795	0.56	–	795	0.15
	(4.20)	(56)			(56)	
FEDERAL×GDPPC	-0.097***			-0.130***		
	(-4.97)			(-5.37)		
TIERS	0.698***	790	0.61	–	790	0.18
	(2.66)	(55)			(55)	
TIERS×GDPPC	-0.080***			-0.110***		
	(-3.09)			(-4.93)		
BOTEL	0.441	749	0.52	–	749	0.05
	(1.29)	(51)			(51)	
BOTEL×GDPPC	-0.071*			-0.248***		
	(-1.79)			(-3.85)		
SECEL	0.524***	728	0.47	–	728	0.07
	(2.65)	(49)			(49)	
SECEL×GDPPC	-0.070***			-0.082***		
	(-3.19)			(-3.36)		
BOSEC	0.379***	728	0.47	–	728	0.06
	(2.61)	(49)			(49)	
BOSEC×GDPPC	-0.053***			-0.086***		
	(-3.29)			(-4.01)		
AUTON	0.665***	765	0.53	–	765	0.08
	(3.17)	(52)			(52)	
AUTON×GDPPC	-0.080***			-0.160***		
	(-3.69)			(-6.16)		
RESID	1.141***	775	0.60	–	775	0.05
	(5.32)	(52)			(52)	
RESID×GDPPC	-0.129***			-0.149***		
	(-5.82)			(-5.54)		
AUTRES	0.748***	783	0.59	–	783	0.10
	(4.22)	(53)			(53)	
AUTRES×GDPPC	-0.095***			-0.159		
	(-5.10)			(-6.50)		
EXPDEC	0.020***	350	0.57	0.018***	350	0.19
	(4.40)	(35)		(3.30)	(35)	
EXPDEC×GDPPC	-0.002***			-0.002***		
	(-5.19)			(-4.00)		
REVDEC	0.033***	350	0.56	0.038***	350	0.29
	(5.74)	(35)		(4.36)	(35)	
REVDEC×GDPPC	-0.004***			-0.004***		
	(-6.09)			(-4.56)		
TAXDEC	0.007**	353	0.60	0.005	353	0.19
	(2.06)	(35)		(1.20)	(35)	
TAXDEC×GDPPC	-0.001**			0.000		
	(-2.06)			(-1.20)		
VIMB	-0.002	344	0.58	0.000	344	0.15
	(-1.37)	(34)		(-0.15)	(34)	
VIMB×GDPPC	0.000			0.000		
	(1.46)			(0.26)		
EMPLDEC	0.021***	700	0.51		700	0.12
	(4.32)	(46)			(46)	
EMPLDEC×GDPPC	-0.003***			-0.003***		
	(-5.13)			(-5.07)		

Note: t-values are reported in parentheses; standard errors are calculated using White correction; ***, **, and * indicate significance at 1%, 5%, and 10%, respectively.

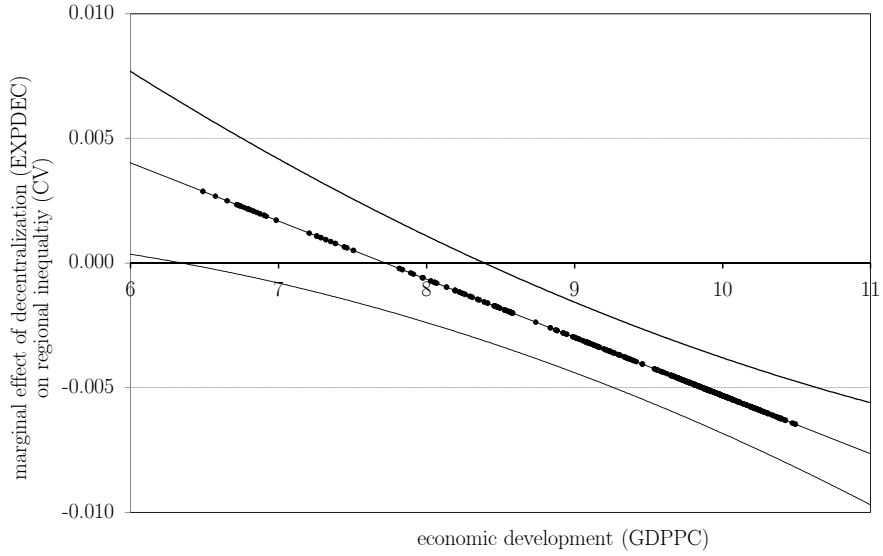

Figure 2: Marginal effect of decentralization (EXPDEC) on regional inequality (CV)

consequences from expenditure decentralization, while richer countries benefit. The results reported in Table 5 suggest, the general finding of poor countries to suffer from decentralization while rich countries benefit with respect to regional inequality holds for a wide range of econometric specifications. Therefore, the hypothesis of an impact of economic development on the relationship between decentralization and regional inequality can be confirmed in line with Shankar and Shah (2003) and Rodríguez-Pose and Ezcurra (2010). Moreover, I find no systematic differences between the various decentralization measures. It is noteworthy that considering 5-year period averages, the interaction effect of decentralization and economic development is only significant for measures of political decentralization. Thus, political decentralization might be more decisive for potential negative redistributional effects.

5 Summary and conclusion

This paper analyzes the impact of political and fiscal decentralization on regional inequalities. Theoretical considerations imply that decentralization might increase regional inequality, for example due to a weakened redistributional capacity of the central government [Prud'homme (1995)], but at the same time the efficiency enhancing effects of decentralization might also promote regional growth and convergence [Qian and Weingast (1997)]. Existing studies on decentralization from other research fields emphasize that the efficiency enhancing effects of decentralization are more likely to occur in high developed countries, since decentralization might cause coordination problems, excessive regulation, and corruption in developing countries undermining the potential efficiency gains [Tanzi (1996)]. Hence, the impact of decentralization on regional inequality may depend on the level of economic development: high-income countries with adequate institutions

and high redistributional capacities might benefit from decentralization, while in developing countries the negative redistributional consequences of decentralization might offset potential efficiency gains resulting in higher regional inequalities.

To investigate this research question, I have collected a unique data set on regional inequality covering 56 countries between 1980 and 2009. The data shows that there is an inverse-U-shaped relationship between regional inequality and economic development supporting Kuznets (1955) and Williamson (1965). Moreover, I find a slight overall increase in regional inequalities in the world. In contrast to the existing literature, the new data set allows me to apply instrumental variable techniques in a cross-section of countries, which are best suited to solve the potential endogeneity problems of decentralization in this context. Former studies have ignored endogeneity or used lagged levels of decentralization measures as instruments, which are not convincing due to its persistence over time. The econometric analysis implies, that political as well as fiscal decentralization have a decreasing impact regional inequalities. My interpretation of this finding is that the efficiency enhancing effects of decentralization overcompensate negative redistributional consequences. Furthermore, results of interaction models suggest that decentralization increases regional inequality in less developed countries, while decentralization contributes to lower inequalities in high developed countries. In general, there is no robust difference between measures of political and fiscal decentralization.

In light of the global decentralization trend, the findings of this study have important implications for the design of governments. Several observers suspect increasing regional inequalities in decentralizing countries and demand the implementation of interregional transfer schemes. This study shows that this effect should not be a concern in high developed countries, since decentralization decreases regional inequalities. However, the decentralization initiatives taking place in developing countries – promoted by international development agencies such as the World Bank – may indeed have negative redistributional consequences justifying the implementation of additional redistributional instruments. The question which instruments are suitable for this purpose is impossible to answer based on this study. In particular, policy makers have to decide whether to redistribute between individuals or regions. Regional inequalities contribute to interpersonal inequalities so that it might be more efficient to redistribute between individuals using tax-transfer schemes instead of redistributing between regions [Musgrave (1959)]. A related study by Hansen et al. (2010) finds that interregional transfers increase regional inequalities if people are mobile, so that interpersonal transfers seem to be more suitable to achieve a more equal income distribution.

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Table A.1: Sources of regional data by country

Country	Territorial level	Period	Source
Argentina	23 provinces; 1 capital region	1991-2002	Dirección Provincial de Estadística
Australia	8 TL2 regions	1990-2008	OECD Regional Statistics
Austria	9 NUTS2 regions	1980-2004	Cambridge Econometrics
Belgium	11 NUTS2 regions	1980-2004	Cambridge Econometrics
Bolivia	9 departments	1988-2009	Instituto Nacional de Estadistica
Brazil	26 states; 1 federal district	2002-2007	Instituto Brasileiro de Geografica e Estatistica
Bulgaria	6 TL2 regions	1995-2007	OECD Regional Statistics
Canada	12 provinces and territories (Northwest Territories including Nunavut)	1981-2004	Statistics Canada
Chile	13 regions	1996-2006	National Statistics Institute
China	30 provinces, autonomous regions, and cities	1994-2008	National Bureau of Statistics of China
Colombia	33 departments	1990-2007	Departamento Administrativo Nacional de Estadística
Croatia	3 TL2 regions	1990-2007	OECD Regional Statistics
Czech Republic	8 TL2 regions	1990-2007	Cambridge Econometrics and OECD Regional Statistics
Denmark	3 NUTS2 regions	1980-2004	Cambridge Econometrics
Finland	6 NUTS2 regions	1980-2004	Cambridge Econometrics
France	22 NUTS2 regions	1980-2004	Cambridge Econometrics
Georgia	9 provinces	2003-2009	National Statistics Office of Georgia
Germany	30 NUTS2 regions (West)	1980-2004	Cambridge Econometrics
Greece	13 NUTS2 regions	1980-2004	Cambridge Econometrics
Hungary	7 NUTS2 regions	1990-2007	Cambridge Econometrics and OECD Regional Statistics
India	28 states and union territories	1980-2005	Directorate of Economics & Statistics of respective State Governments, and Central Statistical Organisation
Indonesia	33 provinces	2004-2008	Badan Pusat Statistik
Iran, Islamic Rep.	28 provinces	2000-2003	Statistical Center of Iran
Ireland	2 NUTS2 regions	1980-2004	Cambridge Econometrics
Italy	20 NUTS2 regions	1980-2004	Cambridge Econometrics
Japan	10 TL2 regions	1990-2005	OECD Regional Statistics
Kazakhstan	16 regions and cities	1998-2009	Agency of Statistics of the Republic of Kazakhstan
Korea, South	7 TL2 regions	1990-2007	OECD Regional Statistics
Latvia	6 NUTS3 regions	1996-2007	EUROSTAT
Lithuania	10 NUTS3 regions	1995-2007	EUROSTAT
Malta	2 NUTS3 regions	2000-2007	EUROSTAT
Mexico	32 states; 1 capital region	1980-2006	Instituto Nacional de Estadística y Geografía
Mongolia	21 provinces; 1 capital region	2000-2006	National Statistical Office

Table A.1 countinued

Country	Territorial level	Period	Source
Netherlands	12 NUTS2 regions	1986-2004	Cambridge Econometrics
New Zealand	2 TL2 regions	2000-2003	OECD Regional Statistics
Norway	7 NUTS2 regions	1980-2004	Cambridge Econometrics
Panama	9 provinces	2002-2007	Instituto Nacional De Estadistica
Peru	24 departments	2001-2009	Instituto Nacional de Estadística e informática - Dirección Nacional de Cuentas Nacionales
Philippines	17 districts	2002-2008	National Statistics Office
Poland	16 NUTS2 regions	1990-2007	Cambridge Econometrics and OECD Regional Statistics
Portugal	7 NUTS2 regions	1980-2004	Cambridge Econometrics
Romania	8 NUTS2 regions	1995-2007	EUROSTAT
Russian Federation	7 federal regions	1998-2008	Federal State Statistics Office
Slovak Rep.	4 TL2 regions	1990-2007	Cambridge Econometrics and OECD Regional Statistics
Slovenia	2 NUTS2 regions	1995-2007	EUROSTAT
South Africa	9 provinces	2001-2008	Statistics South Africa
Spain	18 NUTS2 regions	1980-2004	Cambridge Econometrics
Sweden	8 NUTS2 regions	1980-2004	Cambridge Econometrics
Switzerland	7 NUTS2 regions	1980-2004	Cambridge Econometrics
Tanzania	21 administrative regions	2002-2007	National Bureau of Statistics
Thailand	7 geographic regions	2001-2009	National Statistics Office Thailand
Turkey	26 TL2 regions	1990-2006	OECD Regional Statistics
U.S. of America	51 states	1980-2008	U.S. Department of Commerce, OECD Regional Statistics
Ukraine	27 districts	2004-2008	State Statistics Commitee of Ukraine
United Kingdom	37 NUTS2 regions	1980-2004	Cambridge Econometrics
Uzbekistan	12 provinces; 1 republic; 1 capital region	2008	Uzbekistan in Figures - UinF
Venezuela	23 states; 1 federal district	2007	Banco Central de Venezuela

Table A.2: Empirical literature on decentralization and regional inequality

Author(s)	Journal	Sample	Period	Decentralization measures	Methodology	Result
Kim et al. (2003)	*Annals of Regional Science*	15 provinces (Korea)	1971-1997	regional concentration of education expenditures and infrastructure expenditures, etc.	OLS	0
Akai and Hosio (2009)	*Journal of Income Distribution*	50 states (USA)	1993-2000	expenditure and revenue decentralization	Panel OLS, TSLS	–
Kanbur and Zhang (2005)	*Review of Development Economics*	28 provinces (China)	1952-2000	expenditure decentralization	OLS	+
Bonet (2006)	*Annals of Regional Science*	33 districts (Columbia)	1990-2000	expenditure and revenue decentralization	OLS	+
Shankar and Shah (2003)	*World Development*	22 countries	1980-1999	expenditure decentralization	OLS	–
Gil Canaleta et al. (2004)	*Urban Studies*	17 countries	1980-1996	federal dummy, Lijphart index, expenditure and revenue decentralization, etc.	correlations	–
Rodríguez-Pose and Gill (2004)	*Environment and Planning A*	11 countries	1980-1999	expenditure decentralization	correlations	+
Ezcurra and Pascual (2008)	*Environment and Planning A*	12 countries (EU)	1980-1999	expenditure decentralization	Panel OLS	–
Lessmann (2009)	*Environment and Planning A*	22 countries (OECD)	1980-1999	expenditure and revenue decentralization	Panel OLS, TSLS, GMM	–
Rodríguez-Pose and Ezcurra (2010)	*Journal of Economic Geography*	26 countries	1990-2005	expenditure decentralization and political decentralization (Schneider)	Panel TSLS	–/+

Note: "0": no significant effects; "+": coefficient of decentralization is positive and significant; "–": coefficient of decentralization is negative and significant.

Table A.3: Political and Fiscal Decentralization: Correlations

	Political Decentralization					Electoral Decentralization			Fiscal Decentralization			
	FEDERAL	TIERS	AUTON	RESID	AUTRES	BOTEL	SECEL	BOSEC	EXPDEC	REVDEC	TAXDEC	VIMB
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
FEDERAL	1.00											
TIERS	0.05	1.00										
AUTON	0.61***	0.01	1.00									
RESID	0.90***	0.06	0.57***	1.00								
AUTRES	0.81***	0.04	0.86***	0.80***	1.00							
BOTEL	0.08	-0.13	-0.07	0.07	0.01	1.00						
SECEL	0.24**	-0.07	0.04	0.21	0.16	0.43***	1.00					
BOSEC	0.19*	-0.14	-0.02	0.16	0.10	0.83***	0.86***	1.00				
EXPDEC	0.47***	-0.04	0.27**	0.27**	0.38***	0.16	0.30**	0.28**	1.00			
REVDEC	0.49***	0.00	0.23*	0.33***	0.39***	0.11	0.25*	0.23*	0.94***	1.00		
TAXDEC	0.15	0.10	-0.01	0.18	0.10	-0.07	-0.03	-0.12	0.17	0.35***	1.00	
VIMB	-0.12	-0.14	0.05	-0.18	-0.05	0.18	0.09	0.20	0.10	-0.14	-0.79***	1.00
EMPLDEC	0.37***	0.03	0.23**	0.30***	0.33***	0.46***	0.23*	0.33***	0.70***	0.64***	0.19	0.00

Note: ***, **, and * indicate significance at 1%, 5%, and 10%, respectively.

Table A.4: Data sources & definitions

Variable	Definition	Source
CV	Coefficient of variation of regional GDP per capita	various sources
GINI	Adjusted Gini coefficient of regional GDP per capita	various sources
WCV	Population weighted coefficient of variation of regional GDP per capita	various sources
GDPPC	Log of the GDP per capita in 2005 $ prices.	WDI 2010
UNITS	Number of regions considered for the calculation of measures of regional inequality.	various sources
AREA	Log of area in square kilometers.	WDI 2010
UNEMPL	Unemployment ratio.	WDI 2010
OPENNESS	Sum of imports and exports (total trade) as a share of the GDP.	WDI 2010
ETHNIC	Ethnolinguistic fractionalization is computed as one minus Herfindahl index of ethnolinguistic group shares, and reflects the probability that two randomly selected individuals from a population belonged to different groups.	Alesina et al. (2003)
URBAN	Share of urban living population in total population.	WDI 2010
FEDERAL	Dummy for countries with a federal constitution.	Treisman (2008)
TIERS	Number of vertical government tiers.	Treisman (2008)
AUTON	Local jurisdictions have a certain amount of 'autonomy' regarding a given question, if the constitution reserves exclusive decision-making power on that question.	Treisman (2008)
RESID	A sub-national legislature is said to have 'residual authority', if the constitution assigns the exclusive right to legislate on issues that are not specifically assigned to one level of government.	Treisman (2008)
AUTRES	Sub-national governments have autonomy and/or residual autonomy.	Treisman (2008)
BOTEL	Dummy variable, which is one if a country has elections at the lowest tier of government.	Treisman (2008)
SECEL	Dummy variable, which is one if a country has elections at the second lowest tier of government.	Treisman (2008)
BOSEC	Sum of *BOTEL* and *SECEL*	Treisman (2008)
EXPDEC	The degree of expenditure decentralization relates the sum of sub-national (state & local) government expenditures to total government expenditures.	IMF GFS
REVDEC	The degree of revenue decentralization relates the sum of sub-national (state & local) government revenues to total government revenues.	IMF GFS
VIMB	Grant-share of sub-national government expenditures.	IMF GFS
TAXDEC	Share of sub-national government tax revenues in total government revenues.	IMF GFS
EMPLDEC	Share of sub-national government employment in total government employment.	Treisman (2008)
EURLANG	Population share speaking a primary language of Western Europe – English, French, German, Portuguese, and/or Spanish.	Hall and Jones (1999)
DEMO18	Number of years of democracy since 1800. A country is assumed to be democratic if the the polity2 index provided by the PolityIV project is positive	Marshall and Jaggers (2009)
DEMOP2	Democracy index as provided by the PolityIV project	Marshall and Jaggers (2009)
POLITY2	Polity2 index as provided by the PolityIV project	Marshall and Jaggers (2009)
INTDEMO	Dummy variable for countries with uninterrupted democracy (polity2 index ¿0) since 1950	Marshall and Jaggers (2009)
LAW	Dummy variable for the English Common Law System.	CIA World Factbook
LEGOR	Dummy variable for countries with a German legal origin	Porta et al. (2008)
PTANTS	Population share belonging to the Protestant Church.	La Porta et al. (1999)

Table A.5: Robustness test: OLS and TSLS using GINI and and WCV

	Dependent variable: GINI						Dependent variable: WCV					
	OLS			TSLS			OLS			TSLS		
	Coeff.	Obs.	R^2	Coeff.	Obs.	R^2	Coeff.	Obs.	R^2	Coeff.	Obs.	R^2
FEDERAL	-0.033*	56	0.76	-0.050	48	0.76	-0.082**	54	0.71	-0.130	46	0.69
	(-1.98)			(-1.24)			(-2.09)			(-1.24)		
TIERS	0.006	55	0.74				0.028	53	0.69			
	(0.41)						(0.92)					
AUTON	0.004	52	0.75				0.003	50	0.70			
	(0.22)						(0.05)					
RESID	-0.019	52	0.76				-0.019	50	0.71			
	(-1.10)						(-0.46)					
AUTRES	-0.021	53	0.76	-0.136*	51	0.58	-0.042	51	0.70	-0.306*	49	0.45
	(-1.29)			(-1.84)			(-1.00)			(-1.92)		
BOTEL	-0.038	51	0.74				-0.045	49	0.69			
	(-1.40)						(-0.66)					
SECEL	-0.010	49	0.70				-0.019	47	0.67			
	(-0.56)						(-0.53)					
BOSEC	-0.015	49	0.71	-0.072**	48	0.59	-0.024	47	0.68	-0.169**	46	0.43
	(-1.18)			(-2.18)			(-0.77)			(-2.50)		
EXPDEC	-0.001	48	0.79	-0.002*	42	0.78	-0.004**	47	0.74	-0.003	41	0.76
	-1.31			-1.69			-2.15			-1.37		
REVDEC	-0.001*	48	0.80	-0.002*	42	0.80	-0.004**	47	0.75	-0.003	41	0.76
	(-1.93)			(-1.89)			(-2.49)			(-1.51)		
TAXDEC	0.000	48	0.78	-0.001	42	0.78	-0.001	47	0.72	-0.002	41	0.70
	(-0.75)			(-0.84)			(-0.81)			(-1.26)		
VIMB	0.001	47	0.79				0.002	47	0.73			
	(1.44)						(1.55)					
EMPLDEC	0.000	46	0.75				-0.001	44	0.68			
	(0.68)						(-0.65)					

Note: t-values are reported in parentheses; standard errors are calculated using White correction; ***, **, and * indicate significance at 1%, 5%, and 10%, respectively.

Table A.6: Panel results (5-year averages)

	Dependent variable: Coefficient of variation of regional GDP p.c. (CV)					
	Random effects			Fixed effects		
	Coeff.	Obs.	Adj.-R^2	Coeff.	Obs.	Adj.-R^2
FEDERAL	-0.058	193 (56)	0.658	–	–	–
	(-1.21)					
TIERS	0.014	191 (55)	0.644	–	–	–
	(0.34)					
AUTON	-0.030	183 (52)	0.648	–	–	–
	(-0.62)					
RESID	-0.045	185 (52)	0.667	–	–	–
	(-0.88)					
AUTRES	-0.078*	187 (53)	0.673	–	–	–
	(-1.69)					
BOTEL	-0.115*	179 (51)	0.604	–	–	–
	(-1.76)					
SECEL	-0.063	174 (49)	0.579	–	–	–
	(-1.37)					
BOSEC	-0.062*	174 (49)	0.587	–	–	–
	(-1.90)					
EXPDEC	-0.004	88 (36)	0.558	-0.007**	92 (37)	0.19
	(-1.56)			(-2.15)		
REVDEC	-0.001	88 (36)	0.604	-0.004	92 (37)	0.19
	(0.56)			(-1.22)		
TAXDEC	0.001	88 (36)	0.643	0.000	92 (37)	0.17
	(1.56)			(0.53)		
VIMB	-0.001	86 (35)	0.625	0.000	90 (36)	0.20
	(-0.85)			(-0.22)		
EMPLDEC	0.001	166 (46)	0.640	–	–	–
	(0.37)					

Note: t-values are reported in parentheses; standard errors are calculated using White correction; ***, **, and * indicate significance at 1%, 5%, and 10%, respectively.

Table A.7: Robustness test: Annual Panel RE and FE using GINI and and WCV

	Dependent variable: GINI						Dependent variable: WCV					
	RE			FE			RE			FE		
	Coeff.	Obs.	R^2	Coeff.	Obs.	R^2	Coeff.	Obs.	R^2	Coeff.	Obs.	R^2
FEDERAL	-0.040**	795	0.49	–	–	–	-0.068**	782	0.51	–	–	–
	(-2.06)	(56)					(-2.18)	(54)				
TIERS	0.004	790	0.47	–	–	–	0.026	777	0.46	–	–	–
	(0.21)	(55)					(0.85)	(53)				
AUTON	-0.018	765	0.55	–	–	–	-0.051	752	0.47	–	–	–
	(-1.07)	(52)					(-1.49)	(50)				
RESID	-0.019	775	0.55	–	–	–	-0.013	762	0.51	–	–	–
	(-1.11)	(52)					(-0.47)	(50)				
AUTRES	-0.038**	783	0.54	–	–	–	-0.068**	770	0.50	–	–	–
	(-2.25)	(53)					(-2.27)	(51)				
BOTEL	-0.054**	749	0.51	–	–	–	-0.079**	736	0.47	–	–	–
	(-2.28)	(51)					(-2.02)	(49)				
SECEL	-0.020	728	0.47	–	–	–	-0.037	715	0.40	–	–	–
	(-1.31)	(49)					(-1.23)	(47)				
BOSEC	-0.024	728	0.48	–	–	–	-0.041**	715	0.41	–	–	–
	(-2.15)	(49)					(-1.97)	(47)				
EXPDEC	-0.001***	350	0.45	-0.001***	350	0.05	-0.001***	342	0.42	-0.002***	342	0.00
	(-3.00)	(35)		(-4.76)	(35)		(-3.69)	(34)		(-3.14)	(34)	
REVDEC	-0.001	350	0.46	-0.001***	350	0.05	-0.001**	342	0.42	-0.001	342	0.15
	(-1.51)	(35)		(-2.70)	(35)		(-2.04)	(34)		(-0.74)	(34)	
TAXDEC	0.000	353	0.49	0.000	353	0.05	0.000	345	0.42	0.000	345	0.00
		(35)		(0.56)	(35)		(0.10)	(34)		(-0.24)	(34)	
VIMB	0.000	344	0.49	0.000	344	0.04	0.000	344	0.42	0.000	344	0.00
	(0.54)	(34)		(0.39)	(34)		(0.20)	(34)		(0.34)	(34)	
EMPLDEC	0.000	700	0.49	–	–	–	-0.002	687	0.44	–	–	–
	(-0.51)	(46)					(-1.77)	(44)				

Note: t-values are reported in parentheses; standard errors are calculated using White correction; ***, **, and * indicate significance at 1%, 5%, and 10%, respectively.

Table A.8: Robustness test: Panel, 5-year period averages, RE and FE using GINI and and WCV

	Dependent variable: GINI						Dependent variable: WCV					
	RE			FE			RE			FE		
	Coeff.	Obs.	R^2	Coeff.	Obs.	R^2	Coeff.	Obs.	R^2	Coeff.	Obs.	R^2
FEDERAL	-0.026	193	0.67	–	–	–	-0.054	189	0.63	–	–	–
	(-1.33)	(56)					(-1.27)	(54)				
TIERS	-0.002	191	0.65	–	–	–	0.014	187	0.60	–	–	–
	(-0.17)	(55)					(0.44)	(53)				
AUTON	-0.003	183	0.67	–	–	–	-0.022	179	0.59	–	–	–
	(-0.13)	(52)					(-0.45)	(50)				
RESID	-0.013	185	0.68	–	–	–	-0.004	181	0.60	–	–	–
	(-0.60)	(52)					(-0.09)	(50)				
AUTRES	-0.023	187	0.68	–	–	–	-0.048	183	0.60	–	–	–
	(-1.22)	(53)					(-1.13)	(51)				
BOTEL	-0.045	179	0.64	–	–	–	-0.063	175	0.56	–	–	–
	(-1.61)	(51)					(-1.24)	(49)				
SECEL	-0.016	174	0.60	–	–	–	-0.025	170	0.53	–	–	–
	(-0.79)	(49)					(-0.57)	(47)				
BOSEC	-0.019	174	0.61	–	–	–	-0.030	170	0.53	–	–	–
	(-1.36)	(49)					(-1.05)	(47)				
EXPDEC	-0.001*	88	0.50	-0.002***	88	0.09	-0.001	86	0.49	-0.001	86	0.05
	(-1.77)	(36)		(-3.14)	(36)		(-1.51)	(35)		(-1.08)	(35)	
REVDEC	-0.001	88	0.52	-0.002	88	0.09	-0.001	86	0.49	-0.001	86	0.05
	(-0.76)	(36)		(-2.41)	(36)		(-0.78)	(35)		(-0.52)	(35)	
TAXDEC	0.000	88	0.55	0.000	88	0.09	0.000	86	0.48	0.000	86	0.05
	(1.31)	(36)		(0.30)	(36)		(0.01)	(35)		(-0.84)	(35)	
VIMB	0.000	86	0.54	0.000	86	0.08	0.000	86	0.48	0.000	86	0.05
	(0.16)	(35)		(0.49)	(35)		(0.57)	(35)		(0.98)	(35)	
EMPLDEC	0.000	166	0.66				-0.001	162	0.59			
	(0.42)	(46)					(-0.71)	(44)				

Note: t-values are reported in parentheses; standard errors are calculated using White correction; ***, **, and * indicate significance at 1%, 5%, and 10%, respectively.

Table A.9: Panel results using interaction variables (5-year averages)

	Dependent variable: Coefficient of variation of regional GDP p.c. (CV)					
	Random effects			Fixed effects		
	Coeff.	Obs.	Adj.-R^2	Coeff.	Obs.	Adj.-R^2
FEDERAL	0.394	193	0.66	–	193	0.21
	(1.35)	(56)			(56)	
FEDERAL×GDPPC	-0.051			-0.124**		
	(-1.63)			(-2.09)		
TIERS	0.283	191	0.66	–	191	0.05
	(1.07)	(55)			(55)	
TIERS×GDPPC	-0.032			-0.067		
	(-1.10)			(-1.29)		
BOTEL	-0.001	179	0.60	–	179	0.07
	(0.00)	(51)			(51)	
BOTEL×GDPPC	-0.014			-0.125		
	(-0.38)			(-1.17)		
SECEL	0.487	174	0.56	–	174	0.08
	(1.51)	(49)			(49)	
SECEL×GDPPC	-0.063*			-0.104**		
	(-1.76)			(-2.00)		
BOSEC	0.235	174	0.57	–	174	0.07
	(1.16)	(49)			(49)	
BOSEC×GDPPC	-0.035			-0.091**		
	(-1.52)			(-2.20)		
AUTON	0.064	183	0.65	–	183	0.19
	(0.23)	(52)			(52)	
AUTON×GDPPC	-0.011			-0.108*		
	(-0.34)			(-1.68)		
RESID	0.982*	185	0.67	–	185	0.18
	(1.93)	(52)			(52)	
RESID×GDPPC	-0.112**			-0.170**		
	(-2.09)			(-2.48)		
AUTRES	0.368	187	0.67	–	187	0.21
	(1.24)	(53)			(53)	
AUTRES×GDPPC	-0.051			-0.153***		
	(-1.57)			(-2.64)		
EXPDEC	0.020**	88	0.58	0.010	88	0.23
	(1.97)	(36)		(0.58)	(36)	
EXPDEC×GDPPC	-0.003**			-0.002		
	(-2.54)			(-1.09)		
REVDEC	0.028***	88	0.64	0.030	88	0.23
	(3.09)	(36)		(1.10)	(36)	
REVDEC×GDPPC	-0.003***			-0.004		
	(-3.32)			(-1.24)		
TAXDEC	0.013	88	0.67	-0.001	88	0.23
	(1.64)	(36)		(-0.14)	(36)	
TAXDEC×GDPPC	-0.001			0.000		
	(-1.59)			(0.19)		
VIMB	-0.006	86	0.63	0.002	86	0.21
	(-1.02)	(35)		(0.43)	(35)	
VIMB×GDPPC	0.001			0.000		
	(1.01)			(-0.43)		
EMPLDEC	0.015***	166	0.64	–	166	0.17
	(3.03)	(46)			(46)	
EMPLDEC×GDPPC	-0.002***			-0.002**		
	(-2.97)			(-2.51)		

Note: t-values are reported in parentheses; standard errors are calculated using White correction; ***, **, and * indicate significance at 1%, 5%, and 10%, respectively.