THE IMPACT OF THE CENTRALIZATION OF REVENUES AND EXPENDITURES ON GROWTH, REGIONAL INEQUALITY AND INEQUALITY[1]

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SUMMARY

This paper focuses on determining the effect of the centralization/decentralization of government activity on economic growth, regional inequality and household inequality. While there is a small empirical literature that examines the relationship between decentralization and growth, we are not aware of any empirical studies that explicitly examine the relationship between different degrees of fiscal decentralization and regional or household inequality.

Using data for 13 OECD countries, the empirical analysis generated no pervasive evidence that revenue centralization or expenditure centralization is associated with faster or slower growth. On the other hand, the analysis found that lower levels of regional inequality are associated with both revenue centralization and expenditure decentralization. This result is consistent with the view that revenue decentralization exacerbates regional disparities when fiscal capacity is unevenly distributed across regions. A somewhat surprising result was obtained for the case of household equality where it was found that increased revenue centralization is associated with more inequality.

[1] This paper was first prepared under the auspices of The Consortium for Economic Policy Research and Advice (CEPRA) in January 2002 -- a project of cooperation and technical assistance sponsored by the Canadian International Development Agency (CIDA). The project is being carried out by the Association of Universities and Colleges of Canada (AUCC), working in conjunction with experts in academia, government and the non-governmental sector in both Canada and the Russian Federation. The authors benefited from the comments and suggestions of Harvey Lazar.

I. INTRODUCTION

This study examines whether there exists a link between the centralization of revenues and expenditures and the level of economic growth, regional inequality or household inequality. Contrasting views concerning the efficacy of decentralized government organization exist in the literature. The decentralization of revenues and expenditures has often been proposed as a method of improving local control of public services so that the services provided more closely match local preferences. Decentralization can also lead to competition between governments and, thereby, make governments operate more efficiently. However, decentralized governments may be less efficient because they cannot take advantage of potential economies of scale. Further, competition between regions may lead to disruptive tax and expenditure competition. Resolving the question of whether decentralization is an attractive policy option or not hinges crucially on identifying which of these contrasting views is supported by observed economic behaviour.

The outline of this study is as follows. Section II provides a brief overview of the centralization-decentralization debate and discusses the findings of the existing empirical literature. Section III begins with a discussion of the data used in this study. This is followed by a description of the empirical methodology and a discussion of the empirical findings. The final section provides a summary and conclusion.

II. CENTRALIZATION AND DECENTRALIZATION

Analyzing the impact of centralized versus decentralized forms of government requires the ability to identify and measure the degree to which authority has been assigned to different levels of government. From a theoretical perspective, Habibi et. al. (2001) propose a three stage delineation of the decentralization process, identifying “deconcentration”, “delegation” and “devolution” as the stages or degrees of decentralization that could exist within an economy or political unit. Deconcentration refers

to the assignment of administrative authority from higher-level to lower-level governments so that local authorities simply administer centrally developed and financed programs with little or no discretion. Delegation refers to the actual transfer of decision-making power and fiscal resources to local authorities from the central authority. However, under delegation the central authority retains control over the resource allocation process. The most complete form of decentralization is devolution in which local authorities have full control over fiscal and allocative decisions without interference from the central authority. Devolution could occur in a "hard" form in which local authorities possess the ability to set tax rates and raise revenues or in a "soft" form in which local authorities receive revenues via automatic and unconditional transfers from the central authority.

While the Habibi et. al. theoretical construct provides a very precise delineation of the decentralization process, the actual measurement of the degree of centralization or decentralization that is typically used in empirical studies is considerably less precise. Empirical studies have usually focused on either measures of expenditure decentralization or measures of revenue decentralization. For example, Habibi et. al. (2001) in their study of the impact of increased decentralization in Argentina used a revenue decentralization measure defined as the ratio of the value of the resources controlled by lower level governments (provinces) to the total value of available resources for all levels of government. Conversely, Xie, Zou and Davoodi (1999) and Davoodi and Zou (1998) measured the degree of decentralization across countries using an expenditure measure, defined as the ratio of spending by subnational governments to the spending of all levels of government (net of intergovernmental transfers).

The existence of intergovernmental transfers, particularly those flowing from higher-level to lower-level governments, creates difficulty in applying both revenue-based and expenditure-based decentralization measures. Intergovernmental grants blur the distinction between national and subnational government authority. However, without detailed information about the nature of these grants (whether they are automatic or discretionary and whether they are conditional or unconditional), it is not possible to disentangle completely the overlapping authority between national and subnational government. Thus, both revenue-based and expenditure-based measures of the degree of decentralization tend to be somewhat crude.

II.1 Decentralization and Growth

The fundamental economic argument advanced in favour of decentralized government activity has been that decentralization is a means to enhance the efficiency of government activity, to increase social welfare and to promote economic development and growth. The standard basis for this efficiency argument is individual voter and taxpayer mobility so that the creation of "local jurisdictions" provides market-type solutions to the preference revelation problem inherent in the provision of public goods and services.

The central provision of public goods and services will tend to impose uniformity of provision across communities that may have different preferences for those goods and services. Decentralization allows local governments to offer differing amounts of these public goods and services. If taxpayers/voters are mobile and possess different preferences, they can locate in jurisdictions that offer expenditure and tax packages that are consistent with their preferences. Local governments can respond to preferences revealed through individuals "voting with their feet" and provide levels of public goods and services that are optimal for community preferences. Thus, decentralization may be more efficient than centralized government organization in matching community preferences with the supply of public goods.

Moreover, efficiency may also be enhanced by a decentralized system of government if it encourages innovation in public good provision. Again, mobility of taxpayers/voters and competition among jurisdictions for these individuals may provide an incentive for local jurisdictions to seek cost-effective methods of providing public goods. The existence of these incentives should increase the probability of

discovering such cost-effective innovations and quicken the pace of technological progress.

For the decentralization of government authority to be efficient it is necessary that individual preferences differ and that individuals be mobile across local jurisdictions. If preferences do not differ then the uniform provision of public goods and services is optimal and decentralization carries no advantage over centralization. If individual taxpayers/voters are not mobile then the mechanism by which preferences for public goods and services are signaled in a market replicating fashion to local authorities is not operational.

However, differences in preferences and mobility are not sufficient to guarantee that a decentralized system of government will be more efficient than a centralized one. Decentralized systems may be less efficient. For example, if decentralization occurs through a federalist system with national and subnational jurisdictions, competition among levels of government may cause an increase in the overall size of government beyond its optimal size. Folster and Henrekson (2001) found a negative relationship between economic growth and government size. As another example, if public good provision is subject to economies of scale, the improved preference matching associated with local jurisdiction provision of such goods may not yield a welfare gain sufficient in size to offset the losses associated with smaller scale production of the goods.

Durham (1999) offers a different view from the standard argument regarding the potential efficiency gains associated with decentralized systems of government. In his view, an important driving force of economic growth is the existence of well-established and protected private property rights. However, a dilemma arises in that governments strong enough to protect property rights are also strong enough to eliminate them. Federal systems, with decentralized political power, constrain the ability of any one government level to violate private property rights because no one jurisdiction has monopoly power over market regulation. These constraints enhance the credibility of private property rights in federalist systems and, consequently, enhance the economic growth process.

Clearly, given the above discussion, the issue of whether a decentralized system of government organization enhances economic efficiency and growth is an empirical one. Davoodi and Zou (1998) examined this issue using a panel data set comprised of 46 countries over a sample period of 1970 to 1989. Measuring decentralization as expenditure decentralization (ie. the ratio of subnational government spending to total government spending, net of intergovernmental transfers), they found a negative relationship between the degree of decentralization and economic growth in developing countries and no relationship in developed countries. Xie, Zou and Davoodi (1999) examined the same issue using a purely time series analysis of the US economy over the 1951-94 period. They found that the share of state and local government spending out of total government spending on output had no statistically significant impact on aggregate output growth during the sample period.

II.2 Decentralization and Equality

In addition to issues of economic efficiency and growth, the differential impact of decentralized versus centralized government organization on the distribution of income has also been addressed. Concerns about adverse effects arising from decentralization on both regional and individual equality have been expressed.

With respect to regional inequality, if countries are composed of wealthy and less wealthy regions then a move towards the decentralization of government authority may have an adverse impact on the distribution of income and social welfare across regions. Durham (1999) argues that less wealthy regions will have, by definition, a poorer tax base with which to finance the provision of public goods and services and transfers designed to redress individual inequality. Without the ability to access the resources of wealthy regions, which would occur naturally with a more centralized form of government or could occur under decentralized government through a system of

intergovernmental transfers, less wealthy regions would be relatively disadvantaged by decentralization.

Kneebone (1997) maintains that decentralization may also adversely affect the distribution of income across individuals. If a local jurisdiction in a decentralized system of government wished to redistribute income within its jurisdiction towards lower income individuals there may be an adverse spillover effect. A more generous redistribution policy would be attractive to low income individuals residing in other jurisdictions and, if these individuals were mobile, create an incentive to move to the jurisdiction with the more generous policy and raise the cost of the policy in that jurisdiction.[2] Thus, local jurisdictions may choose to "free ride" on each other with respect to income redistribution policies. This would reduce or eliminate such policies overall and, ultimately, worsen the distribution of income across individuals.

A large theoretical and empirical literature exists regarding issues of income distribution and inequality in general. Much of the literature relating to economic growth and the distribution of income has focused on "territorial" (countries or regions) inequality and the issue of convergence. The question addressed by this analysis has been: as the growth process occurs over time, do countries or regions within a country converge to similar levels of per capita income and output or do they ultimately diverge?

The theoretical basis of the convergence hypothesis is the one-sector neoclassical growth model with exogenous technological change. With decreasing returns to scale and mobility of factors and technology, the model predicts strong or unconditional convergence (all economies converge to the same steady state). However, the same model with either artificial barriers to relative price equalization or a process of innovation adoption disrupted by poor socio-political conditions yields a prediction of weak or conditional convergence ("similar" economies converge to similar steady states). In contrast to the one-sector neoclassical growth model, endogenous growth models with external effects and aggregate increasing returns to scale predict that the forces of market competition will lead to neither unconditional nor conditional convergence but rather to divergence with a "winner take all" outcome to the innovation process.

Given the range of predictions arising from theoretical growth models, the issue of convergence versus divergence has become an empirical issue. In a carefully crafted recent study, Evans and Karras (1996) test the convergence hypothesis for both the 48 contiguous US states and a group of 54 countries. Their empirical analysis finds no support for unconditional convergence or for divergence, but does generate evidence, both at the country level and the US state level, that economies converge conditionally. Thus, economies that are sufficiently similar, so as to have access to similar technological knowledge, will eventually converge.

The empirical results indicating some support for the conditional convergence hypothesis have implications for the question of whether decentralization has an impact on the distribution of income across countries or regions. If regions or countries conditionally converge, and if the manner in which government activity is organized matters as one of the conditioning elements, then the degree of decentralization will determine in part the similarity or dissimilarity among economies. Since similarity will determine the income and output levels to which economies will converge, the degree of decentralization may impact the cross territorial distribution of income in the steady state.

III. EMPIRICAL ANALYSIS AND RESULTS

[2] While fiscally-induced migration across jurisdictions is a theoretical possibility, the thesis remains to be confirmed empirically. Within the Canadian context, Mills, Percy and Wilson (1983) and Shaw (1986) report evidence that interprovincial migration patterns are responsive to fiscal variables while Liaw and Ledent (1987,1988) find no such relationship.

III.1 Data

The relationship between the degree of centralization/decentralization and economic growth and equality is examined using data from 13 OECD countries, a listing of which appears in Table 1. Data are available from the early 1960s to the late 1990s, but data availability varies by country from eleven years to 37 years. The choice of countries to include in the data set was based primarily on the availability of comparable data and a desire to include a mixture of countries with both relatively centralized and relatively decentralized systems of government in order to have sufficient variation in the centralization measures. The analysis was limited to OECD countries because OECD data are roughly comparable. Only developed economies were included as the goal was to study countries that were not extremely different in institutions, level of development and economic structure.

The empirical analysis utilizes three measures of the extent of centralization or decentralization within a country: a revenue-based measure and two alternative expenditure-based measures. Revenue centralization (CREV) is measured as the ratio of central government revenue to the sum of central government revenue and the revenues (net of intergovernmental transfers) of lower levels of government. Expenditure centralization is measured in "gross" form as central government current expenditure less transfers to other governments divided by total government current expenditure (CEXP), while in "net" form the expenditure measure excludes interest payments by the central and other levels of government from the ratio calculation (NETCEXP). The gross expenditure measure summarizes the centralization of total government spending net of transfers while the net expenditure measure summarizes the centralization of program spending net of transfers. The averages of each of these measures is reported in Table 1 for the 13 OECD countries included in the sample. The countries with the most centralized revenues and expenditures are Belgium, France and the United Kingdom. The most decentralized countries according to these measures are Canada and Germany (West).[3]

The use of both a revenue-based and an expenditure-based measure of centralization in the empirical analysis below represents a departure from other empirical studies. Habibi *et al*. (2001) use a single revenue-based measure while Xie, Zou and Davoodi (1999) use a single expenditure-based measure in their empirical studies. Differentiating between centralization on the revenue side and centralization on the expenditure side is important. For example, in federal systems it is not uncommon for expenditures to be decentralized to lower levels of government and revenue collection to be centralized with a set of intergovernmental transfers allocating the centrally collected revenue to the expenditure units (an organization consistent with the "soft" form of devolution identified by Habibi *et al*. (2001)). To assess whether these three centralization measures convey different information, the rank correlations of these measures were calculated for the sample of 13 countries (see Part B of Table 1). These correlations are 0.9615 for CEXP and NETCEXP, 0.7143 for CREV and CEXP, and 0.7033 for CREV and NETCEXP. Thus, there does appear to be some degree of different informational content in the expenditure and

[3] It is often unclear which level of government is ultimately responsible for the determination of the level of social security revenues and expenditures. There exist many different alternatives: the social security system may operate independently, it may be controlled by the central government or by regional governments or by both jointly, control may lie effectively with one level of government even though the constitution indicates a different form of control, or there may be a combination of all these possibilities. Given the difficulty with allocating responsibility for the social security system to one particular level of government, the data employed to construct the centralization measures used here excludes the revenues and expenditures of the social security system. One possible alternative approach is to represent the social security system as a separate branch of government and include it in the denominator of each centralization measure. All the estimates reported below were re-calculated using this alternative approach and none of the conclusions changed.

revenue centralization measures, although the correlation between the two expenditure-based measures is quite high.

While the use of revenue-based and expenditure-based measures of centralization are consistent with other empirical studies (see, for example, Habibi et. al. (2001), Xie, Zou and Davoodi (1999) and Davoodi and Zou (1998)), these measures must be recognized as imperfect indicators of the degree of centralization. Neither measure is capable of identifying the significance of intergovernmental conditional and unconditional grants in a federal system. If countries use tied or cost-sharing arrangements, revenue-based and expenditure-based measures will under-estimate the influence of the central government on the decision-making of lower levels of government. Additionally, the problem of accounting for the impact of transfers is compounded for those countries that are members of the European Union. The EU itself makes transfers directly to sub-national regions and no adjustment in this analysis has been made to account for this supra-national intergovernmental relationship.[4] Finally, the revenue-based and expenditure-based measures of centralization have been constructed using aggregate levels of revenues and expenditures which consequently ignore compositional effects. The actual effect of decentralization may depend critically on the types of spending (consumption or investment) and revenue (income taxes or consumption taxes) that have been decentralized. For each of these reasons it is necessary to interpret the results of the empirical analysis which follows with some caution.

III.2 Centralization and Real Per Capita Growth

The methodology used to examine whether a relationship exists between real growth and revenue and expenditure centralization proceeded in two steps. The first of these examines the relationship between the average growth rates of the 13 countries and their average levels of revenue and expenditure centralization. The purpose in doing this is to determine whether countries that have more centralized revenues or expenditures, on average, have grown more quickly or more slowly on average.

Figure 1 plots the average real per capita growth rate against the average ratio of central government revenues to total government revenues for each country (the data given in Part A of Table 1). An examination of this figure does not provide any discernable evidence that the degree of revenue centralization is related to the real per capita rate of growth. In Figure 2, average growth is plotted against the average ratio of the expenditure of the central government to total government expenditure. Figure 3 provides a similar plot using net government expenditure (that is, government expenditure less interest payments). In both these cases, there seems to be a very weak positive relationship between growth and the degree of centralization.

The absence of a strong systematic relationship between growth and centralization indicated by Figures 1 through 3 is confirmed in the regressions of Table 2. These regressions provide a measure of the relationship between real per capita growth (RPCGDPG) and each of the three centralization measures as well as tests of the statistical significance of this relationship. In all three cases, the coefficient representing the relationship between centralization and growth is statistically insignificant. In addition, the extremely small R^2 values imply that the variation in the fiscal centralization measures can only account for an extremely small proportion of the variation in the rate of growth. Thus, when using data that has been averaged over time for each country, there appears to be no relationship between the rate of growth and the degree of centralization.

The comparison of average data undertaken above has several shortcomings. First, it examines the impact of revenue and expenditure centralization on growth in isolation from one another. Second, there are many factors that determine growth and none of these factors are taken into account in the comparisons of Figures 1 to 3 and Table 2. The omission of important determinants of growth can bias the estimates of

[4] However, these transfers are small in relation to the expenditures of most sub-national governments.

the coefficients associated with the centralization measures. Third, this comparison does not incorporate information that could be gleaned from the variation in the growth rates and centralization measures for each country across time. However, the limited number of available data points across time for each country makes the analysis of individual country data problematic.

In order to provide a fuller analysis of the impact of revenue and expenditure centralization on growth, two changes were made to the estimation strategy. First, a growth equation was estimated including both measures of revenue and expenditure centralization. Second, this growth equation was estimated using annual data that had been pooled across countries. This created a panel data set of 324 observations (after allowing for the data necessary to generate lagged variables and additional explanatory variables) that reflects differences across both countries and time.[5] As the number of observations available for each country is different, in order to maximize the number of observations used in the empirical analysis, a different number of observations are used for each country. That is, the data set is unbalanced. In order to account for country specific effects, country dummy variables were added to the regression equation as were individual year dummy variables to account for common shocks across time.[6]

Third, in order to control for other factors that may be important determinants of growth, several control variables were added to the estimating equation. These included central government transfers to other levels of government as a proportion of GDP (TRANSFER), to control for countries with large transfer systems, a potentially important variable when examining fiscal decentralization, and the lagged growth rate ($RPCGDPG_{-1}$) in order to account for the slow adjustment of the growth rate. In addition, explanatory variables were added to the growth equation that have commonly been included in previous research on growth.[7] These were two measures of the size of government - the ratio of total government revenue to GDP (GOVREV/GDP) and the ratio of total government consumption to GDP (GOVC/GDP), the rate of inflation (INFLATION), a measure of the degree of openness of the economy - the ratio of the sum of exports and imports to GDP (OPEN), the change in a country's terms of trade (DTOT), and two measures of human capital - the average years of secondary schooling of females (SYRF) and males (SYRM).[8] Exact descriptions of the sources of the data used to create these variables and all the other variables used in this study are given in the Appendix.

Estimates of growth equations using the time series data that have been pooled across countries are presented in Table 3. As most of the current period explanatory variables are likely to depend on the current growth rate, and so are endogenous, the parameters are estimated using a two-stage least squares estimation technique.[9] Six different versions of the model are estimated. These vary by which control variables are included in the estimating equation and whether the measure of expenditure centralization is the "net" measure, excluding interest payments, or the total expenditure measure.

The results given in this Table appear to be reasonable. Two tests for misspecification of the

[5] The growth literature has often averaged data over time for 5-year periods. This excludes much potentially useful variation in the data. The alternative is to use annual data and include year dummy variables to account for short run shocks as we have done.

[6] The inclusion of both country and year fixed effects is now common (Besley and Case (2000)). The year dummy variables reflect the impact of omitted common effects that impact all countries similarly in a given year. If omitted, the covariances across countries in the same period would be non-zero (Pesaran et al (1999)).

[7] The review by Durlauf and Quah (1999) summarizes the many control variables that have been used in empirical growth equations.

[8] The two education variables were chosen from among the many available because they were found to be significant by Forbes (2000).

[9] The instruments used are given in the notes to Table 3.

estimating equation - the RESET test and the AR1 test - do not provide any indication of misspecification. Of the control variables listed above, only three are statistically significant determinants of growth and the signs of the estimated parameters associated with these significant variables are as expected. They indicate that a larger government and more inflation are both associated with a lower rate of growth while more open economies have higher rates of growth. The coefficient on the lagged dependent variable is positive and significant, indicating that the growth rate adjusts gradually to changes in the explanatory variables. However, this coefficient is small, indicating that adjustment is relatively fast.

The results with respect to the measures of fiscal centralization are mixed. The estimated coefficients associated with the measure of revenue centralization (CREV) are all negative, indicating that greater centralization of revenue collection is associated with slower growth, but in only one case is the estimated parameter statistically different from zero. In particular, this parameter is not significant when the additional control variables are included in the estimating equation, an indication that its significance may be due to omitted variables bias.

The coefficients associated with the two expenditure centralization measures (CEXP and NETCEXP) are all positive, implying that greater centralization of expenditures is associated with faster growth, and in five of the six cases they are statistically significant using a 95 percent confidence interval. (Note that the fiscal variables are not significant as often if the method of ordinary least squares is used to estimate the parameters rather than two-stage least squares. For comparison purposes these results are presented in Table 4.) While expenditure centralization may have a positive relationship with growth, it is unlikely that expenditure can be centralized without also centralizing revenue, and the results provide weak evidence that revenue centralization may actually be associated with lower growth. In addition, the positive effect of expenditure centralization would only occur if greater centralization did not also increase the size of government (GOVREV/GDP), as this variable has a negative effect on growth.

The magnitudes of the coefficient estimates in Table 3 (and Table 4) are not straightforward to interpret. To give some idea of the meaning of these estimates, Table 5 provides simulations of the impact on the growth rate (both in the current period, the "short run", and in the long run) of 10 percent increases in each of the explanatory variables. Relative to the other variables, the centralized expenditure variable is associated with a large impact on growth. However, although it is not statistically significant, the effect of the revenue centralization variable is as large as that of the expenditure centralization variable, although opposite in sign. Thus, if expenditure decentralization led to less revenue centralization, the effect on growth of these two changes may cancel each other out.

III.3 Centralization and Regional Inequality

The next goal of this study is to determine the impact of greater fiscal centralization (or decentralization) on the inequality of incomes across regions. There appears to be no standard way of measuring the extent of regional income inequality in a country. Many possible alternatives are sensitive to the units of measurement or the number of regions in the country, making comparisons across countries difficult. To facilitate the comparison of regional inequality measures across countries, the gini inequality measure that is commonly used to measure individual income inequality is used here to measure the inequality of regional incomes. Specifically, the per capita income of each region in a country is determined and then the gini coefficient is calculated with the per capita income of a region taking on the role of individual income in the standard gini coefficient calculation.[10] An important characteristic of this measure of regional inequality is that it does not take into account the relative population sizes of the regions. This implies that large regions do not dominate the measure, but may over emphasize the importance of regional inequality

[10] For a discussion of inequality measures see Deaton (1997). The exact formula used to calculate the regional Gini is given on page 139 of Deaton (1997).

from a social perspective if the poorer regions all have small populations.

The average across time of the regional Gini coefficients (RegGini) for the 11 countries for which regional data are available are provided in Table 6. The greater is the Gini coefficient, the greater is the level of regional inequality. The Gini coefficients in Table 6 are smaller than those that are typical for individual-income based Gini coefficients because the level of inequality between the average per capita incomes of regions is generally much less than the inequality between individuals in a particular region. The smallest degree of regional inequality is in Sweden, while the greatest extent of regional inequality is in Italy, Austria and Belgium.

In order to determine whether there is some indication of a relationship between regional inequality and the level of fiscal centralization, the average values of the regional Gini coefficients for each country are plotted against the three fiscal centralization measures in Figures 4 through 6. In all three figures there appears to be a vague positive relationship between the level of centralization and the level of regional inequality. However, this effect is certainly not pronounced. In order to determine whether this relationship is statistically significant, the log of the average regional Gini coefficient for each country was regressed on each of the three centralization measures.[11] These results are reported in Table 7. While all three of the estimated coefficients are positive, none are statistically significant and the proportion of the variation in the regional Gini that is explained by movements in the fiscal variables is quite small (that is, the R^2 values are small).

The results in Figures 4 through 6 and Table 7 provide some evidence, although rather weak, that greater fiscal centralization is associated with higher regional inequality. In order to investigate this finding more completely, the annual data for each country is pooled and several control variables are added to the estimating equation, one of which is the lagged dependent variable.[12] The results using the pooled annual data are reported in Table 8.[13] The estimation methodology used is ordinary least squares in this case as a Hausman test for endogeneity of the explanatory variables does not provide any evidence of endogeneity. Once again, the two specification tests do not indicate problems with the estimating equation and the R^2 statistic is quite high.

Given that there is little available evidence on the determinants of regional inequality, the control variables added to the estimating equation in this case were the same as those added to the growth equation (except that the lagged growth rate was replaced with the lagged level of real per capita output). Of these control variables, the openness measure, the level of government consumption, the inflation rate and the lagged level of real GDP were all found to be significant determinants of regional inequality. The estimated coefficients associated with these variables imply that they are all positively correlated with greater regional inequality (perhaps because some regions have grown while others have not). The coefficient on the lagged dependent variable, in the range of .35 to .5, indicates that, as would be expected, regional inequality adjusts slowly, but adjustment is not extremely slow (the mean lag is two years or less).[14]

The estimated coefficients of the fiscal centralization variables are similar in sign to those in the growth regressions. The coefficient

[11] Use of the log of the regional Gini is consistent with the methodology used in the literature that relates individual inequality to growth.

[12] There are not enough observations for any one country to estimate the relationship between regional inequality and the fiscal centralization measures using the data from one country only.

[13] The number of observations used in Table 8 is less than that used to calculate the averages in Table 6 as there were fewer observations for which all the explanatory variables were available, and several observations had to be used in order to calculate the lagged dependent variable and the lagged variables used as instruments in the Hausman test for endogeneity.

[14] If the lagged dependent variable is not included in the estimating equation, the residuals exhibit serial correlation.

associated with the measure of centralized revenues is negative and significant when all the explanatory variables are added to the estimating equation. This provides evidence that greater centralization of revenues is associated with lower regional inequality. This would not be unexpected as centralization of revenue collection is likely to help smooth regional differences in tax raising ability. On the other hand, the estimated coefficients associated with the expenditure centralization measures imply that centralized expenditure is associated with greater regional inequality. These results would seem to imply that regional inequality can be reduced by raising revenues centrally while divesting expenditure responsibility from the center to the regions. Interestingly, however, the importance (as a ratio of GDP) of transfers from the center to other levels of government does not appear to significantly affect regional inequality as the coefficient on the TRANSFER variable is insignificant.

In order to evaluate the relative importance of the explanatory variables as determinants of regional inequality, the impact on the level of the regional Gini coefficient of a 10 percent change in each explanatory variable is calculated. These calculations are presented in Table 9. Changes in the revenue and expenditure centralization measures have much larger impacts on regional inequality than any of the other explanatory variables. Furthermore, while the impact of revenue centralization is at least as large as that of expenditure centralization, the magnitudes of the two effects are relatively similar (although opposite in sign). This would imply that a policy of either decentralizing both revenues and expenditures or centralizing both revenues and expenditures is likely to have a relatively small impact on regional inequality (although decentralizing both would still tend to reduce regional inequality). On the other hand, a policy of decentralizing expenditures, while centralizing revenue collection would be associated with a potentially large reduction in regional inequality.

III.4 Centralization and Inequality Between Individuals

It has often been suggested that the decentralization of revenues and expenditures will increase the inequality of incomes across individuals (or households). The rationale for this is that competition between regional governments for investment and taxpayers causes taxes and expenditures on redistribution to be lower than would be the case under a centralized system of government. In order to investigate the relationship between individual inequality and the extent of fiscal decentralization, comparable data on Gini coefficients (based on income after taxes and transfers) are required by country across time.[15] These data are available for the 13 countries used in the growth equations, and include from one to seven observations for each country (see Table 10) for a total of 56 observations. Unlike the growth rate and regional inequality measures used above, household income-based Gini coefficients are not available for every year for each country. The temporal discontinuity in these data means that it is not possible to analyze the dynamics of individual inequality adjustment.

The average household Gini coefficients for each country are reported in Table 10 (along with the averages, across the same observations, of the centralization and expenditure measures). The country with the greatest income inequality between households is the United States, while Sweden has the least inequality.

In order to gain an initial indication of whether there is any relationship between individual inequality and the fiscal centralization measures, the average Gini coefficients for the 13 countries given in Table 10 are plotted against the averages of each of the three centralization measures. The plot between the household Gini and the average measure of revenue centralization given in Figure 7 does not indicate any type of discernable systematic relationship. Similarly, in

[15] As noted in the Appendix, these data are taken from the Luxembourg Income Study database. Very similar results are obtained if, as has been widely done in other studies of inequality, the "acceptable" Gini coefficient observations in the Deininger and Squire (1996) database are used (although this data is not based on disposable income). For a discussion of the comparability of inequality measures see Atkinson and Brandolini (2001).

Figures 8 and 9, there does not appear to be any relationship between the expenditure centralization measures and the household Gini. The absence of a relationship is confirmed in the regression of the log of the average Gini coefficients on the average data for the revenue centralization measure and the two expenditure centralization ratios (reported in Table 11). As in the cases of per capita growth and regional inequality, the estimated coefficients are all statistically insignificant and the proportion of the variation in the average Gini explained by the average centralization measures is extremely small.

To more fully investigate the impact of fiscal decentralization on individual inequality, the individual Gini observations are pooled into one sample and regressed on the annual values of the fiscal centralization measures rather than their averages. Furthermore, in order to determine whether other determinants of inequality have an important impact on the relationship between inequality and the fiscal centralization measures, the estimating equation is estimated while including the same control variables that were used to explain regional inequality. All the estimates were undertaken using ordinary least squares as a Hausman test for endogeneity did not indicate that any of the current period control variables were endogenous.

The estimated coefficients for six different specifications of the household inequality equation are provided in Table 12. The two specifications that include INFLATION, the only additional control variable that is statistically significant, are not rejected by the RESET test. The estimated coefficient associated with the INFLATION variable indicates that higher inflation is associated with lower inequality.

The estimated coefficients associated with the revenue centralization variable in Table 12 are all positive (and significant when the INFLATION variable is included). This implies a positive relationship between more centralized revenue collection and individual inequality. This evidence contradicts the usual theoretical argument that it is regional tax competition that keeps taxes low and redistributive programs less generous. On the other hand, none of the coefficients associated with the two expenditure centralization measures are significant. In other words, the degree of fiscal centralization on the expenditure side is not systematically associated with greater or less individual inequality.

The results presented in Table 13 provide an indication of the magnitude of the effects represented by the estimated parameters given in Table 12. Only the centralized revenue measure (CREV) has a large effect on inequality. A 10 percent increase in the revenue centralization ratio increases inequality by almost 6 percent.

IV. SUMMARY AND CONCLUSIONS

This paper has focused on determining the effect of the centralization/decentralization of government activity on economic growth, regional inequality and household inequality for a sample of 13 OECD countries. While there is a small empirical literature that examines the relationship between decentralization and growth, we are not aware of any empirical studies that explicitly examine the impact of different degrees of fiscal decentralization on regional or household inequality.

With respect to economic growth, the empirical analysis generated no pervasive evidence that revenue centralization affects growth, although there is some evidence that the centralization of expenditures is associated with faster growth. This result is broadly consistent with the results obtained by other researchers, such as Davoodi and Zou (1998) and Xie, Zou and Davoodi (1999), who could not find evidence that government organization affects economic growth in developed economies.

More definitive empirical results were obtained in the examination of inequality. The analysis found that lower regional inequality is associated with greater revenue centralization combined with greater expenditure decentralization. This result is consistent with the view that revenue decentralization exacerbates regional disparities when fiscal capacity is unevenly distributed across regions. A somewhat surprising result was obtained for the case of household equality where it was found that

increased revenue centralization is associated with more household inequality.

It is important to recognize that the empirical results reported in this paper should be interpreted with some caution. Due to data limitations, the analysis has not been able to address the important issues associated with the composition of government spending (consumption versus investment) and the composition of intergovernmental transfers (conditional versus unconditional and automatic versus discretionary). It may be the case that how a country decentralizes, in particular the manner in which program spending responsibilities are distributed across jurisdictions and the role and type of intergovernmental grants, may be more important for economic growth and inequality than the level of an aggregate decentralization measure.

Appendix: Data Sources and Details

Note: All data are annual.

Fiscal Centralization Measures:

Expenditure Centralization (CEXP): Central government current expenditures less transfers to other government subsectors divided by central government current expenditures less transfers to other government subsectors plus state-level current expenditures minus state transfers to other government subsectors plus local government current expenditures. (Note that state (or provincial) data are only distinguished from local-government data for three countries - Austria, Canada and West Germany.) Calculated from the data in Tables 6.1, 6.2 and 6.3, OECD, *National Accounts*, Volume II, CD-ROM.

Net Expenditure Centralization (NETCEXP): Calculated the same as CEXP except expenditures at all levels of government exclude interest payments. These are given by "Property Income Paid" (generally all or almost all made up of interest payments) in Tables 6.1, 6.2 and 6.3, OECD, *National Accounts*, Volume II, CD-ROM.

Revenue Centralization (CREV): Central government revenue divided by central government revenue plus state government revenue minus transfers from other government subsectors plus local government revenue minus transfers from other government subsectors. Calculated from data in Tables 6.1, 6.2 and 6.3, OECD, *National Accounts*, Volume II, CD-ROM.

Growth, Regional Inequality and Inequality Measures:

Gini: Gini coefficients associated with the distribution of household incomes in a country. This is a measure of income inequality. It is bounded by zero and one, with a value closer to one indicating greater inequality. The gini coefficients used are the cross-country "comparable" Gini coefficients provided by the Luxembourg Income Study (LIS). These Gini coefficients are all based on disposable income (after taxes and transfers) and were downloaded on 7 November 2001 from the LIS website: http://lisweb.ceps.lu/keyfigures.htm (where a detailed description of this data can be found).

Real Per Capita GDP Growth Rate (RPCGDPG): Real GDP growth rate minus the population growth rate. The real GDP growth rate is calculated using the data on Real GDP, OECD, *National Accounts*, Volume II, CD-ROM, Table 1 for each country. Data on population are from the International Monetary Fund, *International Financial Statistics*, CD-ROM, except for some data for the former West Germany. For the years 1983-1990, these are from OECD, *Labour Force Statistics*, 1979-99; while for 1991-1992, they are from OECD, *Labour Force Statistics*, 1972-92.

$RPCGDPG_{-1}$: Real per capita GDP growth rate lagged one period.

RegGini: The Gini coefficient for regional per capita income. This is a measure of income inequality across regions. The regional gini for a particular country in a given year is calculated by letting the per capita income of each region in a country take the role of an observation on an individual in the standard gini coefficient calculation. The exact method used to calculate the gini is given in equation 3.7b of Deaton (1997, 139).

Data for European countries is obtained from the Eurostat NUTSII database and was downloaded from the website of Michele Boldrin (http://www.econ.umn.edu/~mboldrin/Research/Current_Research/ec_growth.html) on 8 July 2001. Except for the United Kingdom, the gini for the

European countries was calculated using regional GDP per capita in ecus. The UK calculation uses regional GDP per capita using PPP exchange rates since only this data set included data on London. The German gini is for Western Germany only and does not include data for Berlin (since distinct data on West Berlin is not available). The calculations for both Spain and France did not include several small overseas regions.

The regional gini for Canada was calculated using real provincial GDP and population data from Statistics Canada's CANSIM database to calculate real GDP per capita for each province. The real GDP Cansim identifiers for each of the ten provinces are (by province from east to west): D24691, D24725, D24759, D24793, D24827, D24861, D24895, D24929, D24963, D24997. Similarly, for the population data they are: C241869, C242649, C243429, C244209, C244989, C245769, C246549, C247329, C248109, C248889.

The regional gini for the US was calculated using real Gross State Product and state population to calculate real per capita Gross State Product for each state. This per capita Gross State Product data was then used to create the regional gini. Data on Real Gross State Product were downloaded from the Bureau of Economic Analysis web site (http://www.bea.doc.gov/bea/regional/gsp/) on 3 August 2001. Population data for 1990 to 1997 are from the *Statistical Abstract of the United States 2000*, Table 20, page 23. Population data for 1986 to 1989 are from the *Statistical Abstract of the United States 1995*, Table 27, page 28 (where the 1986 population is calculated as the mean of the 1985 and 1987 values).

RegGini$_{-1}$: **RegGini** lagged one year.

Control Variables:

DTOT: Percent change in the terms of trade. Calculated as the change in the ratio of the indices for the unit value of exports and the unit value of imports. Source is the IMF IFS 2000 CD-ROM except for the following observations: Austria, 1969-97, IMF IFS Yearbook, 1999; Belgium, 1969-97, IMF IFS Yearbook, 1999; Belgium, 1960-68, IMF IFS Yearbook, 1990; United Kingdom, 1960-62, IMF IFS Yearbook, 1990.

GOVREV/GDP: General (consolidated) government total revenue as a proportion of GDP. Revenue is Total Current Receipts of General Government from Table 6 for each country, OECD, *National Accounts*, Volume II, CD-ROM, while GDP is from Table 1 for each country, OECD, *National Accounts*, Volume II, CD-ROM.

GOVC/GDP: Government final consumption expenditure as a proportion of GDP. Both variables are from Table 1 for each country, OECD, *National Accounts*, Volume II, CD-ROM.

INFLATION: The annual inflation rate. This is calculated from the price index that results from taking the ratio of nominal to constant dollar GDP. Both nominal and constant dollar GDP for each country are taken from Table 1 for each country, OECD, *National Accounts*, Volume II, CD-ROM.

INV/GDP: The investment to GDP ratio. Investment (Gross Fixed Capital Formation) and GDP are taken from Table 1 for each country, OECD, *National Accounts*, Volume II, CD-ROM.

OPEN: A measure of an economy's openness to trade. This is given by the ratio of exports plus imports to GDP. Exports, Imports and GDP are taken from Table 1 for each country, OECD, *National Accounts*, Volume II, CD-ROM.

RPCGDP$_{-1}$: Lagged real per capita GDP. So that the cross-country data are in the same units, this is measured in real US dollars. This variable is calculated using current GDP (from Table 1, OECD, *National Accounts*, Volume II, CD-ROM) divided by population (see the source in **RPCGDPG**), converted to US dollars using the average annual exchange rate (from the International Monetary Fund, *International Financial Statistics*, CD-ROM), deflated by the US GDP price index (calculated from the current and constant dollar GDP data in Table 1, OECD, *National Accounts*, Volume II, CD-ROM).

SYRF, SYRM: Average years of secondary schooling of females and males, respectively, who are 25 years old or older. This is part of the Barro-Lee data set and was downloaded on 13 August 2001 from http://www.cid.harvard.edu/ciddata/ciddata.html. This data is described in Barro and Lee (1996). Note that this data is available only at 5-year intervals and, thus, all the observations for 5 years have the same observation. For example, the value for 1960 is used as the data point for 1960 through 1964.

TRANSFER: Central government transfers to other levels of government as a proportion of GDP. Transfers are "Transfers to Other Government Subsectors", OECD, *National Accounts*, Volume II, CD-ROM, Table 6.1 for each country while GDP is from Table 1 for each country, OECD, *National Accounts*, Volume II, CD-ROM.

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Table 1: Data for the Real Per Capita GDP Growth Rate Sample

Part A: Averages of Country Data

Country	Sample Period	Number of Obser-vations	Real Per Capita GDP Growth Rate	Revenue Centralization Ratio (*Rank*)	Expenditure Centralization Gross (*Rank*)	Ratio Net(*Rank*)
Australia	1969-96	28	.018117	.763105 (*7*)	.536647 (*8*)	.545338 (*7*)
Austria	1976-96	21	.021417	.674394 (*9*)	.613283 (*6*)	.587047 (*4*)
Belgium	1961-97	37	.027532	.910472 (*1*)	.805334 (*1*)	.786908 (*1*)
Canada	1961-97	37	.022257	.499905 (*13*)	.425142 (*12*)	.392023 (*12*)
Denmark	1976-95	20	.020873	.707200 (*8*)	.406965 (*13*)	.335140 (*13*)
France	1970-97	28	.020214	.840713 (*5*)	.764662 (*2*)	.771684 (*2*)
Germany (West)	1961-92	32	.026749	.520925 (*12*)	.432626 (*11*)	.426869 (*11*)
Italy	1980-95	16	.018609	.908978 (*2*)	.658075 (*4*)	.561407 (*6*)
Netherlands	1977-96	20	.015840	.887169 (*3*)	.536452 (*9*)	.515282 (*8*)
Spain	1985-95	11	.026059	.819563 (*6*)	.630237 (*5*)	.581479 (*5*)
Sweden	1980-96	17	.011272	.622918 (*10*)	.529631 (*10*)	.480050 (*10*)
United Kingdom	1961-96	36	.020074	.863748 (*4*)	.682341 (*3*)	.680513 (*3*)
United States	1961-97	37	.019965	.594428 (*11*)	.543661 (*7*)	.507912 (*9*)
Average*			.020691	.739501	.581927	.551666

* This is the average of the average values for the 13 countries listed.

Part B: Correlations of Country Average Data

(i) Simple Correlations:

	Expenditure Centralization	Net Expenditure Centralization	Revenue Centralization
Expenditure Centralization	1.0000		
Net Expenditure Centralization	0.9747	1.0000	
Revenue Centralization	0.7430	0.6820	1.0000

(ii) Rank Correlations:

	Expenditure Centralization	Net Expenditure Centralization	Revenue Centralization
Expenditure Centralization	1.0000		
Net Expenditure Centralization	0.9615	1.0000	
Revenue Centralization	0.7143	0.7033	1.0000

Table 2: Regressions of the Average of the Real Per Capita Growth Rate on the Average of Each Centralization Measure

RPCGDPG =	.0213 - .0008 CREV (3.07) (.09)	R^2 = .0007
RPCGDPG =	.0170 + .0063 CEXP (2.71) (.59)	R^2 = .0308
RPCGDPG =	.0171 + .0066 NETCEXP (3.08) (.67)	R^2 = .0397

Number of Observations = 13

t-statistics are in brackets

Each observation is the average across time for an individual country. The averages for each country are taken over the sample periods given in Table 1.

Table 3: Per Capita Growth Regression - All Observations

Dependent Variable: Real Per Capita GDP Growth Rate (RPCGDPG)

Estimation Technique: Two-Stage Least Squares

Number of Observations: 324

Explanatory Variables	**I**	**II**	**III**	**IV**	**V**	**VI**
CREV	-.0818 (1.50)	-.0199 (.42)	-.1337** (2.46)	-.0625 (1.32)	-.0223 (.56)	-.0097 (.25)
CEXP	.1540** (3.07)		.2063** (4.13)		.1041** (2.72)	
NETCEXP		.0782* (1.82)		.1342** (3.01)		.0960** (2.42)
$RPCGDPG_{-1}$	.1572** (2.78)	.1516** (2.71)	.1752** (2.97)	.1701** (2.91)	.1600** (2.75)	.1598** (2.75)
TRANSFER	.0911* (1.91)	.0290 (.70)	.1616** (3.37)	.0966** (2.29)		
GOVREV/GDP	-.2046** (4.05)	-.2271** (4.59)				
INFLATION	-.2595** (4.64)	-.2626** (4.77)				
OPEN	.0273 (1.47)	.0368** (2.01)				
R^2	.551	.557	.518	.521	.520	.521
RESET Test (t-statistic)	.30	.92	1.75	.46	.74	.72
AR1 Test (t-statistic)	.90	1.11	.37	.25	.14	.10

Notes to Table 3:

1. All standard errors are corrected for heteroscedasticity of unknown form using the White (1980) correction.
2. The number in brackets beneath each estimated coefficient is the absolute value of the t-statistic.
3. Each equation also included year dummy variables, country dummy variables and a constant.

4. ** Coefficient is significant using a 95 percent confidence level.
   * Coefficient is significant using a 90 percent confidence level.
5. Note that R^2 does not have the usual properties when estimation is undertaken using two-stage least squares.
6. The RESET test is a t-test of whether the square of the predicted value of the dependent variable is significant when added to the regression equation.
7. The AR1 Test is a test for first-order serial correlation. This is a t-test of the significance of the lagged residual in a regression of the residuals on the lagged residuals and the explanatory variables.
8. Sample for each country: Austria, 1977-1993; Australia, 1970-1996; Belgium, 1962-1997; Canada, 1962- 1997; Denmark, 1977-1995; France, 1971-1997; Germany (West), 1962-1992; Italy, 1981-1995; Netherlands, 1978-1996; Spain, 1986-1995; Sweden, 1981-1996; United Kingdom, 1962-1996; United States, 1962-1997.
9. Instruments used in the first-stage of the two-stage least squares regression: constant, country dummy variables, year dummy variables, lagged revenue centralization (**CREV**), lagged expenditure centralization (**CEXP**), lagged net expenditure centralization (**NETCEXP**), lagged real per capita growth rate (**RPCGDPG**), **SYRF**, **SYRM**, lagged inflation rate (**INFLATION**), lagged change in the terms of trade (**DTOT**), lagged government consumption-to-GDP ratio (**GOVC/GDP**), lagged investment-to-GDP ratio (**INV/GDP**), lagged total government revenue-to-GDP ratio (**GOVREV/GDP**), lagged transfers from the central to other levels of government (**TRANSFER**), lagged measure of openness (**OPEN**).
10. Additional explanatory variables that were insignificant when added to the models of the first two columns: the government consumption-to-GDP ratio (**GOVC/GDP**), change in the terms of trade (**DTOT**), **SYRF** and **SYRM**.

Table 4: Per Capita Growth Regression - All Observations

Dependent Variable: Real Per Capita GDP Growth Rate (RPCGDPG)

Estimation Technique: Ordinary Least Squares

Number of Observations: 324

Explanatory Variables	**I**	**II**	**III**	**IV**	**V**	**VI**
CREV	.0251 (.57)	.0402 (.98)	-.0252 (.57)	.0020 (.05)	.0205 (.57)	.0278 (.78)
CEXP	.0684* (1.67)		.1284** (3.13)		.0849** (2.42)	
NETCEXP		.0523 (1.38)		.1025** (2.58)		.0828** (2.26)
$RPCGDPG_{-1}$	.1254** (2.30)	.1237** (2.27)	.1606** (2.77)	.1590** (2.75)	.1540** (2.66)	.1537** (2.66)
TRANSFER	-.0037 (.09)	-.0195 (.51)	.0796* (1.90)	.0540 (1.38)		
GOVREV/GDP	-.2266** (5.15)	-.2319** (5.38)				
INFLATION	-.1557** (2.96)	-.1546** (2.95)				
OPEN	.0258 (1.63)	.0279* (1.80)				
R^2	.575	.574	.528	.526	.523	.523
RESET Test (t-statistic)	1.48	1.44	.02	.12	.66	.54
AR1 Test (t-statistic)	.88	.94	.19	.11	.07	.03

Notes to Table 4:

1. All standard errors are corrected for heteroscedasticity of unknown form using the White (1980) correction.

2. The number in brackets beneath each estimated coefficient is the absolute value of the t-statistic.

3. Each equation also included year dummy variables, country dummy variables and a constant.

4. ** Coefficient is significant using a 95 percent confidence level.
   * Coefficient is significant using a 90 percent confidence level.

5. The RESET test is a t-test of whether the square of the predicted value of the dependent variable is significant when added to the regression equation.

6. The AR1 Test is a test for first-order serial correlation. This is a t-test of the significance of the lagged residual in a regression of the residuals on the lagged residuals and the explanatory variables. See Davidson and Mackinnon (1993, p.358).

7. Sample for each country: Austria, 1977-1993; Australia, 1970-1996; Belgium, 1962-1997; Canada, 1962- 1997; Denmark, 1977-1995; France, 1971-1997; Germany (West), 1962-1992; Italy, 1981-1995; Netherlands, 1978-1996; Spain, 1986-1995; Sweden, 1981-1996; United Kingdom, 1962-1996; United States, 1962-1997.

Table 5: The Magnitude of the Impact of Changes in the Explanatory Variables on Growth

Mean Real Per Capita Growth Rate = .0208

	Change in the Real Per Capita Growth Rate due to a 10 Percent Increase in Each Explanatory Variable			
Explanatory	Short Run		Long Run	
Variables	Change	Percent Change	Change	Percent Change
CREV	-.0092†	-44.3†	-.0109†	-52.4†
CEXP	.0090	43.1	.0107	51.2
NETCEXP	.0044	20.9	.0052	24.9
TRANSFER	.0015	7.1	.0018	8.5
GOVREV/GDP	-.0085	-40.9	-.0101	-48.4
INFLATION	-.0014	-6.9	-.0017	-8.0
OPEN	.0015†	7.4†	.0018†	8.5†

Notes: These changes are calculated using the coefficient estimates of Column I in Table 3 except for those associated with NETCEXP which use the estimated coefficient from Column II of Table 3.

Long run estimates take into account the dynamic effect through the lagged dependent variable.

The percent change is calculated at the mean.

† - These calculations should be treated with caution as they are based on estimated coefficients that are statistically insignificant using a 90 percent confidence interval.

Table 6: Data Averages for the Regional Gini Sample

Country	Sample Period	Number of Obser-vations	Regional Gini[1]	Revenue Centralization Ratio	Expenditure Centralization Ratio (Net)
Australia	none				
Austria	1988-96	9	.14612 (9)	.69373	.61710(.57567)
Belgium	1980-96	17	.13636 (11)	.90821	.81562(.77977)
Canada [2]	1981-97	17	.11861 (10)	.47284	.41263(.36324)
Denmark	none				
France[3]	1982-96	15	.07732 (22)	.81687	.74882(.75213)
Germany[4] (West)	1980-94	15	.10661 (30)	.51337	.42925(.41414)
Italy	1980-95	16	.14223 (20)	.90898	.65808(.56141)
Netherlands	1987-96	10	.08735 (12)	.88704	.57114(.53657)
Spain[5]	1985-95	11	.11666 (16)	.81956	.63024(.58148)
Sweden	1985-96	12	.05837 (6)	.62418	.53207(.48061)
United Kingdom	1994-96	3	.10735 (37)	.93045	.70672(.68750)
United States[6]	1986-97	12	.10594 (50)	.56492	.51425(.45691)
Average		11	.10936	.74001	.60326(.56267)

[1] The number in brackets following the gini value is the number of regions used to calculate the gini.
[2] Excludes the Yukon and Northwest Territories.
[3] Excludes overseas territories.
[4] Excludes Berlin.
[5] Excludes Ceuta, Melilla, and the Canary Islands.
[6] Excludes the District of Columbia and all territories.

Table 7: Regressions of the Average of the Regional Gini Coefficient on the Average of Each Centralization Measure

Log(RegGini) =	-2.427 + .2446 CREV (6.03) (.46)	R^2 = .023
Log(RegGini) =	-2.463 + .3611 CEXP (5.59) (.50)	R^2 = .027
Log(RegGini) =	-2.349 + .1832 NETCEXP (5.93) (.27)	R^2 = .008

Number of Observations = 11

t-statistics are in brackets

Each observation is the average across time for an individual country. The averages for each country are taken over the sample periods given in Table 6.

Table 8: Regional Gini Coefficient Regressions

Dependent Variable: Log of the Regional Gini Coefficient (RegGini)

Estimation Technique: Ordinary Least Squares

Number of Observations: 121

Explanatory Variables	**I**	**II**	**III**	**IV**	**V**	**VI**
CREV	-.8759** (3.91)	-.7884** (3.48)	-.5931** (2.31)	-.5255** (2.07)	-.5929** (2.35)	-5352** (2.14)
CEXP	.7267** (2.56)		.5976** (2.49)		.6966** (2.91)	
NETCEXP		.6253** (2.63)		.6368** (2.76)		.6867** (3.06)
$RegGini_{-1}$	.3411** (4.01)	.3502** (4.08)	.4617** (4.91)	.4636** (4.86)	.4616** (4.90)	.4696** (4.88)
TRANSFER	-.1160 (.61)	-.2284 (1.34)	.0014 (.01)	-.1043 (.63)		
$RPCGDP_{-1}$	.0000102** (3.86)	.0000103** (3.89)				
INFLATION	.6939** (2.82)	.6423** (2.67)				
OPEN	.2595** (2.40)	.2522** (2.34)				
GOVC/GDP	1.206** (2.56)	1.149** (2.46)				
R^2	.987	.987	.984	.984	.984	.984
RESET Test (t-statistic)	.66	.21	1.20	1.55	1.17	1.63
AR1 Test (t-statistic)	.88	.68	1.70*	1.56	1.70*	1.67*
Hausman Test (F-statistic, degrees of free-dom in brackets)	1.09 (6,80)	1.24 (6,80)	1.12 (3,87)	.17 (3,87)	1.61 (2,89)	.20 (2,89)

Notes to Table 8:

1. All regressions also included a constant, country dummy variables, and year dummy variables.

2. All standard errors are corrected for heteroscedasticity of unknown form using the White (1980) correction.

3. The number in brackets beneath each estimated coefficient is the absolute value of the t-statistic.

4. ** Coefficient or test statistic is significant using a 95 percent confidence level.
   * Coefficient or test statistic is significant using a 90 percent confidence level.

5. The RESET test is a t-test of whether the square of the predicted value of the dependent variable is significant when added to the regression equation.

6. The AR1 Test is a test for first-order serial correlation. This is a t-test of the significance of the lagged residual in a regression of the residuals on the lagged residuals and the explanatory variables. See Davidson and Mackinnon (1993, p.358).

7. A Hausman test was used to test all the current period explanatory variables jointly for endogeneity. The F-statistic reported is for this test. This test did not indicate any of the explanatory variables were endogenous. The instruments used in the Hausman test included a constant, the year dummy variables, the country dummy variables, **SYRM**, **SYRF**, and lagged values of **CREV**, **CEXP**, **NETCEXP**, **TRANSFER**, **INFLATION**, **DTOT**, **GOVC/GDP**, **GOVREV/GDP**, **OPEN**, **INV/GDP**, and **RPCGDP**.

8. Sample for each country: Austria 1989-1993; Belgium, 1981-1996; Canada, 1982- 1997; France, 1983-1996; Germany (West), 1981-1992; Italy, 1981-1995; Netherlands, 1988-1996; Spain, 1986-1995; Sweden, 1986-1996; United Kingdom, 1995-1996; United States, 1987-1997.

9. Variables that were added to the estimating equation, but which were individually and jointly insignificant, were **SYRM**, **SYRF**, **DTOT** and **GOVREV/GDP**. These were all tested for endogeneity as well and none were found to be endogenous.

Table 9: The Magnitude of the Impact of Changes in the Explanatory Variables on Regional Inequality

Mean Regional Gini Coefficient = .1096

	Change in the Regional Gini Coefficient due to a 10 Percent Increase in Each Explanatory Variable			
Explanatory	Short Run		Long Run	
Variables	Change	Percent Change	Change	Percent Change
CREV	-.0065	-6.0	-.0097	-8.9
CEXP	.0047	4.3	.0072	6.6
NETCEXP	.0037	3.2	.0058	5.3
TRANSFER	-.0002†	-.2†	-.0003†	-.3†
$RPCGDP_{-1}$	.0020	1.9	.0031	2.8
INFLATION	.0003	.3	.0005	.4
OPEN	.0018	1.6	.0027	2.5
GOVC/GDP	.0024	2.2	.0037	3.4

Notes: These changes are calculated using the coefficient estimates of Column I in Table 8 except for those associated with NETCEXP which use the estimated coefficient from Column II of Table 8.

Long run estimates take into account the dynamic effect through the lagged dependent variable.

The percent change is calculated at the mean.

† - These calculations should be treated with caution as they are based on an estimated coefficient that is statistically insignificant.

Table 10: Data Averages for the Gini Coefficients Sample

Country	Sample Period	Number of Obser-vations	Gini	Revenue Centralization Ratio	Expenditure Centralization Ratio (Net)
Australia	1981, 85, 89, 94	4	.29700	.75119	.53145(.53823)
Austria	1987, 95	2	.25200	.68379	.61935(.58184)
Belgium	1985, 88, 92, 97	4	.23450	.90390	.81958(.77901)
Canada	1971, 75, 81, 87, 91, 94, 97	7	.28986	.48986	.40793(.36822)
Denmark	1987, 92, 95	3	.25100	.70475	.42727(.34381)
France	1979, 81, 84, 89, 94	5	.29020	.83318	.75697(.76413)
Germany (West)	1973, 78, 81, 83, 84, 89, 94	7	.25657	.51435	.42351(.41172)
Italy	1986, 91, 95	3	.31233	.89913	.66926(.56017)
Netherlands	1983, 87, 91, 94	4	.25875	.88665	.55061(.52207)
Spain	1990	1	.30300	.81041	.61218(.56221)
Sweden	1981, 87, 92, 95	4	.21625	.60826	.53224(.48649)
United Kingdom	1969, 74, 79, 86, 91, 95	6	.29800	.87766	.67838(.67695)
United States	1974, 79, 86, 91, 94, 97	6	.33617	.58658	.50871(.46049)
Average		13	.27659	.73459	.57980(.54272)

Table 11: Regressions of the Average of the Gini Coefficient on the Average of Each Centralization Measure

Log(Gini) =	-1.349 + .0768 CREV (7.06) (.30)	R^2 = .0081
Log(Gini) =	-1.296 + .0064 CEXP (7.35) (.02)	R^2 = .00004
Log(Gini) =	-1.297 + .0077 NETCEXP (8.30) (.03)	R^2 = .00007

Number of Observations = 13

t-statistics are in brackets

Each observation is the average across time for an individual country. The averages for each country are taken over the sample periods given in Table 10.

Table 12: Gini Coefficient Regressions

Dependent Variable: Log of the Gini Coefficient (Gini)

Estimation Technique: Ordinary Least Squares

Number of Observations: 54

Explanatory Variables	**I**	**II**	**III**	**IV**	**V**	**VI**
CREV	.7969**	.8407**	.5493	.5499	.5281	.4915
	(3.50)	(3.67)	(1.50)	(1.60)	(1.47)	(1.41)
CEXP	.3093		.2385		.2602	
	(.88)		(.47)		(.62)	
NETCEXP		.2487		-.5104		-.4909
		(.89)		(1.50)		(1.49)
TRANSFER	.0681	-.0466	-.1377	-.3817		
	(.08)	(.06)	(.13)	(.43)		
INFLATION	-1.096**	-1.147**				
	(6.83)	(6.60)				
R^2	.881	.881	.823	.826	.822	.826
RESET Test (t-statistic)	1.12	1.00	1.27	1.63	1.39	2.24**
Hausman Test (F-statistic, degrees of freedom in brackets)	.64 (4,34)	.41 (4,34)	.47 (3,36)	.59 (3,36)	.03 (2,38)	.11 (2,38)

Notes to Table 12:

1. All regressions also include a constant and country dummy variables, but not year dummy variables due to the small number of observations.

2. All standard errors are corrected for heteroscedasticity of unknown form using the White (1980) correction.

3. The number in brackets beneath each estimated coefficient is the absolute value of the t-statistic.

4. ** Coefficient is significant using a 95 percent confidence level.
   * Coefficient is significant using a 90 percent confidence level.

5. The RESET test is a t-test of whether the square of the predicted value of the dependent variable is significant when added to the regression equation.

6. A Hausman test was used to test all the current period explanatory variables for endogeneity, both individually and jointly. The F-statistic reported is for the joint test. This test did not indicate any of the explanatory variables were endogenous either individually or jointly. The instruments used in the Hausman test included a constant, the country dummy variables, **SYRM**, **SYRF**, and lagged values of **CREV**, **CEXP**, **NETCEXP**, **TRANSFER**, **INFLATION**, **GOVC/GDP**, **GOVREV/GDP**, **OPEN**, **INV/GDP**, and **RPCGDP**.

8. The sample is the same as that given in Table 10 except the one observation for Spain has been dropped, as with country dummy variables its inclusion would make no difference to the parameter estimates. In addition, the 1994 observation for Germany could not be used as data on some of the other explanatory variables did not exist for this year.

9. Variables that were added to the estimating equation, but which were individually and jointly insignificant, were **SYRM**, **SYRF**, **GOVREV/GDP**, **OPEN**, **GOVC/GDP** and $\mathbf{RPCGDP}_{-1}$.

Table 13: The Magnitude of the Impact of Changes in the Explanatory Variables on Inequality

Mean Gini Coefficient = .27852

Explanatory Variables	Change in the Gini Coefficient due to a 10 Percent Increase in Each Explanatory Variable: Change	Percent Change
CREV	.0160	5.8
CEXP	.0049†	1.7†
NETCEXP	.0037†	1.3†
TRANSFER	.0001†	.5†
INFLATION	-.0014	-.5

Note: These changes are calculated using the coefficient estimates of Column I in Table 12 except for those associated with NETCEXP which use the estimated coefficient from Column II of Table 12.

† - These calculations should be treated with caution as they are based on estimated coefficients that are statistically insignificant.