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Regional Redistribution: Applying Data from Household Income Data

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I. Introduction

This paper evaluates the use of microeconomic data, namely household income surveys from the Luxembourg Income Study (LIS), for researching interregional redistribution. Patterns of regional growth and regional redistribution are the focus of a growing body of literature. Most of these studies use macroeconomic indicators like real GDP to estimate per capita income. LIS survey data offers researchers the opportunity to construct estimates of regional income distribution and interregional redistribution based on household income information for over 25 countries.

The goal of this paper is to present a preliminary analysis of interregional inequality and redistribution in four federal states – the United States of America, Canada, Germany and Australia, using LIS data. Firstly, it estimates interregional inequality based on household income before and after redistribution. Secondly, it evaluates two methods of measuring interregional redistribution. In the first method, interregional redistribution is defined as the percentage reduction in interregional inequality from before taxes and transfers to after and calculated by comparing the "between-group" Theil Index before and after redistribution. In the second method, a simple regression model is used to estimate the effect of pre-redistribution mean income in a region on its post-redistribution mean income after controlling for population.

The format of the paper is follows. Section II offers a brief overview of the literature, focusing on the key theoretical arguments that have framed the study of interregional redistribution. Section III provides a description of the LIS household income data and a discussion of research methodology.

The empirical results from the data analysis are presented in Section IV. Finally, Section V sums up the main findings of this paper and explores ways to expand this research in the future.

II. Literature Review

Theoretical discussion about interregional redistribution begin with the debate over spatial convergence. The neoclassical growth model predicts that spatial inequality diminishes over time due to decreasing returns to capital and factor mobility (Sala-i Martin, 1996). Those challenging this thesis point to the logic of "race to the bottom" and "backwash effects" (Myrdal, 1957). Empirical research has shown that even when convergence occurs in the long run, it may be preceded by divergence in the short run (Williamson, 1965). Recent works on economic geography and interregional economics, which emphasize agglomeration growth and returns to spatial concentration, have attempted to explain spatial unevenness in the modern economy (Fujita, Krugman and Venables, 1999). The natural question that arises in the face of spatial inequality, especially when it is contained within the borders of a country, is about the appropriate role of government. Specifically, should fiscal systems undertake interregional redistribution over and above the interpersonal redistribution that is common to most welfare states?

The case for regional redistribution has two components: one economic and one political. The economic argument for interregional transfers is partially derived from the notion that the net fiscal benefit from public goods and services should be the same across jurisdictions, regardless of their relative endowment. This logic, which emerges from the fiscal federalism literature, is most often applied to intergovernmental relations in federal systems (Oates, 1999). The equalization system in Canada wherein the federal government transfers a share of its revenue to poorer provinces, is premised on the belief that the provinces should be able to provide comparable public services (Boadway and Hayashi, 2002). Similarly, the German federal system tries to achieve horizontal fiscal balance through an interregional redistribution scheme and asymmetric federal grants.

A related economic argument in favor of regional redistribution emphasizes risk-sharing between regional jurisdictions.This view holds that regions within a union or federal system have limited ability to deal with asymmetric and transitory economic shocks since they lack control over monetary policy. Interregional transfers, which serve as a fiscal mechanism to address such

shocks, perform an "efficiency-enhancing role" by allowing regions to collectively share the costs of macroeconomic risks (Persson and Tabellini, 1996; von Hagen, 1992).

The political rationale for regional redistributions in federal systems is based on the presumption that regional disparities give rise to political instability. Bolton and Roland (1997) predict that where conflicts over redistributions are high and the benefits of unification are low, secession is the equilibrium outcome for both rich and poor regions. Shah and Shankar (2001) point out the tension between the need for regional balance in federal systems, and the relative inability of federal governments to ensure it. This is because central governments in federal systems are less able to achieve interregional redistribution due to the division of power. While unitary states enjoy greater freedom in their choice of redistributive policies, a different political dynamic arises when they attempt to decentralize authority to subnational units. Regions that are poor are less likely to accept decentralization if they fear losing out on revenues, and the central government may be forced into instituting greater interregional redistribution.

To sum up, both economic and political considerations necessitate interregional redistribution in federal and decentralized states. The exact mechanisms employed to achieve this end varies across countries, ranging from explicit revenue-sharing and equalization grants to conditional grants, matching formulas and emergency funds. This complicates the measurement of redistribution, especially if the goal is to make cross-national comparisons. Another complication arises from the choice of economic indicators. Most studies on regional convergence rely on macroeconomic data like real GDP to study spatial patterns and to estimate per capita regional income. Shah and Shankar (2001) base their calculations of interregional inequality on per capita GRDP (gross regional domestic product), and von Hagen (1992) develops measures of regional insurance and permanent redistribution based on real GSP (gross state product). In contrast, Boadway and Hayashi (2002) base their analysis of redistribution through equalization on provincial tax collection.

An alternative and relatively underutilized way of measuring income inequality between subnational units is to use household income data from household surveys. While some studies have used census data to construct regional aggregates, this avenue of research has remained relatively unexplored due to the unavailability of household income data that is comparable across countries (Mahler, 2002; Sala-i Martin and Sachs, 1991). The Lux-

embourg Income Study has developed a comprehensive set of cross-national survey data on household income that makes such research possible. As was mentioned earlier, this paper uses LIS data to develop estimates of interregional income inequality and redistribution in the United States, Australia, Canada and Germany.

III. The Luxembourg Income Study: Data and Methodology

The LIS data is a compilation of national household income surveys from member countries. The datasets are organized chronologically into waves, and the data for individual countries has been manipulated or "lissified" to allow for cross-national comparisons. The four countries included in this study are all federal systems with territorial subunits that are politically well-defined. The subnational unit of analysis corresponds to states in the United States and Australia, *länder* in Germany, and provinces in Canada. Since the early surveys did not include information on the geographical location of household, the corresponding data was omitted from this study. Table 1 summarizes the datasets used in this paper to study trends in regional income inequality and redistribution since the mid-1980s. The cross-country analysis presented in subsequent sections focuses on income data from 1994, the most recent year for which data from all four countries is available.

The LIS Income Variables

The main LIS income variables used for measuring regional per capita income before and after redistribution are household market income and household disposable income respectively. Household market income (MI) includes income from labor (wages, salary and income from self-employment), income from property, occupational pension, and other cash income (regular private transfers, alimony and child support and other miscellaneous sources of regular cash income) received by all household members. Disposable income (DPI) refers to post-tax and transfer income, and is derived by first adding social transfers to the market income and then subtracting income taxes and mandatory employee contributions. The LIS data does not list social transfers by source, or provide a break-down of taxes by the level of government to which it is paid.

Table 1: Summary of LIS Data

Country	Years	Number of Subnational Units (States, Provinces etc.)
US	1986, 1991 1994, 1997 2000	50 states + District of Columbia
Canada	1987, 1991 1994, 1997	10 Provinces
Germany	1989, 1994	16 *länder*
Australia	1985, 1989 1994	7 states

Following the methodology suggested by Atkinson, Rainwater and Smeeding (1995), household income is divided by the square root of the number of household members to "equivalize" or adjust for economies of scale. Since some LIS datasets do not distinguish between missing values and instances of zero income, all records with zero income are excluded from the study (Föster, Jesuit and Smeeding, 2002). The equivalenced income is top- and bottom-coded to minimize the effect of extreme values and weighted by person (Gottschalk and Smeeding, 1997).

Measures of Income Inequality and Regional Redistribution

Two measures of interregional inequality are presented in this paper: the Theil Index and the Regional to National Median Income Ratio. The Theil Index is a convenient measure of regional inequality because it can be additively decomposed by population subgroup (Föster, Jesuit and Smeeding, 2002; Cowell, 2000). In other words, total income inequality can be written as the summation of two elements – "within-group" inequality (the weighted sum of inequalities within each subgroup) and "between-group" inequality (the inequality between the mean income of each subgroup). For the purposes of this paper, the population subgroups correspond with the states.

The "between - group" Theil, therefore, measures inequality between states, whereas the "within-group" Theil is a measure of interpersonal inequality within regions [1]. The Regional to National Median Income Ratio, an alternative measure of interregional inequality, is calculated for each region by taking the ratio of the region's median income to the national median income.

An estimate of regional redistribution is calculated from the "between - group" Theil indexes before and after redistribution. For the purposes of this paper, interregional redistribution is defined as the percentage reduction in the "between-group" Theil index of inequality from before to after taxes and transfers [2]. In other words, inter-regional redistribution, R, can be represented as

$$R = \frac{T_{mi} - T_{dpi}}{T_{mi}} \tag{1}$$

where T_{mi} and T_{dpi} are the "between - group" Theil indexes for market income and disposable income respectively.

As was stated earlier, the LIS data does not provide information on the level of government that funds a given program of social transfers or that receives revenues from a particular tax source. It does not, for example, distinguish between a federally-funded cash-assistance program and state-sponsored unemployment insurance. Therefore, the Theil index of inequality and the estimate of redistribution developed in this paper reflect the over-all "redistributiveness" of the federal system, and are not indicators of the role of any one level of government.

A second measure of interregional redistribution involves a simple regression model that estimates the effect of pre-redistribution inequality on redistribution within each country for a given year. In other words, the change in the regional mean income from before redistribution to after redistribution, the net transfer from redistribution, is regressed on the mean regional per capita income before redistribution, after controlling for population share. The regression can be restated as the following:

$$E(\triangle\ M) = \beta_0 + \beta_1 M_{mi} + \beta_2 P \tag{2}$$

[1] All Theil indexes reported in this paper refer to "between - group" measures.

[2] This measurement of interregional redistribution modifies the definition of redistribution presented by Iverson and Soskice in their upcoming paper on the relationship between electoral politics and redistribution in democracies

where $\triangle\ M = M_{dpi} - M_{mi}$ and is the net benefit from redistribution. For a given state, M_{dpi} is the mean regional disposable income, M_{mi} is the mean regional market income and P its share of the total population. β_1, the regression coefficient for the pre-redistribution regional mean, gives us an estimate of how one unit change in the pre-redistribution mean income of region effects its post-redistribution mean income. This measure does not control for any interpersonal redistribution that may be happening at the state level. It assumes that the redistribution function of the federal system is a national process, and estimates the overall "redistributiveness" of the system.

IV. Results

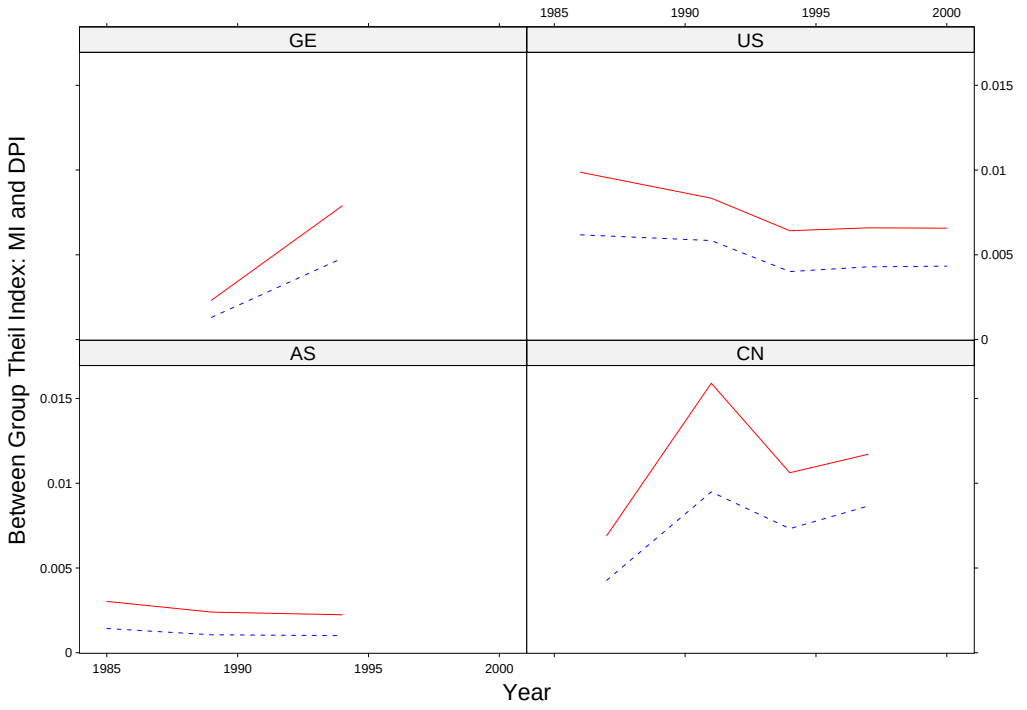
This section presents a descriptive analysis of regional inequality and interregional redistribution for the four federal systems. The results show that there is considerable variation in the levels of interregional inequality between countries, as well as in their interregional "redistributiveness". Comparing the pre-redistribution regional variation and the percentage reduction in inequality after redistribution revealed that the federal systems with less interregional disparities undertook greater redistribution.

Interregional Inequality

As stated in the previous section, the Theil index of inequality can be decomposed into two elements – "within-group" inequality and "between-group" inequality. Table 2 lists the "between-group" Theil measures before and after redistribution by year for the four countries, and the percentage decrease in inequality between regions after redistribution.

Figure 1 plots the Theil indexes for both market income and disposable income across the years for each of the four countries. Interregional inequality pre- and post- redistribution exhibit similar changes over the years. The results show that interregional inequality, both before and after redistribution, decreased over time in the United States and Australia. In Canada, however, regional disparity in income fluctuated over the years, with a sharp increase between 1987 and 1991. The results are less meaningful in the case of Germany since data was only available for 1989 and 1994. Unsurprisingly, interregional differences increased during this time corresponding to the reunification of east and west Germany in 1990. In the case of Canada and the

Figure 1: This graph shows between-group Theil indexes before and after redistribution. The red line refers shows interregional inequality based on pretax and transfer market income (MI), and the blue dotted line corresponds with disposable income (DPI).



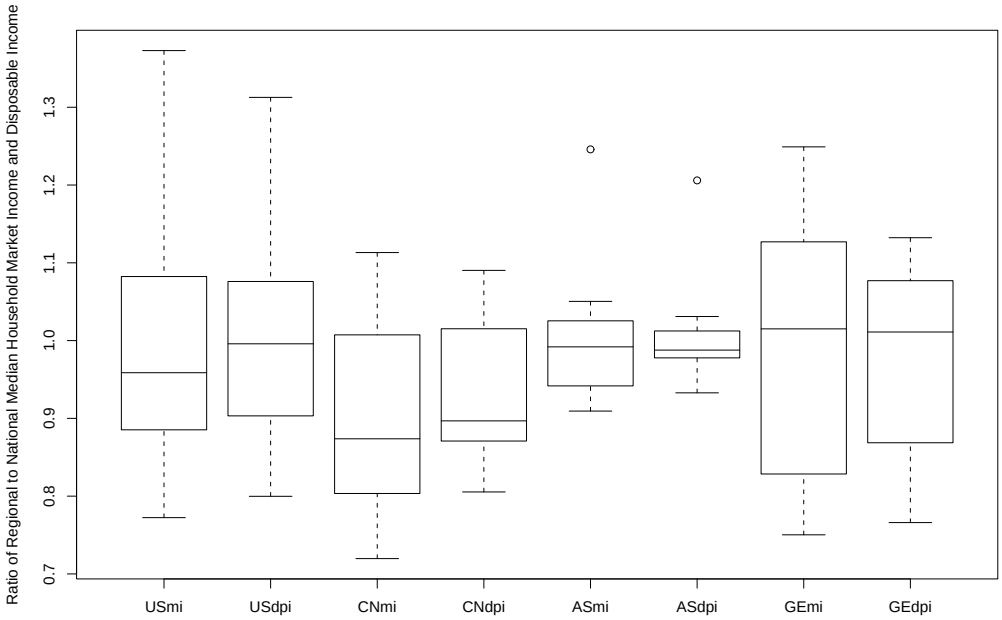
United States, the results correspond to Shankar and Shah's (2001) findings about regional income convergence.

Interregional Redistribution using the Theil Index

This section presents a comparison of pre- and post- redistribution interregional inequality in 1994 for the four countries, and estimates the extent of interregional redistribution.

Figure 2 presents box-and-whisker plots for Regional to National Median Ratios before and after redistribution in 1994. This comparison reflects

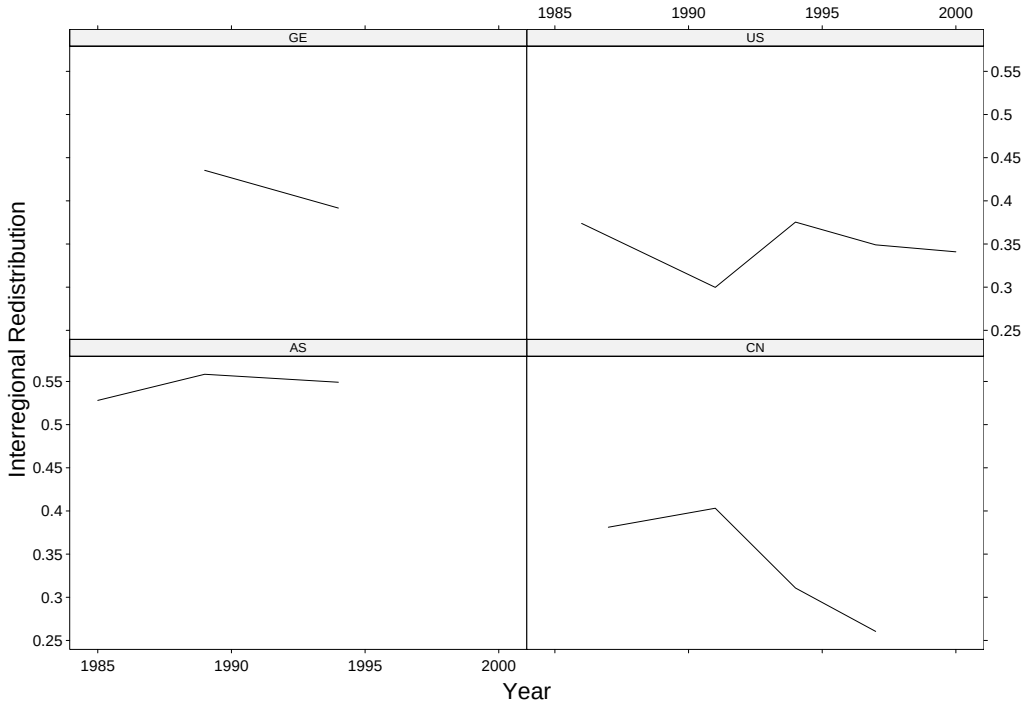
Figure 2: This figure presents the Regional to National Median Income Ratio before and after redistribution in 1994. MI refers to market income and DPI refers to disposable income.



the overall effect of redistribution in reducing interregional variation. The lengths of the boxes, which represent the interquartile range, and the span of the whiskers, which represent the range between the maximum and minimum ratio of regional to national median, decreased in every case after redistribution. In other words, the variation in the ratios of regional median to national median decreased after redistribution.

The measures for interregional redistribution, R, derived from the percentage reduction in the "between-group" Theil index, are presented in table 2 and figure 3 depicts these trends over time. The percentage reduction in regional variations in per capita income through redistribution remained

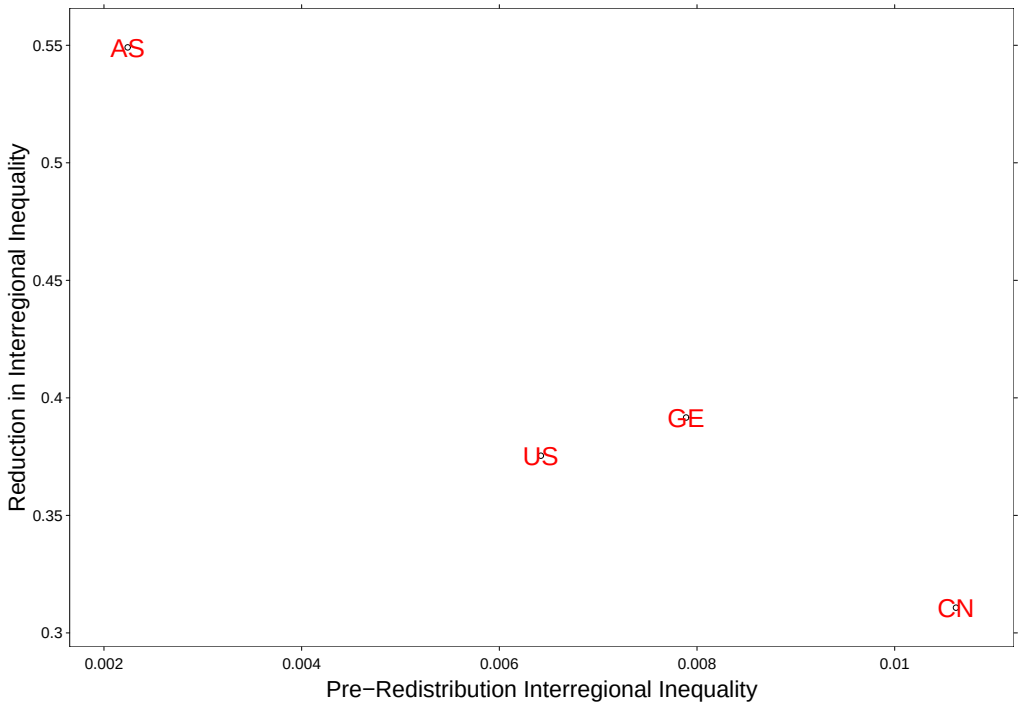
Figure 3: This figure shows the trends in interregional redistribution over time.



fairly constant in Australia. Interregional redistribution has fluctuated over the years in Canada and the United States, and appears to be decreasing in recent years in both countries. Again, in the case of Germany, there is insufficient data to say anything conclusive about longitudinal trends. Taking an average across the years, interregional inequality went down by 34% in the United States and Canada, by 41% in Germany and by 55 percent in Australia (see table 3 for exact figures).

Figure 4 plots the measure of interregional redistribution and the "between-group" Theil index before redistribution for all four countries in 1994. Interestingly, Australia, which has the lowest pre-redistribution interregional inequality achieves the greatest degree of interregional redistribution of the

Figure 4: This figure shows the relationship between interregional inequality before redistribution and interregional redistribution in 1994.



four federal systems, while Canada has the highest Theil index of interregional inequality but exhibits the least interregional redistribution.

Interregional Redistribution using Regression

The regression model described in section III estimates the relationship between the pre-redistribution mean income of a region and its net gain from redistribution, defined here as the difference between the regional mean disposable income and the regional mean market income. The results for 1994 are summarized in table 4.

The coefficients of regression for pre-redistribution regional mean income were statistically significant and negative in all four countries. This implies that as the pre-redistribution mean income of a regional increased, the net benefit from redistribution decreased. The magnitude of the coefficient, or the rate at which the net benefit decreases, varied across the countries. In Germany, a one unit increase in the mean regional income pre-tax and transfers decreased the net benefit from redistribution by 0.43 units. In contrast, a one unit increase in the mean regional market income in Canada, reduced the benefit from redistribution by 0.33 units. The corresponding numbers for Australia and the United States were .35 and .41 respectively. The 95% confidence intervals for these estimates are a good indication of their accuracy. In Canada, the effect could have been as low as 0.15 units and as high as 0.50 units, while in Australia the range from 0.37 units to 0.46 units was significantly narrower.

V. Conclusion

This paper examines the use of LIS data to study interregional income inequality and redistribution and presents two alternative methods of estimating redistribution. Current trends in regional inequality show that it is on the decline in Australia and the United States, but has increased in Canada and Germany in recent years. The Theil Index analysis revealed that taxes and transfers in all four countries have a net effect of reducing interregional inequality. Australia, which has the least pre-redistribution interregional disparity achieved the greatest reduction in inequality, whereas Canada with the most regional inequality achieved the least. The results from the regression analysis show that all four federal systems engaged in positive interregional redistribution—the net benefit from redistribution decreased as the mean

pre-redistribution income of a region increased—but the rate of redistribution varied considerably across the four. This result is consistent with the findings from the Theil index analysis.

These preliminary results are promising, but they also point out some of the draw-backs in using LIS data for studying regional inequality and avenues for future research. Firstly, disaggregating the net transfers received by households by level of government in order to control for the interpersonal transfers that state governments undertake may not be easily achieved. The LIS data does give a break-down of benefits received from different social programs, but the source of the funds is not identified. Morevoer, some subcategories like social assistance in the form of means-tested cash benefits could include programs funded by the federal government as well as the states. One potential way of dealing with this problem would be introduce variables for state-wise expenditure on social programs, weighted by population. This would control for the effect of interpersonal redistribution at the state level, and provide a better estimate of how much interregional redistribution is achieved by federal spending. Secondly, the regional means computed in this paper do not reflect real income. If price variations are significant across regions, then the disposable income would need to be weighted according to purchasing power in order to make it comparable across regions.

Table 2: This table presents Theil measures before and after redistribution. Market Income (MI) and disposable income (DPI) refer to income before and after redistribution respectively.

Country	Year	Theil Index: MI	Theil Index: DPI	Reduction in Theil Index
US	1986	0.00987	0.00618	0.3738602
	1991	0.00834	0.00584	0.2997602
	1994	0.00642	0.00401	0.3753894
	1997	0.00659	0.00429	0.3490137
	2000	0.00657	0.00433	0.3409437
CN	1987	0.0069	0.00427	0.3811594
	1991	0.0159	0.00949	0.4031447
	1994	0.01062	0.00732	0.3107345
	1997	0.01171	0.00866	0.2604611
GE	1989	0.00232	0.00131	0.4353448
	1994	0.00789	0.0048	0.3916350
AS	1985	0.00303	0.00143	0.5280528
	1989	0.0024	0.00106	0.5583333
	1994	0.00224	0.00101	0.5491071

Table 3: This table presents the average regional redistribution and average regional inequality before redistribution.

Country	Average Regional Inequality (Before Redistribution)	Average Regional Redistribution (Reduction in Theil Index)
CN	0.0113	0.34
US	0.0076	0.35
GE	0.0051	0.41
AS	0.0026	0.54

Table 4: This table presents the coefficient of redistribution for 1994.

Country	Regression Coefficient	95% Confidence Interval
CN	-0.33**	(-0.51, -0.15)
US	-0.36***	(-0.41, -0.31)
GE	-0.43***	(-0.52, -0.32)
AS	-0.41***	(-0.46, -0.37)
Significance codes: 0 '***' 0.001 '**' 0.01 '*'		

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