A MEASURE OF INTERREGIONAL REDISTRIBUTION

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Abstract

This paper develops a disaggregated index of interregional distribution generated by federal fiscal activity based on a comparison between relative federal revenues and expenditures assigned to various regions and the pattern of income disparities among regions. To explore the properties of this index, we present three special cases under known degrees of distribution and calculate the indices using the Canadian data for 1996. The local indices are then aggregated to derive a global index of interregional redistribution. Our results show that the federal fiscal system in 1996 delivered a degree of interregional redistribution 1.8 times what would have been generated under equal per capital expenditures by region and nearly half of the redistribution that equalizes the per capita income via federal expenditures.

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1. INTRODUCTION

The fiscal activity of governments may generate a variety of redistributional effects. It may alter the relative economic position of individuals with different income levels. It may also influence the relative position of individuals with equal incomes but different non-economic characteristics. The first effect may be called vertical redistribution as it involves vertical equity, while the second effect may be called horizontal redistribution. In a federal state, the central government may also affect the relative economic situation of regions with different levels of average income. This effect is sometimes also called horizontal redistribution.[1] In order to avoid confusion with the term which applies to issues of horizontal equity among individuals, we will use the term interregional redistribution, where region may refer to a state or a province.

Economists have developed a variety of indices to measure the degree of vertical redistribution, especially in connection with the redistributional impact of taxation. Some of these indices are disaggregated (local indices) and provide information on redistribution for each selected step in the income distribution. For example, Musgrave and Thin (1948) developed indices that measure the change in average tax rates as income increases (average rate progression) or the change in marginal tax rates as income increases (marginal rate progression). Baum (1987) developed a local index that compares a taxpayer's share of pre-tax income with his/her share of after-tax income (relative share adjustment). Other indices, based on the concept of Gini coefficient, are global and provide a single value of the degree of redistribution. They generally involve a comparison of three slightly different Gini coefficients (Gn, Gy and Gg). The first one (Gn) is calculated based on income under distributionally-neutral government spending or taxation; the second one (Gy) is based on income

incorporating the actual pattern of government spending or taxation; and the third one (Gg) is a measure of redistribution of government spending or taxation (Gg). For example, Kakwani's (1976) index is based on the difference between Gg and Gy, The index developed by Reynolds and Smolensky(1977) is based on the difference between Gn and Gy and the global index proposed by Musgrave and Thin (1948) involves the ratio of one minus Gn to one minus Gy. As shown by Cassady, Ruggeri and Van Wart (1996), there is often a close relationship between local and global indices and the latter may be derived as aggregates of the former. Economists have also developed a variety of indices of indices of horizontal redistribution.[2]

However, less attention in the literature on fiscal redistribution has been paid to redistribution among regions generated by federal fiscal activity. When the effect of the fiscal activity of the central government(hereafter called federal government) is evaluated, the analysis is usually confined to the calculation of what are commonly called federal fiscal balances. These balances are calculated by assigning to each province a portion of both federal revenues and expenditures on the basis of a selected methodology. It may be argued that there is no need to develop separate indices for interregional redistribution because one can apply the indices available for analyzing redistribution among individuals. For example, if we represent the economic position of a province by its per capita income and list the provinces in ascending order of per capita income, we can treat the resulting series in the same manner as a distribution of average income by income class and apply the indices of vertical redistribution. We suggest in this paper that it may be desirable to use indices specifically designed for interregional redistribution in order to take into account explicitly the components of the federal fiscal system which affect directly the relative economic position of different regions. In this manner we gain useful information on both the channels through which federal fiscal activity

affects interregional redistribution as well as the degree of such redistribution.

It is the purpose of this paper to present a disaggregated index of interregional distribution. This index, based on Mansell and Schlenker (1995), involves a comparison between relative federal revenues and expenditures assigned to the various regions and the pattern of income disparities among regions. To explore the properties of this index, we present three special cases under known degrees of distribution and calculated the indices using the Canadian data for 1996. The local indices are then aggregated to derive a global index of interregional redistribution. Our results show that the federal fiscal system in 1996 delivered a degree of interregional redistribution 1.8 times what would have been generated under equal per capital expenditures by region and nearly half of the redistribution that equalizes the per capita income via federal expenditures. The paper is organized as follows. Section II presents the suggested index and explores some of its properties. Section III applies that index to the Canadian situation in two steps: first it discusses the methodology used in calculating federal fiscal balances and the concept of income used for measuring income disparities, and then estimates the values of the proposed index and its main components. The last section contains some concluding remarks.

2. A MEASURE OF INTERREGIONAL REDISTRIBUTION IN A FEDERAL SYSTEM

The proposed measure of interregional redistribution is based on the relationship between the main components of federal fiscal balances and regional income disparities. Specifically, it is a measure of relative contribution that each region makes to the financing of federal expenditures it receives compared to its relative economic position. Accordingly, called the Relative Share Index (*RSI*) ,

its measure for the i^{th} region is defined as:

$$(1) \qquad RSIi = \frac{(ri / r) / (ei / e)}{yi / y} \times 100$$

where ***ri*** , ***ei*** and ***yi*** are per capita federal revenues, per capita federal expenditures, and per capita income for region i, respectively, and ***r, e, y*** are the averages for all regions. A value of 100 indicates that the province's contribution to the financing of federal expenditures is commensurate with its share of income. A value greater then 100 indicates that a region a net contributor to the federal fisc; and a value less than 100 indicates that a region is a net gainer.

Notice that equation (1) can be expressed in terms of total federal revenues received ***(Ri)*** from region ***i*** and total federal expenditures ***(Ei)*** disbursed to the region as follows:

$$(2) \qquad RSIi = \frac{(Ri / Ei)(E / R)}{yi / y} \times 100$$

where R and E are, respectively, total federal revenues and expenditures.

In order to explore some of the properties of this index we first derive its values under known degrees of redistribution. We consider three special cases: (a) the situation where the federal fiscal system does not generate regional redistribution, (b) the situation where redistribution is delivered only via the spending side and through equal per capita federal spending in each region and (c) the

situation where fiscal redistribution equalizes post-fisc income per capita, thus eliminating entirely regional income disparities.

Case A: A Distributionally-Neutral Federal Fiscal System

Let us consider the case where neither revenues nor expenditures affect the distribution of per capita income by province by assuming that both per capita federal revenues and expenditures are a fixed proportion of per capita income in each province. We call the index so derived ***RSIi(N)*** to distinguish it from the actual ***RSIi***, where *N* symbolizes distributionally-neutral.

Assumption 1. $ei = ayi$, where $a = e/y = E/Y$

Assumption 2. $ri = byi$, where $b = r/y = R/Y$

Expanding the terms ***ri*** and ***ei*** and recognizing that $ri/ei = Ri/Ei$, we can express the ratio of ***ri*** to ***ei*** as

(3) $$Ri/Ei = byi/ayi = b/a = R/E$$

Substituting (3) for ***Ri/Ei*** in (2) yields

(4) $$RSIi(N) = y/yi$$

Expression (4) indicates that, when the federal fiscal system is distributionally neutral across regions, the values of ***RSIi(N)*** follow a decreasing pattern when regions are ranked in ascending order of per capita income. Graphically they are represented by a downward sloping curve with slope depending on the degree of income disparities among regions.

Case B: Redistribution Only Through Federal Expenditures

We now consider the case where the federal fiscal system redistributes income only through the spending side in the form of equal per capita expenditures in each region. Federal revenues per capita are a fixed percentage of per capita income in each province. We call this index ***RSIi(PC)***.

Assumption 1. Net federal expenditures per capita are equal in each region, i.e., $ei = e$

Assumption 2. Net federal revenues per capita are a fixed percentage of per capita income in each region, i.e., $ri = byi$, where $b = r/y = R/Y$

It follows from the above two assumptions that

(5) $$ri/ei = byi/e = (R/Y)(yi/(E/P) = (R/E)yi(Y/P) = (R/E)(yi/y)$$

Recognizing that $ri/ei = Ri/Ei$ and substituting this into equation (2) yields,

(6) $$RSIi(PC) = 1$$

Expression (6) indicates that, when the estimated ***RSI*** values are unity for all regions, there is a degree of regional redistribution through the federal fiscal system which is delivered solely through equal per capita expenditures in each region. A pattern of upward sloping ***RSIi*** where regions are ranked in ascending order of per capita income indicates a degree of interregional redistribution higher than the above one.

C. Maximum Redistribution

We can derive the ***RSIi*** values for maximum redistribution by keeping federal revenues distributionally-neutral and assigning federal expenditures to each region in a manner that results in equal post-fisc income per capita for all regions. The problem is then to choose ***ei*** to equalize this post-fisc income, i.e., $yi + (ei-ri) = y$. Accordingly,

(7) $$ei = y - yi + ri$$

In expression (7) the determination of ***ei*** is based on a balanced budget situation. When the federal budget is not balanced, we must solve $yi + (E/R)ei - ri = y$ for ***ei.*** The value of ***ei*** in this general case is

(8) $$ei = (R/E)\ (y - yi + ri)$$

Substituting ***ei*** in (1) and remembering that $ri = byi$ we can derive the value of ***RSIi*** under maximum

redistribution (denoted by ***RSIi(M)***) as [3]

(9) $$RSIi(M) = b/[1 - (1-b)(yi\backslash y)]$$

The expressions for calculating ***RSIi*** under the three special cases described above help evaluate the results of estimated RSIi values under given federal fiscal balances and regional disparities for any federal system. For example, if a region has per capita income which is 80% of the national average ($y/yi = 1.25$) and the estimated *RSIi* value is 1.125, it means that the federal fiscal system delivers half of the redistribution to this province that would occur under neutral revenues and equal per capita federal spending. If the ratio of federal revenues to total income is .3, the maximum redistribution *RSIi* value for this region is .68 and the difference from the no-redistribution case is .57. The actual difference of .125 represents 22% of the maximum redistribution.

3. INTERREGIONAL REDISTRIBUTION IN CANADA

In this section we present estimates of interregional redistribution in Canada for the year 1996, developed in two stages. In the first stage we discuss in details the methodology used in our calculations and the second stage we present the components of the our redistributional index and the estimated *RSIi* values.

A. Methodology

A. Federal Fiscal Balances

In calculating federal fiscal balances we confined our analysis to Canadian residents only. Federal revenues collected from non-residents do not impose a burden on the residents of the various regions; similarly , those residents do not benefit from federal spending directed at non-residents. We also focused our analysis on jurisdictions rather than individuals by calculating the contribution that a province makes to the federal coffers through the tax burden borne by its residents and the contribution that federal expenditures make to the economic position of that province. In allocating federal revenues we used the assumptions generally applied in allocating tax burden in tax incidence studies.[4] Specifically, personal income taxes were allocated to individual taxpayers based on their residence. Social insurance (payroll) taxes were allocated on the basis of the location of employment. The broad-based consumption tax - the Goods and Service Tax (GST) - was allocated according to the provincial distribution of personal consumption expenditures. Excise taxes, such as levies on fuel, tobacco and alcoholic beverages were allocated on the basis of the provincial distribution of the consumption of the taxed products. On the expenditure side, transfer payments to persons and businesses were allocated on the basis of the residence of the recipients. Interest on the public debt was allocated according to the provincial distribution of interest income. The wage component of federal purchases was allocated on the basis of the location of employment The non-wage component was assigned on the basis of the provincial distribution of private income from current production, approximated by net national income at factor net of the total government component.[5]

The federal fiscal balances by province derived through the above allocation are shown in Table 1. We notice that in 1996 the federal fiscal system in Canada generated some redistribution among

regions. The three richest provinces - Alberta, Ontario and British Columbia - paid in federal taxes more than they received in federal expenditures. The less affluent provinces received more in federal spending than they paid in federal taxes. The net loss to the richest provinces ($5.2 billion), however, was much less than the total net gain by the other provinces ($23.1 billion) because the federal government ran a deficit of $18 billion.

B. Income Disparities.

The denominator of our redistributional index is an indicator of regional income disparities. In our calculations we used a broad concept of income that represents the economic status of each province under the assumption that federal fiscal activity does not redistribute income among provinces. We start with a distributionally-neutral federal fisc and then measure how the actual pattern of federal spending and taxation is related to this pattern of income disparities. The derivation of this income measure is shown in Table 2. The first component of this income measure includes the components of income from current production which are usually found in the *National Income Accounts*. We then add a number of income sources which are received by persons, but are not generated from current production, and the amount of taxes assigned to factor income. We call the sum of these two components private income. Finally we include the actual fiscal balances of provincial and local governments and the federal balances assigned to provinces under the assumption that federal revenues and expenditures are allocated in proportion to private income in each province. We call this income measure neutral-fisc income.

We notice from Table 2 that neutral-fisc income per capita is not distributed equally among

provinces. Three provinces - Alberta, Ontario and British Columbia - have above-average per capita incomes; Quebec Saskatchewan and Manitoba have per capita incomes about 10% below the national average, while the Atlantic provinces have per capita incomes substantially lower than the national average.

B. Estimates

Our estimates of the *RSIi* for Canada in 1996 are shown in Table 3. We notice that, with the exception of Nova Scotia, there is clear demarcation between richer and poorer provinces. The three richest provinces have *RSI* values in excess of one, indicating that they make a contribution to the federal fisc more than commensurate to their level of per capita income relative to the national average. The poorer provinces, with the exception of Nova Scotia, make a less than commensurate contribution. As a result, as shown in Figure 1, we have *RSIi* values with a positively sloped pattern as we move from lower to higher per capita income by province. This pattern indicates that in 1996 the federal fiscal system in Canada generated interregional redistribution to a degree higher than that resulting from proportional taxation and equal per capita expenditures across provinces.

Table 4 compares the actual *RSIi* with those estimated under the three special cases. The last two columns of table 5 provide estimates of the degree of redistribution among regions relative to our reference cases. Let us compare first the actual degree of redistribution, measured by the difference between actual *RSIi* and distributionally-neutral *RSIi(N)*, with the degree of redistribution under the assumption of distributionally-neutral revenues and equal per capita expenditures by calculating the ratio of the former to the latter. We notice that, with the exception of Nova Scotia, in all other

provinces the degree of federal redistribution exceed what would be generated by equal per capita expenditures alone. The value of this ratio, however, varies widely among provinces, ranging between .95 in Nova Scotia and 3.45 in Saskatchewan. A measure of the overall degree of redistribution relative to the equal per capita expenditure case can be derived by calculating the weighted average of the provincial ratios, where the weights are the provincial shares of distributionally-neutral base income. Our estimate shows that in 1996 the federal government generated redistribution among province equal to 1.8 times the amount that would be generated by equal per capital expenditures alone. When we calculate the provincial ratios by using the difference between maximum and actual RSIi we derive the proportion of maximum redistribution generated by the federal fiscal system. As shown by the last column of Table 4, we have again considerable interprovincial variation in this ratio. Th ratio ranges from a low of .20 in Alberta to a high of 1.19 in Saskatchewan. This polar ratios indicate that, in Saskatchewan, federal fiscal balances were more than sufficient to bridge the gap between per capita provincial income and the national average income, both measured by distributionally-neutral base income per capita. By contrast, in Alberta the federal balances eroded only a small portion of the income differential from the national average. The weighted average of the provincial ratios is .48 which indicates that, in 1996, federal fiscal balances cut interprovincial income disparities almost in half. These proportions of maximum redistribution also show that the provincial distribution of income in Canada is favourable to interprovincial redistribution. The three richest provinces combined account for nearly two-third of income. Therefore, it took on the average 38% of maximum redistribution for these three provinces to deliver 68% of maximum redistribution for the remaining seven provinces.

4. CONCLUSIONS

This paper introduced a disaggregated index of interregional redistribution. Called the Relative Share Index (RSI), this index incorporates explicitly the basic components of federal fiscal balances by region as well as the degree of regional income disparities. We showed that, when the federal fiscal system does not generate redistribution among regions, the index simply reflects the degree of income disparities measured by the reciprocal of the ratio of per capita income in a region to the national average. If redistribution is delivered solely on the expenditure side in the form of equal per capita federal expenditures in each province, the index has a value of one for each region. We also showed that the expression for maximum redistribution, i.e. redistribution that equalizes per capita income in all regions, depends on the average federal tax rate and the degree of income disparities. We used this index to measure the degree of interregional redistribution in Canada for 1996. Our results show that the federal fiscal system in 1996 delivered a degree of interregional redistribution 1.8 times what would have been generated by under equal per capita expenditures by region and nearly half of the maximum degree of redistribution.

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TABLE 1: Federal Fiscal Balances by Province in 1996, $ Million

Province	Federal Expenditures	Federal Revenues	Balance
Newfoundland	4762	2237	2525
Prince Edward Island	1179	680	499
Nova Scotia	7822	5173	2649
New Brunswick	5819	3712	2107
Quebec	38678	29566	9112
Ontario	67658	69852	-2194
Manitoba	8839	5831	3008
Saskatchewan	8149	4914	3234
Alberta	15884	17619	-1735
British Columbia	22942	24189	-1247
All Provinces	181733	163774	17959

TABLE 2: Calculation of Neutral-fisc Income by Province in 1996 $ million

	NF	PEI	NS	NB	QC	ON	MB	SK	AB	BC	Total
Wages and Salaries and Supplementary Labour Income	5602	1419	10539	8859	96885	175317	14336	11443	43952	58450	426802
Government Components	*1778*	*432*	*3147*	*2327*	*22530*	*34104*	*3726*	*2894*	*7832*	*11679*	90449
Private Wages and Salaries	3824	987	7392	6532	74355	141213	10610	8549	36120	46771	336353
Accrued Income of Farm Operators	5	18	43	28	774	298	557	1399	844	81	4047
Net Income of Non-Farm Unincorporated Business	693	213	1491	981	10096	19586	1830	1579	4708	7065	48242
Interest and Miscellaneous Investment Income	701	144	1137	1170	11920	18576	2627	2744	9146	8600	56765
Profits Retained in Canada	308	122	623	645	7422	17431	775	1679	7229	3545	39779
Current Transfers from Corporations	15	4	25	20	194	297	30	27	74	104	790
Subtotal	**5546**	**1488**	**10711**	**9376**	**104761**	**197401**	**16429**	**15977**	**58121**	**66166**	**485976**
Superannuation	*376*	*111*	*1089*	*669*	*6016*	*12210*	*1044*	*839*	*2066*	*3781*	28201
RRSP Withdrawals	*81*	*24*	*197*	*146*	*1475*	*3034*	*269*	*221*	*769*	*1073*	7289
Realized Capital Gains	*70*	*41*	*224*	*128*	*2048*	*4613*	*373*	*521*	*1992*	*2388*	12398
CIT Assigned to Capital Income	31	19	122	73	1084	2264	171	219	940	1105	6029
Employer Portion of Payroll Taxes	420	97	736	546	8706	12038	976	697	2289	3566	30071
Private Income	**6524**	**1780**	**13079**	**10938**	**124091**	**231560**	**19262**	**18474**	**66176**	**78079**	**569964**
Net Provincial Balances	110	29	-60	177	5499	5748	43	-554	-2303	1381	10070
Net Local Balances	51	10	38	73	2066	1656	183	176	508	1300	6061
Federal Balances Allocated to Private Income	206	56	412	345	3910	7296	607	582	2085	2460	17959
Neutral-fisc Income	6891	1875	13469	11532	135566	246261	20095	18678	66467	83221	604054
Neutral-fisc Income Per Capita ($)	**12283**	**13786**	**14468**	**15315**	**18637**	**22184**	**17721**	**18330**	**23900**	**21438**	**20427**

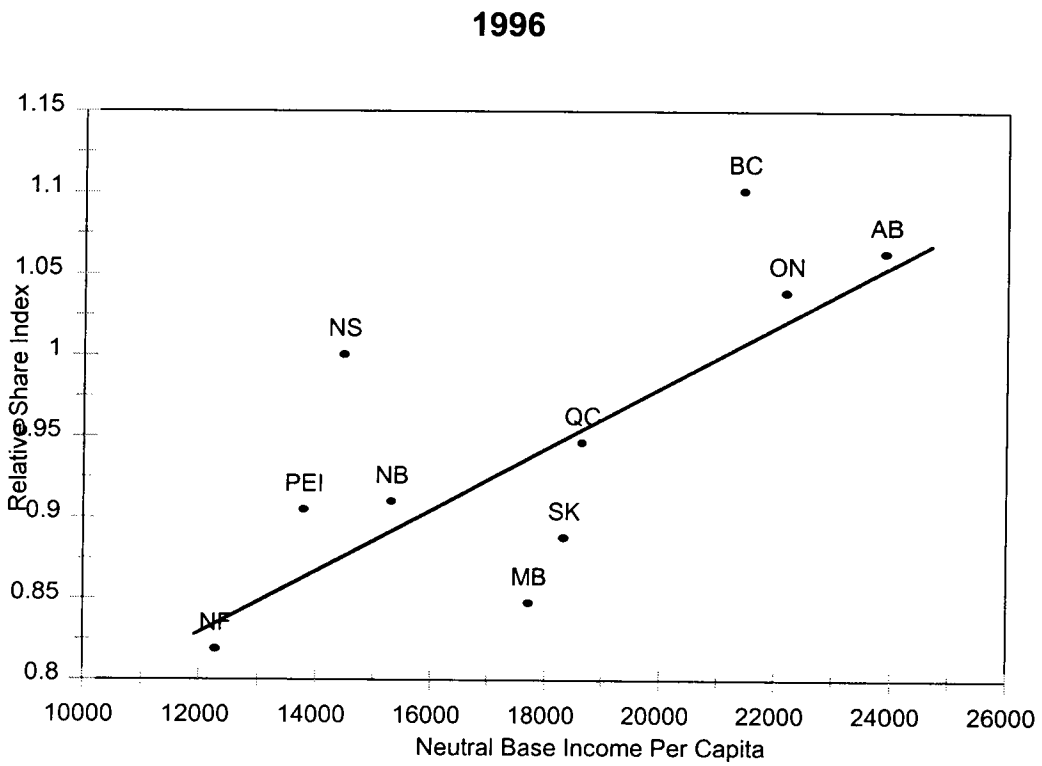
TABLE 3: Estimated RSI Values for Canadian Provinces, 1996

Province	*Ri/Ei*	*E/R*	*y/yi*	*RSIi*
Newfoundland	0.47	1.1	1.66	0.86
Prince Edward Island	0.57	1.1	1.49	0.94
Nova Scotia	0.66	1.1	1.41	1.02
New Brunswick	0.64	1.1	1.33	0.94
Quebec	0.76	1.1	1.10	0.92
Ontario	1.03	1.1	0.92	1.04
Manitoba	0.66	1.1	1.15	0.83
Saskatchewan	0.60	1.1	1.11	0.73
Alberta	1.11	1.1	0.86	1.04
British Columbia	1.05	1.1	0.95	1.10

TABLE 4:. Estimated Values of *RSIi* for Canada, 1996, Actual and under Selected Cases

	RSIi (A)	*RSIi(N)* (B)	*RSIi(PC)* (C)	*RSIi(M)* (D)	(A-B)/(C-B)	(A-B)/(D-B)
Newfoundland	0.86	1.66	1	0.48	1.21	0.68
Prince Edward Island	0.94	1.48	1	0.53	1.13	0.59
Nova Scotia	1.02	1.41	1	0.56	0.95	0.46
New Brusnwick	0.94	1.33	1	0.60	1.18	0.53
Quebec	0.92	1.10	1	0.82	1.80	0.64
Ontario	1.04	0.92	1	1.28	1.50	0.33
Manitoba	0.83	1.15	1	0.73	2.13	0.76
Saskatchewan	0.73	1.11	1	0.79	3.45	1.19
Alberta	1.04	0.85	1	1.80	1.27	0.20
British Columbia	1.10	0.95	1	1.17	3.00	0.68
Weighted Average					1.80	0.48

FIGURE 1: The Estimated RSIi and Neutral-fisc Income Per Capita



Notes

1. See, for example, Ruggeri and Yu (2000).

2. See, for example, Plotnick (1982), Musgrave (1991).

3. In order to obtain positive values of *RSIi(M)* it is necessary that, for any region, $yi/y > (1-b)$. A situation of low average tax rates and high regional disparities would yield negative values of *RSIi* under maximum redistribution.

4. See, for example, Ruggeri, Van Wart and Howard (1996).

5. A more detailed explanation of the allocation procedure is found in Ruggeri and Yu (2000).