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EVALUATING THE EFFICIENCY AND EQUITY OF FEDERAL FISCAL EQUALIZATION

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ABSTRACT

In theory, federal transfers that make household location decisions efficient will offset differences in federal-tax payments and local tax revenues on capital, but not local tax revenues from residents. Transfers that redistribute resources equitably across regions will likely target areas with individuals of low earnings potential or low real incomes. Examining these metrics in practice, federal transfer differences across Canadian provinces are neither efficient nor equitable, but exacerbate pre-existing inefficiencies and underfund minorities. Total locational inefficiencies cost the economy 0.41 percent of income annually and cause Atlantic and Prairie provinces to have populations 31 percent beyond their efficient long-run levels.

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1 Introduction

Federal governments make fiscal equalization payments to local governments with the stated goal of equalizing the fiscal capacity of local governments to provide services. Fiscal equalization programs exist in a number of federations, often explicitly, as in Canada, Australia, Germany and South Africa, or implicitly, such as in the European Union or the United States. Economists have long debated over how fiscal equalization programs may be used to make the population locate more efficiently, or be targeted towards areas so that public resources are distributed more equitably (see Buchanan 1950, 1951, 1952; Scott 1950, 1952; Jenkins 1951; Musgrave 1961; Feldstein 1970; Courchene 1981; Oakland 1994; Usher 2007). The following research attempts to provide a model rich enough to clarify these debates theoretically, and realistic enough to be applied to data, providing a framework to evaluate actual fiscal equalization programs beyond what is available in the existing literature.

Regional differences in fiscal capacity arise from differences in available tax bases, generally divided into two categories: source or residence (i.e. destination). Source-based taxes are levied on local factors such as land and capital, which may be owned by non-residents. Residence-based taxes are levied on the incomes of local residents; they include direct taxes on labor income and indirect taxes on property. It is generally accepted that it is efficient and equitable for federal governments to redistribute differences in source-based tax capacities unless they are paid to provide local services to these factors (Boadway and Flatters 1982; Mieszkowski and Toder 1983). For example, there is no compelling economic reason for a migrant to be entitled to revenues from taxes on local oil production, effectively obtaining property rights over oil by moving across a border to an oil-rich region.[1]

Less consensus exists over the need to equalize differences in fiscal capacity from residence-based taxes. Tiebout (1956) argues that it is efficient for local residence-based taxes to be linked directly to local expenditures, and thus operate as benefit taxes. The Tiebout equilibrium is made

[1] In certain cases, these tax revenues may be seen as compensation for negative local externalities associated with oil drilling. But, when households are mobile, such compesnation is inefficient since it negates the proper disincentive for households to avoid polluted areas.

inefficient if the local tax-benefit link is broken through federal redistribution. Yet, efficiency in the Tiebout equilibrium depends on the assumption that households sort into communities where everyone has the same demand for public goods, which is unlikely to occur across large regions, such as a state or province. Without requiring perfect sorting, Buchanan (1950) and, more formally, Boadway and Flatters (1982), argue that it is efficient for the federal government to equalize differences in residence-based tax capacities when tax payments increase with income. Otherwise, households will move inefficiently towards high-income communities, where they receive the benefits of local public services at a relatively low tax price. This argument is now widely accepted in the academic and policy literature on fiscal federalism (see Inman and Rubinfeld 1997; Musgrave 1997; Boadway 2004). Yet, as I show below, it does not provide a rationale for federal transfer differences across regions: the corrective federal transfers needed to eliminate inefficient migration sum up to zero for each region. In the end, a policy that tries to eliminate differences in residence-based tax capacities will cause inefficient migration across sub-national borders.

Another clarification emphasized here, but underemphasized in the federalism literature, is that otherwise identical individuals living in separate regions may earn different amounts because of interregional wage differentials. When workers are mobile, wage levels vary across regions to compensate workers for differences in local amenities and costs-of-living, so that they are no better off in high-wage areas than in low-wage areas. Putting externalities aside, it is not a matter of federal intervention whether a worker in a high-wage area consumes this compensation either in privately-provided or publicly-provided goods, e.g. a nicer car or a nicer roadway. Furthermore, as modeled by Albouy (2009), otherwise identical individuals pay more in federal taxes in high-wage areas than in low-wage areas, without receiving greater benefits. Thus, absent other reforms, efficient federal transfers will refund the federal tax differences that arise from interregional wage differentials.[2]

In discussions of horizontal equity and the "equal treatment of equals," Buchanan and others typically presume that two individuals earning the same nominal incomes in different regions are

[2]Poschmann (1998) also considers provincial inequalities in federal taxation, but does not distinguish amounts due to locational wage differences.

equals. Yet, if regions offer different wage levels, these two individuals may be far from equal. Rather, it is more appropriate to treat two individuals as equals if, counter-factually, they were to earn the same amount in the same region. In addition, cost-of-living differences imply that individuals in different regions with the same nominal incomes may have different real incomes. Furthermore, real income differences may arise from differences in amenities. As such, an individual in Hawaii may have a lower nominal and real income than an individual in Michigan, but still be better off because of amenities. This further underscores the need to disentangle how income differences across regions depend on the composition of the local labor force from the location itself.

The theoretical model that provides these insights also provides empirically verifiable conditions that will be satisfied if federal transfers are provided efficiently and equitably across regions, at least according to the criteria considered here. These conditions are modeled around a measure of *net fiscal benefits*, which expand on federal transfers to include local source-based revenues minus the federal tax differentials due to local wage levels. For efficiency, the measurable net fiscal benefits from residing in a province subsidizes the net positive externalities from residing in that same province, such as from paying for non-congestible public goods.

To determine whether federal transfers are distributed equitable many criteria might be chosen. I choose two plausible measures based on the average earnings capacity and real incomes of individuals. If interregional labor markets are in equilibrium, then fiscal benefits may be targeted towards areas where locals have low earnings potential, controlling for interregional wage differences.[3] It seems more defensible to give to areas where incomes are low because local residents lack marketable skills, rather than to areas where incomes are low because the cost-of-living is cheap or the local amenities are desirable. In the case where markets are out of equilibrium, and wages do not compensate for cost-of-living or quality of life differences, then evaluation becomes more difficult. Then, it may be defensible to target fiscal benefits towards areas where real income levels are low.

[3]This represents a refinement on Buchanan's criteria for equity since it controls for effects of location on income.

These verifiable conditions are examined for Canada, which has a substantial and well-studied system of fiscal equalization that accounts for most federal transfer differences across provinces. Somewhat surprisingly, there is little evidence of workers sorting across provinces according to their observable skills. While the Atlantic and Prairie provinces (excluding Alberta) – those receiving disproportionately more in federal transfers – have a labor force slightly less educated than other provinces, they also contain a smaller proportion of ethnic and immigrant minorities, who generally earn less than similarly-educated white natives. The lack of sorting suggests that wage differences across provinces are due mainly to local quality-of-life and firm productivity differences, modeled fully in Albouy and Leibovici (2009). Provinces receiving greater federal transfers have low nominal incomes because of their location, not because of their workforce.

Federal transfer policy effectively equalizes residence-based capacities much more than it equalizes source-based capacities, contrary to what efficiency dictates. Furthermore, federal transfers differences exacerbate federal tax inequalities: provinces paying the most to the federal government receive the least in federal transfers. Overall, measurable net fiscal benefits differences are large and do not appear to subsidize positive externalities. On average, federal transfers alone negate 43 percent of the income gain from moving to a higher-wage province, while total net fiscal benefits negate 76 percent of this gain, causing labor to be located inefficiently.[4] According to simulated estimates below, the Atlantic and Prairie provinces are over-populated by 31 percent beyond what is efficient, while Quebec, British Columbia, and Ontario are under-populated. Rather than reduce the costs of locational inefficiencies from unequal federal taxes and source-based tax revenues, federal transfers raise these costs by 0.15 percent of income, or C$1.6B (billion) per year.

In terms of equity, it may appear that federal transfer policy does better, since it is largely directed towards provinces with low nominal incomes. Yet, this view is misleading since the potential earnings of residents in transfer-receiving provinces are typically as high as residents in giving provinces: if equals are defined through their potential income, equals appear to be treated quite

[4]This effect is explained in a different light by Shaw (1986).

unequally according to where they live. In fact, provinces with a greater proportion of linguistic, immigrant, and ethnic minorities are at a fiscal disadvantage. Furthermore, the real incomes of residents in receiving provinces are relatively high, suggesting that the federal government could be transferring funds regressively. If labor markets are in equilibrium, then these real income differences compensate for local amenities, and federal payments instead subsidize citizens to live in the least amenable areas – a policy which is difficult to rationalize. Migration patterns suggest that many individuals would prefer to leave these areas if they were not indirectly paid to stay.

Section 2 presents a theoretical model of regions with mobile individuals and local and federal public sectors to determine how federal transfer levels are set efficiently. The measurable net fiscal benefits of residing in different Canadian provinces are estimated in section 3, which involves determining how much provincial wage differences are due to worker composition differences. Section 4 tests the externality and equity justifications for net fiscal benefit differences across provinces. The long-run effects of fiscal benefit distortions on provincial price levels, wages, employment and national welfare are simulated in section 5. Section 6 concludes and the Appendix contains additional detail on the theory and data used in the main text.

2 Federal Location Model with Transfers

2.1 Model Set-Up

The theoretical model is similar to Flatters et al. (1974), Stiglitz (1977), Boadway and Flatters (1982), and Wildasin (1980, 1986), but allows for regional differences in productivity and quality of life as in Rosen (1979) and Roback (1982). Conditions characterizing efficient levels of federal transfers are presented here without burdening the reader with the details of the full model and various derivations, which are given in Appendix A. In short, there are E types of individuals, $e = 1, ..., E$, and J regions, $j = 1, .., J$, not all of which need to be occupied, each with a population composition described by the vector $\mathbf{N}^j = (N_1^j, ..., N_E^j)$, using the scalar $N^j = \sum_e N_e^j$ to refer to the total population of city j. The total population of each type in the federation is

fixed, and preferences of each type are represented by the utility function $U_e\left(x, y, g^j; Q^j\right)$, which depends on three goods: (i) a tradable private good, x, (ii) a non-tradable (home) private good, y, and (iii) a local publicly-provided good, $g^j = G^j(N^j)^{-\alpha}$, with congestion parameter $\alpha \in [0, 1]$, where $\alpha = 0$ corresponds to the case of a pure public good, and $\alpha = 1$, a publicly-provided private good. Private consumption bundles in region j may vary by type e, but the publicly-provided good, G^j, is uniformly provided across all types within the population, and each individual contributes equally to congesting it, although tastes for g^j may differ. Each location j is characterized by i) an exogenous quality of life, Q^j, determined by local amenities; ii) productivity in the tradable sector, A_X^j; iii) productivity in the non-tradable sector, A_Y^j; iv) productivity in the public sector, A_G^j; and v) the supply of land, L^j. All three goods are produced from land, labor, and mobile capital, K^j, whose total level is fixed nationally, or determined by an international fixed price. The local public sector does not provide services to capital or firms.

Factor markets are perfectly competitive and factors are fully mobile within each region. Thus, they command the same price within region regardless of sector, including the public sector.[5] Land is immobile across regions and earns a local price r^j. Capital is fully mobile across regions and earns a gross price i^j. Every labor type e is also fully mobile across regions and earns the local wage w_e^j, which will vary to compensate workers for differences in cost-of-living, determined by p^j, quality of life, Q^j, and the local-government good, g^j. Each type also owns a portfolio of capital and land, which earn incomes I_e and R_e that do not depend on where the individual lives.

To pay for the local-government goods, local public sectors levy taxes, which for simplicity, are linear.[6] Source-based taxes on land and capital are levied at rates τ_L^j and τ_K^j. Residence-based taxes on income from wages, rents, and interest are given by τ_w^j, τ_R^j, and τ_I^j. The budget constraint of local governments requires that their expenditures equal their revenues:

$$p_G^j G^j = (\tau_L^j L^j + \tau_K^j K^j) + N^j(\tau_w^j \bar{w}^j + \tau_R^j \bar{R}^j + \tau_I^j \bar{I}^j) \tag{1}$$

[5]Results would not change significantly if another fixed factor used only in the production sector, such as natural resource reserve, is introduced.

[6]Progressive tax rates lead to similar conclusions, but complicate the notation substantially.

where $p_G^j G^j$ are expenditures on the local government good and $\bar{w}^j = (1/N^j)\sum_e N_e^j w_e^j$, $\bar{R}^j = (1/N^j)\sum_e N_e^j R_e$, and $\bar{I}^j = (1/N^j)\sum_e N_e^j I_e$. Local governments pay factors their marginal product and produce and allocate G^j efficiently at the level obeying the generalized Samuelson condition

$$(N^j)^{1-\alpha}\overline{MRS}_{Gx}^j = MRT_{Gx}^j \tag{2}$$

where $\overline{MRS}_{Gx}^j$ and MRT_{Gx}^j are the average marginal rate of substitution and marginal rate of transformation between the local-government good and the private tradable good.

The federal government levies taxes τ_w^F, τ_R^F, and τ_I^F to raise revenue. Besides making its own purchases, valued at G^F, the federal government provides transfers to individuals, F_e^j, based upon their type e and region j. By letting F_e^j take negative values, the federal government also has recourse to head taxes. Having transfers target individuals rather than local governments follows the work of Buchanan (1950) and Boadway and Flatters (1982), and allows the federal government to attain "first-best" efficient allocations, although I will consider later how results are affected when payments are made to local governments.[7] The federal government obeys the budget constraint:

$$G^F + \sum_j \sum_e N_e^j F_e^j = \sum_j \sum_e N_e^j(\tau_w^F w_e^j + \tau_R^F R_e + \tau_I^F I_e) \tag{3}$$

The average transfer to region j is denoted $\bar{F}^j = (1/N^j)\sum_e N_e^j F_e^j$.

2.2 Pareto Efficient Transfers

The set of Pareto efficient transfers is determined under the constraint that each individual type is fully mobile, and hence receives the same utility regardless of their region or residence, although each type may have a different utility level. Since mobility is a long-run phenomenon, this assumption is valid when differences in fiscal benefits are long-lasting. In this case, the optimal federal

[7] Note that considerations such as the use of matching grants or the "flypaper effect" are ignored in the treatment here, as the subject of this research is not centered on the efficient level of local-government goods, but rather the efficient distribution of the population across regions. In addition, this treatment does not consider how equalization programs affect the incentives of local governments in raising their revenues; see Smart (1998).

transfer is given by

$$F_e^{j*} = \tau_w^F(w_e^j - \bar{w}_e^F) + \left(T_e^j - \frac{p_G^j G^j}{N^j}\right) + (1-\alpha)\frac{p_G^j G^j}{N^j} + F_e \tag{4}$$

where $w_e^F = (1/N_e^{TOT})\sum_j N_e^j w_e^j$ is the average wage earned by type e across locations and T_e^j is the sum of residence-based taxes in location j by type e. Each term in the right-hand side of 4 requires explanation:[8]

1. **Federal tax differential**. This term, $\tau_w^F(w_e^j - \bar{w}_e^F)$, gives the excess federal taxes that a worker of type e in region j pays relative to the national average for type e. If, as assumed, federal benefits are uniform across areas for each type, then it is efficient for federal tax burdens to be uniform as well, or to be made uniform through a grant.

2. **Local taxes in excess of per-capita expenditures**. Substituting in the government budget constraint, this component is given by

$$T_e^j - \frac{p_G^j G^j}{N^j} = \left[\tau_w^j(w_e^j - \bar{w}^j) + \tau_R^j(R_e - \bar{R}^j) + \tau_I^j(I_e - \bar{I}^j)\right] - \frac{\tau_L^j r^j L^j + \tau_K^j i^j K^j}{N^j} \tag{5}$$

   The first term on the right gives the residence-based taxes paid by type e relative to the average local resident: individuals paying more than the average has excess taxes refunded by the federal government, insuring that local taxes operate as benefit taxes. All income redistribution across types at the local level is undone as it is more efficient to redistribute at the federal level.[9] The second term implies that per-capita revenues from source-based taxes are to be fully redistributed across regions.

3. **Public-good externality**, $(1-\alpha)p_G^j G^j/N^j$: when the local-government good is not fully rival, $\alpha < 1$, an individual moving to region j has a beneficial spillover by paying more in local taxes than the amount of the local-government good that they effectively consume.

[8] This condition characterizes efficiency assuming that there are no other distortions in the economy. Most importantly, capital tax rates τ_K^j must be equal across regions for this equation to hold exactly.

[9] This term corresponds to Buchanan (1949) original concept of the "fiscal residuum."

This externality is internalized using a Pigouvian subsidy, which is proportional to per-capita local public expenditures.[10]

4. **Location-independent transfer**: this is a lump-sum transfer that can be set arbitrarily according to the utility that type e gets in the Pareto optimum, so long as the sum of transfers satisfy the federal budget constraint. Thus, federal grants may be used to perform redistributive or need-based functions and achieve any feasible distribution of utilities.

The total amount to be transferred to region j per can be determined by averaging F_e^{j*} over types

$$\bar{F}^{j*} = \tau_w^F(\bar{w}^j - \bar{w}^{j,F}) - \frac{\tau_L^j r^j L^j + \tau_K^j i^j K^j}{N^j} + (1-\alpha)\frac{p_G^j G^j}{N^j} + \bar{F}_e^j \tag{6}$$

where $\bar{w}^{j,F} = (1/N^j)\sum_e N_e^j \bar{w}_e^F$ is the average wage level in region j that would prevail at the national wage level, and $\bar{F}_e^j = (1/N^j)\sum_e N_e^j F_e$. An important result from this aggregation is that all residence-based tax terms sum to zero. The individual federal transfers needed to turn residence-based taxes into pure benefit taxes average out to zero since each depends on the individual tax deviations from the regional average. Thus, the sum of federal transfers to a region needed to eliminate this inefficiency is zero.[11]

This result is implicit in the equations of Boadway and Flatters (1982), similar to (4), but they interpreted it to support Buchanan's view that residence-based taxes should be redistributed as (5) is decreasing in the average income level. Both low and high-income types have an incentive to go to areas with a greater proportion of high-income types, where levels of G^j are high. But that does not imply that individuals need to be paid to live in areas with low-income types, but rather that individuals pay for local government goods. Interregional transfers arise in Buchanan's model out of an implicit rule that the location-independent transfers, F_e, refund exactly the corrective transfers that type e individuals pay or receive on average. Since low-income types pay a tax, while high-income types receive a subsidy, areas with more low-income types have a higher $\bar{F}_e^j$.

[10] Buchanan and Goetz (1972)

[11] Other results of the aggregation are mostly straightforward. The other important result is that federal grants should refund excess federal taxes paid at the regional level. The location independent transfers aggregate to a regional transfer dependent on the composition of individual in location j, perhaps a function of overall need or redistributive aims.

Yet, location-independent transfers can be more or less redistributive than the rule set by Buchanan, and still be efficient.[12]

In a first-best world, the federal government would make transfers F_e^{j*} directly to individuals, who could decide for themselves through the local political progress how to set G^j. But payments made to local governments are necessarily coarser when multiple types live in each region. Aggregate regional grants of this kind cannot perform the same functions that individually targeted grants can. First, they do not correct for type-specific differences in federal tax burdens if regional wage differentials vary by type. Second, aggregate grants cannot correct for individual-specific differences in residence-based taxes. [13] Third, aggregate grants are coarse instruments for redistributing income. While transferring greater funds to local governments with needier individuals should improve the fiscal situations in those areas, there is no guarantee that local governments will pass those additional funds to achieve an equitable and efficient outcome.

If a government grant to location j is paid to residents in equally-divided lump-sum grants, then the grants do nothing to correct for differences in local residence taxes. According to Bradford and Oates (1971), it is possible that through the political process, grants will cause local governments to lower tax rates, redistributing them according to each type's local tax share. In the extreme,

[12]In Buchanan's (1950) example $j \in \{A, B\}$ and $e \in \{s, u\}$ where s is skilled and u is unskilled, all income is from labor $w_s^A = w_s^B = 10000$, $w_u^A = w_u^B = 1000$ $N_s^A, N_u^A, N_s^B, N_u^B = (2, 1, 1, 2)$, with $\tau_w^A = \tau_w^B = 0.1$. No externalities are considered. This implies efficient transfers are $(F_s^{A*}, F_u^{A*}, F_s^{B*}, F_u^{B*}) = (F_s + 300, F_u - 600, F_s + 600, F_u - 300)$ where F_s and F_u are unspecified, implying aggregate transfers to region A and region B should differ by $F_u - F_s$. In the name of equity, Buchanan imposes the rule that no transfers are made across types, meaning $\sum_j N_e^j F_e^j = 0$, and proposes the solution $(F_s^A, F_u^A, F_s^B, F_u^B) = (-100, -200, 200, 100)$, which is consistent with $(F_s, F_u) = (-400, 400)$. The redistribution from the high wage region to the low-wage regions is not needed for efficiency, i.e. correcting the "fiscal residua" that Buchanan emphasized, but only to satisfy Buchanan's rule.

The supporting statement by Boadway and Flatters (1982, pp. 629-30), translated in the notation here uses the same tax rate for for all income sources, $\tau_I^j = \tau_R^j = \tau_w^j = \tau$, with total personal income termed $PI^j = w^j + I + R$

> Suppose, for instance, that both provinces levied the same personal tax rates ($\tau^1 = \tau^{2'}$). The NFB difference due to residence-based taxes would simply be $\tau(\overline{PI}^1 - \overline{PI}^2)$ and would represent the difference in per capita public sector benefits arising solely from differences in residence-based tax bases. Notice that the NFB difference is identical over all income groups. Therefore the equalization program that is called for on efficiency grounds is one that fully equalizes per capita revenues from both source-based taxes and residence-based taxes.

The problem with this argument is that it does not look at how averaging across residents within a region will eliminate this term.

[13]This point is point brought up by Musgrave (1961) in a debate with Buchanan.

all local goods can be paid for federally, eliminating residence-based taxes altogether. This would eliminate the link between local tastes and local provision, as determined by the Samuelson rule (2), making local provision inefficient, undermining a core rationale for federalism. To the extent that funds are distributed unequally, they provide incentives for individuals to locate in higher-receiving areas, making their locations inefficient.

3 Measuring Net Fiscal Benefits in Canada

Although far from representing reality completely, the federal model is realistic enough to incorporate relevant data in order to evaluate, if imperfectly, whether an existing federal transfer system is efficient and equitable. I do this below for Canada for the year 2001. This evaluation is complicated by the fact that not all of the components of (6) are directly measurable: federal transfers, federal tax differentials, and source-based tax revenues can be estimated with considerable accuracy, but public-good externalities and equitable location-independent transfers can only be inferred. Rearranging (6) to put all of the observable components on the left-hand side

$$NFB^j = \bar{F}^j - \tau_w^F(\bar{w}^j - \bar{w}^{j,F}) + \frac{\tau_L^j r^j L^j + \tau_K^j i^j K^j}{N^j} = (1-\alpha)\frac{p_G^j G^j}{N^j} + \frac{1}{N^j}\sum_e N_e^j F_e \qquad (7)$$

where NFB^j denotes the *measurable* net fiscal benefits of locating in region j. Efficient and equitable measurable NFB^j are positively related to inferred estimates of local government expenditures and towards populations that, according to some metric, are most deserving of redistribution.

The best, most recent year to perform this exercise is 2001, since it corresponds to the last Canadian Census with available microdata, necessary for a rigorous analysis. Using these and other data, I estimate the three components on the left hand-side of (7) at the provincial level, seen in table 1, and compare them to plausible estimates of public-good externalities and measures of fiscal need, seen in table 3.[14] These estimates are presented Canadian dollars per capita and presented as deviations from the (population-weighted) national mean.

[14]Sub-provincial data on fiscal transfers are not publicly available.

3.1 Federal Transfers

Federal transfer differences arise from several sources. The most important are explicit fiscal equalization payments, which are unconditional grants calculated from a Representative Tax System model. This model estimates fiscal capacities from both source and residence bases, roughly using the formula

$$EP^j = \max\left\{0, \sum_k \tau_k \left(\bar{B}_k - B_k^j\right)\right\}$$

where k indicates a tax base, B_k^j is the quantity of the tax base in region j, $\bar{B}_k$ is the population-weighted average of the tax base, and τ_k is a federally chosen representative tax rate. This formula benefits provinces with representative tax bases that are below average, but does not penalize provinces with representative tax bases above average. Equalization payments of this kind in 2001 amounted to C$14.2B (billion).[15]

Including only explicit equalization payments underestimates the amount of actual federal redistribution as other transfers systematically target areas with lower nominal tax bases. This is important as the largest federal transfer, the Canadian Health and Social Transfer, a system of block grants worth C$34.9B, was at that time paid disproportionately to lower income provinces.[16] All other federal transfers combined amount to C$3.5B. The measure of federal transfers here is equal to the per capital federal transfers paid to a province's government and the local governments within that province. As shown in Appendix Table 1, these differences are driven largely by equalization payments.

Column 1 of table 1 reports the distribution of federal transfers across areas, averaging over 1999 to 2003 to smooth out any temporary variations. Together, residents of Ontario, Alberta, and

[15] According to the Canadian Constitution

> "Parliament and the government of Canada are committed to the principle of making equalization payments to ensure that provincial governments have sufficient revenues to provide reasonably comparable levels of public services at reasonably comparable levels of taxation." (Subsection 36(2) of the Constitution Act, 1982)

[16] In 2005, these were separated into the the Canada Health Transfer and the Canada Social Transfer. Since 2007, both programs have been adjusting their formulas to move them closer to an equal per capita basis.

British Columbia receive $379 less than average, residents of Manitoba and Saskatchewan receive $863 more, residents of the Atlantic provinces, $1511 more, and of the Territories, $15578 more. Although Quebec is technically a net receiver, its residents receive only $31 per capita more than the average.[17]

3.2 Federal Tax and Wage Differences

Differences in federal tax revenues can be estimated directly from national accounts, but this will not control for differences in labor-force characteristics. Instead, federal tax differences are estimated from inter-provincial wage differences that control for these characteristics, which are then multiplied by the average effective marginal federal tax rate on labor income, $\tau_w = 0.249$.[18]

To calculate wage differences, data on wage earners is taken from the 2.7 percent sample of Canadian Census data from the 2001 Public Use Microdata Files on Individuals. Inter-provincial wage differentials are calculated from the logarithm of hourly wages for full-time workers, ages 25 to 55. The model for wage differences across areas is $\ln w_e^{ij} = X_e\beta + \nu^j + \varepsilon^{ij}$, where ν^j are provincial indicators, X_e, are a set of characteristics with returns β, and an idiosyncratic error term ε^{ij}, with $E(\varepsilon^{ij}|X_e, \nu^j) = 0$.[19] The set of characteristics used is fairly large, fully interacted with gender, and divided into three subsets: i) education (including field of study) and experience, ii) industry and occupation, and iii) immigration, language, and ethnicity. More details are provided in Appendix B. The values of ν^j are estimates of the locational wage effects, interpreted as the causal effect of a worker's location on their wage. Since the error terms average to zero, the average provincial wage can be written as the sum of composition and locational effects, $\overline{\ln w}^j = \bar{X}^j\beta + \nu^j$, where $\bar{X}^j\beta$ is the predicted composition effect, with $\bar{X}^j = (1/N^j)\sum_e N_e^j X_e$. Identifying these

[17] After 59 years of being a "have not" province, Ontario received equalization transfers in the 2009-2010 fiscal year, although projected amounts are less than $27 per capita, which, on average, still make it a giving province.

[18] Direct taxes are measured in CANSIM matrix 354-0006 although they exclude the General Sales Tax. Using these data lead to even larger estimates of federal tax differences across provinces that are strongly correlated with the ones here. Given that predicted earnings are fairly similar across provinces it might be appropriate to use these instead if non-labor income is earned evenly across provinces. The measures used here are conservative in comparison.

[19] Note that this model implies that compensating wage differentials across regions are multiplicatively uniform across types. Thus, two individuals who have the same predicted income in one region also have the same predicted income in another.

differentials requires that workers do not sort across cities according to unobserved characteristics that affect wages.

Table 2 reports the differences in average log wages across provinces, decomposing the differences into location and composition effects, with the latter subdivided into the three categories mentioned above. The location effects vary significantly across areas. The Territories offer a 13 percent wage premium above the national average, while Ontario and British Columbia offer a 6 percent premium, and Alberta and Quebec offer wages just below the national average. The remaining six provinces discount wage levels by over 10 percent.

Despite the large set of controls, composition effects are small relative to the location effects, meaning workers are not sorting strongly across provinces according to their overall observable skill levels. This suggests that differences in unobserved skills, which would bias estimates of the location effects, are likely to be small as well. [20] Residents of Ontario and British Columbia are somewhat better educated, but are also more likely to be immigrants and minorities, and therefore paid less than comparable natives. The opposite situation is true of residents of the Atlantic and Prairie provinces. Predicted wages in Saskatchewan, Manitoba, and PEI are low mainly because of worker industry and occupation.

It is not clear that these variables should be controlled for when estimating locational effects since these industry and occupation are not pre-market characteristics. They should be controlled for in so far as they reflect unobserved skills and compensating wage differentials due to employment, rather than locational characteristics. They should not be controlled for in so far as workers change jobs or industry when they move across provinces.

Interestingly, a regression of composition differences on raw wage differences across provinces yields an insignificant coefficient of 0.01 (s.e.= 0.05), suggesting that wage differences across provinces are driven entirely by location effects rather than composition effects. If industry and occupation are excluded from the composition effects, then the relationship becomes slightly negative with a coefficient of -0.11 (s.e. = 0.03), as workers in lower-paying provinces have higher

[20] This does not preclude sorting within provinces, such as between cities or within metropolitan areas.

observed pre-market skills. These relationships are graphed in Figures 1A and 1B, where the location effect of a province is shown by the distance of its marker from the diagonal line.

Column 2 of table 1 reports the estimated federal tax deficit, i.e. the negative of the federal tax differential, which reports how much less a resident of a province pays in federal taxes relative to the average. As shown in table 2A, the relationship with federal transfers is strongly positive and remarkably linear: every extra dollar in federal transfers received is associated with a 47 cent decrease in federal taxes.[21]

3.3 Source-Based Tax Revenues

Source-based tax revenues are gleaned from four categories of provincial revenues. First, provincial corporate income taxes, worth $14.3B in 2001, are taken to be taxes on capital. Ontario receives 54 percent of these revenues, but has only 38 percent of the population. Second and third are "mining and logging taxes" and "natural resource taxes and licenses," worth $1.1B together, which are from land-based natural resources. Most of the natural-resource revenues fall under the category of "investment income," worth $28.0B. Alberta receives 44 percent of these revenues, but has only 10 percent of the population.

Differentials averaged over 1999 to 2003 are reported in column 3 of table 1. Alberta offers the most in source-based revenues: $2088 more per head than the national average. Saskatchewan offers revenues of $722 per head over the average, and British Columbia and Manitoba also exceed the average. All of the other provinces offer considerably less than the average including Ontario, despite its disproportionate corporate income tax revenues. As seen in Figure 2B, federal transfers are negatively related to source-based revenues, but not nearly enough to offset set them. Dropping Alberta from the sample would cause the relationship to be slightly positive.

When federal transfers are compared to source-based revenues and federal tax deficits added together, the relationship becomes positive, as seen in Figure 2C, implying that federal transfers typically enlarge fiscal benefit differences from source-based revenues and federal taxes.

[21] Given their unusual circumstances, the Territories are excluded from the regression analyses.

4 Explaining Differences in Measurable Net Fiscal Benefits

Differences in measurable net fiscal benefits, reported in table 1, clearly benefit the Atlantic and Prairie provinces and the Territories at the expense of British Columbia, Quebec, and especially Ontario, provinces offering higher wages. The regressions reported in row A of table 4 implies that moving to a province with a wage level one dollar higher is associated with a 43-cent drop in federal transfers and 76-cent drop in net fiscal benefits. Thus, net fiscal benefits severely dull the incentive for labor to move to areas offering a higher return. This apparent distortion may be justified if fiscal benefit differences redistribute resources more equitably or correct for externalities.

4.1 Equity

4.1.1 Earnings Potential

It would seem that equity-motivated transfers would go disproportionately to provinces whose population characteristics predicted low earnings potential at the national wage level. In rows B and C of table 3, two measures of predicted income are calculated, one using all observed characteristics in the wage equation from table 2, and the second excluding industry and occupation.[22]

The variation in predicted incomes is quite small across provinces, making it difficult to assess whether net fiscal benefits are helping to offset inter-provincial inequities. As seen in columns 2 and 3 of table 4 there are no significant relationships between the average predicted income of provincial residents and either federal transfers or net fiscal benefits; when industry and occupation are excluded, the relationships are positive, suggesting that federal transfers are regressive.[23] Even if the relationships went the other way, the differences in predicted earnings are too small to justify the larger differences in fiscal benefits.

[22] Sample selection problems are dealt with by using the predicted earnings of the entire population ages 25 to 55 rather than just those in the wage sample.

[23] The differences between these two measures is driven largely by Saskatchewan, which has low paying industries and occupations. Excluding industry and occupation is justified if this lower pay is due to the compensating wage differentials of jobs, i.e. if lower-paying jobs are more pleasant or come with better non-wage benefits. Exclusion is not justified if industry and occupation variables are due to unmeasured pre-market skills or economic rents that accrue to certain industries or professions.

The results in row D look at the relationship with predicted income according to language, immigration, and ethnicity, and here the relationship is also positive. This implies that federal transfers and other fiscal benefits are directed towards provinces with more English-speaking native whites, away from provinces with a larger fraction of low-earning minorities.[24]

4.1.2 Wage and Cost-of-Living Differences

In the theoretical model, it is assumed that individuals are perfectly mobile and that inter-regional wage variation provides compensation for cost-of-living or amenities. If labor markets are not fully integrated in this sense, then an area may have low real wages because it has an oversupply of labor, unrelieved by emigration because of moving costs or other considerations. In this case, federal transfers or other benefits may help improve the welfare of residents in low-wage provinces in the short-run, albeit distorting long-run incentives for them to go elsewhere in order to eliminate factor imbalances. It is then useful to measure real incomes, deflated by local cost-of-living, to assess the welfare of local residents.

Measures of local cost-of-living can be calculated using local housing cost data, as in Albouy and Leibovici (2009), which can be enriched using limited data on non-housing prices using an 11-city Consumer Price Index from STATCAN. This latter data set only has price information on the largest city in each province (plus Ottawa) and may be inaccurate. Real-income differences using two different cost-of-living measures – with and without CPI data – are reported in columns 5a and 5b of table 3. Regressions on these measures, in rows E and F of table 4, reveal that federal transfers or net fiscal benefits are awarded disproportionately to provinces with *higher* real incomes, although the relationship is only significant with the cost-of-living measure based on housing alone.

Interestingly, real income levels are negatively related to provincial growth rates, countering the view that migration will equilibrate real-wage differences across areas, a view that requires

[24]One caveat to this observation is that transfers are directed disproportionately to provinces with a disproportionate share of aboriginals, such as Saskatchewan and Newfoundland.

provinces to offer the same quality of life.[25] This suggests that migration to Ontario and British Columbia is due to individuals pursuing amenities, possibly climactic or cultural, rather than higher real wages. Yet according to row G, a 1-percent increase in the provincial growth rate is associated with a $70 decrease in federal transfers. This suggests that fiscal incentives inefficiently over-populate the Atlantic and Prairie provinces, which would otherwise see greater emigration.

4.2 Local Public-Good Externalities

The last term in equation (6) represents the externality that an additional migrant to region j has on existing residents through the spillover effects of their spending on local government goods. Efficient federal transfers are supposed to subsidize location in provinces where this externality is strongest. When local-government goods are provided efficiently, this externality is proportional to the local expenditures per capita, and the congestion parameter α. Most empirical estimates of α at the local level are close to one (e.g. Bergstrom and Goodman 1973), implying that most local government goods are much like private goods, and so this term can be ignored. On the other hand, Oates (1988) argues that estimates of α may be systematically biased towards one, and thus these spillover effects may be important.

Combined provincial and local expenditures per capita are reported in column 5a in table 3. As reported in row H of table 4, there is no significant positive relationship between this measure and federal transfers or net fiscal benefits, undercutting the explanation that federal transfers help to subsidize this positive externality. Yet, it is not guaranteed that actual expenditures approximate optimal expenditures. Net fiscal benefits themselves may cause local spending in receiving areas to be too high. These benefits are corrected for in the externality measure reported in column 5b of table 3, which estimates the local-public good externality by netting out the net fiscal benefit from the expenditure measure in 5a – using a coefficient of 0.36 to reflect the share of income spent on provincial and subprovincial government goods – and multiplying the remainder by 0.25 for a

[25] The correlation between the 1991 to 2001 provincial growth rates and the first and second real income measures are -0.81 and -0.31, respectively.

plausible case of $\alpha = 0.75$. The relationship between this measure and net fiscal benefits, shown in row I of table 4, is negative, suggesting that federal fiscal policy may in fact induce individuals to move to areas where their local-public good externality is lower than average, making federal transfer policy even more inefficient.

4.3 Other Efficiency Considerations

Another rationale for federal transfers is that they may help to stabilize local revenue differences over time: local governments provide a form of mutual insurance through these payments, helping to smooth their expenditures, and reducing inefficiencies in consumption and possibly mobility. However, as shown in Figure 3, differences in net fiscal benefits are persistent over time, with some provinces consistently receiving higher benefits than others.[26] In addition, Boadway and Hayashi (2004) find that variation in transfer payments over time appears to have the opposite effect of making provincial revenues less stable over time.

This theoretical analysis in section 2 ignores additional externalities from agglomeration, congestion, and the like. For these to enter the equation, one would have to quantify their relative effects across provinces. For example, some may argue that Toronto is too crowded and hence Ontarians are happy to pay other Canadians to stay out of their cities.[27] The view that Toronto is too crowded seems at odds with the results of Albouy and Leibovici (2009) that Toronto offers one of the best qualities of life in Canada, with other large cities, such as Vancouver, Calgary, Ottawa, and Montreal also occupying top places, making it hard to imagine that the externalities could be so large. Furthermore, as shown in Albouy and Seegert (2009), while residents of a city may wish to pay potential migrants to stay out of their city and live in areas with less desirable characteristics, such a policy may be far from efficient federally. Furthermore, there are many areas in Ontario that remain largely unoccupied and could absorb additional population. At this point, there is no clear

[26] Accoridng to figures in Courchene and Beavis (1973), these differences have persisted since at least the 1960s.

[27] Wildasin (1986) models these congestion effects, although they appear very difficult to measure. The theoretical work of Myers (1990) argues that under perfect mobility, some provinces could be willing to make optimal transfers to keep others out, although Myers makes no specific claims about Canada.

evidence of migration externalities strong enough to merit such large fiscal benefit differences.

5 Simulated Effects of Inefficient Federal Transfers

As differences in measurable net fiscal benefits across provinces are long lasting, and do not appear to improve inter-provincial equity or to correct for externalities, it is appropriate to treat them as a locational tax-subsidy system that inefficiently raises the demand to live in fiscally advantaged provinces and lowers the demand to live in fiscally disadvantaged ones. As a result, fiscally advantaged provinces are not only overpopulated relative to their efficient levels, but also have inflated land and housing costs, and – assuming regional diminishing marginal products of labor – depressed wage levels.[28] In the plausible case where $\alpha = 1$ and workers and firms are perfectly mobile, the long-run effects of these fiscal distortions on employment and prices can be estimated using the theoretical model with the methods presented fully in Albouy (2009).

The effect of fiscal distortions on land rents, wage levels, and housing costs in percentage terms relative to their efficient levels are given by the following approximations:

$$\frac{dr^j}{r^j} = \frac{1}{s_R}\frac{dNFB^j}{\bar{m}} \tag{8a}$$

$$\frac{dw^j}{w^j} = -\frac{1}{s_w}\frac{\lambda_L}{\lambda_N}\frac{dNFB^j}{\bar{m}} \tag{8b}$$

$$\frac{dp^j}{p^j} = \frac{1}{s_y}\frac{\lambda_N - \lambda_L}{\lambda_N}\frac{dNFB^j}{\bar{m}} \tag{8c}$$

where s_R and s_w are average shares of income received from land and labor, s_y is the share of expenditures on housing, λ_N and λ_L are the shares of labor and urban land used to produce tradable private goods, and $dNFB^j/\bar{m}$ is the differential net benefit in province j, divided by average income.[29]

Long-run employment effects are estimated with a reduced form elasticity, ε, which gives the percent increase in local employment that arises from a permanent increase in net fiscal benefits

[28] This requires that agglomeration effects on productivity are fairly weak.

[29] The calibrated estimates of these parameters are $s_w = 0.10$, $s_w = 0.70$, $s_y = 0.33$, $\lambda_L = 0.17$, and $\lambda_N = 0.70$.

equal to one percent of average income, so that by definition

$$\frac{dN^j}{N^j} = \varepsilon \frac{dNFB^j}{\bar{m}}$$

Estimates of this elasticity based on Canadian data are somewhat controversial, although the long-run effects are most plausibly given by Wilson (2003), who extends the short-run estimates of Watson (1986) and Winer and Gauthier (1983). His estimates imply an average elasticity of $\varepsilon = 3.23$.[30]

The deadweight loss from locational inefficiencies created by fiscal imbalances is approximated by the formula

$$DWL = \varepsilon \cdot var\left(\frac{dNFB^j}{m}\right)$$

which is measured as a fraction of total income. In the spirit of Harberger (1964), this formula captures not only the deadweight loss of individuals locating in the wrong provinces, but also the accompanying distortions in other factor markets, such as mobile capital.

The predicted effects of net fiscal benefits on the long-run prices and employment of Canadian provinces are reported in columns 5 through 8 of Table 5, which ranks provinces according to the net fiscal benefits they offer to residents. Taken together, the Atlantic and Prairie provinces have populations 31 percent, and housing-costs 21 percent, beyond their efficient levels, while their wage levels are slightly depressed. The effects on the Atlantic provinces and Manitoba are due mainly to federal-transfer and tax policy, while the effects in Alberta and Saskatchewan have more to do with uncorrected advantages in source-based revenues. The effects for Quebec and British Columbia are small. This means that average effects would not change considerably if Quebec residents are assumed to be less mobile because they are predominantly French-speaking. Ontario, which pays much more in federal taxes than it receives, and is poor in source-based revenues, is

[30]This is obtained by regressing proportional population flows between provinces, *deltm*, on changes in net fiscal benefits between provinces, *delt77*, normalized as a fraction of income. The estimate of -3.23 using provinces is almost half the size of $\varepsilon = -6$ that Bartik (1991) finds using metropolitan areas. Given that mobility responses across provinces should be smaller than across metropolitan areas, the difference between these estimates seems plausible and mutually consistent.

Note that the symmetric treatment of federal transfers and taxes may not be fully warranted.

the most adversely impacted, with housing-cost and employment levels 10 and 14 percent below their efficient levels.

The average effects of net fiscal benefits on prices, employment, and the deadweight burden are reported in Table 6, which considers effect of each component alone, as well as together. The overall cost of the locational inefficiencies created by differences in net fiscal benefits across provinces is 0.41 percent of income per year. Source-based revenues alone account for a 0.21 percent income loss, and when combined with federal taxes, a 0.26 percent loss. What is most striking is that federal transfers increase the cost of locational inefficiencies by an additional 0.15 percent of income, or C$1.6B per year, more than 10 percent of the value of the fiscal equalization system.

6 Conclusion

The results of this analysis of federal transfer policies goes against the presumption – seen in Watson (1986) and Wilson (2003) among others – that federal transfers in the name of fiscal equalization help to mitigate problems of inefficiency and inequity across provinces. In fact, federal transfers appear to be efficiency reducing and may make the distribution of federal funds slightly less equitable, at least according to certain defensible criteria. This evaluation should be taken seriously not only by economists and policy makers in Canada, but also in other countries where equalization systems may exhibit similar features and be subjected to similar evaluations. At a more basic level, this analysis suggests three conclusions about the characteristics of equalization programs that maximize economic efficiency: (i) they distinguish residence-based fiscal capacities from source-based capacities; (ii) they separate income differences due to the location of workers from those due to the composition of the labor force; and (iii) they recognize the importance of providing higher grant levels to regions that pay higher federal taxes as a mechanism for reducing inefficient migration.

Since income differences across Canadian provinces appear to result from cost-of-living and

amenity differences, rather than skill differences in the workforce, there is no obvious manner in which federal transfers can be targeted in an equitable fashion. However, transfer policy could be more efficient by redistributing source-based revenues more intensely and refunding interregional federal tax differences. Such reform would likely meet considerable political composition: Evans (2005) finds that per-capita representation in the House of Commons is 50 percent higher for receiving provinces than for giving ones, and finds the relationship between federal transfers and representation exists across time as well as space. Ultimately, the existing system of fiscal equalization in Canada may have more of a political basis than an economic one.

References

Albouy, David. 2009. "The Unequal Geographic Burden of Federal Taxation." *Journal of Political Economy* 117 (August): 635-667

Albouy, David and Fernando Leibovici. 2009. "Quality of Life, Firm Productivity, and the Value of Amenities across Canadian Cities." mimeo, University of Michigan.

Albouy, David and Nathan Seegert. 2009. "Optimal Population Distribution and the Private-Social Wedge." mimeo, University of Michigan.

Boadway, Robin and Frank Flatters. 1982. "Efficiency and Equalization Payments in a Federal System of Government: A Synthesis and Extension of Recent Results." *The Canadian Journal of Economics* 15 (Nov.): 613-633.

Bergstrom, T.C. and R.P. Goodman 1973. "Private Demands for Public Goods." *American Economic Review* 63: 280-296.

Bradford, David and Wallace Oates. 1971. "The Analysis of Revenue Sharing in a New Approach to Collective Fiscal Decisions." *Quarterly Journal of Economics*, 85 (Aug.): 416–439.

Bradford, David and Wallace Oates. 1971b. "Towards a Predictive Theory of Intergovernmental Grants." *American Economic Review*, 61 (May): 440-448

Buchanan, James. 1949. "The Pure Theory of Government Finance: A Suggested Approach." *Journal of Political Economy* 57: 496-505.

Buchanan, James. 1950. "Federalism and Fiscal Equity." *American Economic Review* 40 (Sep.): 583-99.

Buchanan, James. 1951. "Fiscal Equity in the Unequal Treatment of Unequals: A Rejoinder." *Journal of Political Economy* 59 (Aug.): 358-359

Buchanan, James. 1952. "Federal Grants and Resource Allocation." *Journal of Political Economy* 60 (Jun.): 208-217.

Buchanan, James and Charles J. Goetz. 1972. "Efficiency Limits of Fiscal Mobility: An Assessment of the Tiebout Model." *Journal of Public Economics* 1: 25-43.

Buchanan, James and Richard E. Wagner. 1970. "An Efficiency Basis for Federal Fiscal Equalization." in J. Margolis, ed. *The Analysis of Public Output* (Columbia University Press: New York).

Courchene, Thomas J. 1981. "A Market Perspective on Regional Disparities." *Canadian Public Policy* 7: 506-518.

Courchene, Thomas J. and David A. Beavis. 1973. "Federal-Provincial Tax Equalization: An Evaluation." *Canadian Journal of Economics* 6 (Nov.) 483-502.

Evans, Tom A. 2005. "The Impact of Representation Per Capita on the Distribution of Federal Spending and Income Taxes." *Canadian Journal of Political Science*.

Feldstein, Martin 1970. "Comment on An Efficiency Basis for Federal Fiscal Equalization." in J. Margolis, ed. *The Analysis of Public Output* (Columbia University Press: New York).

Flatters, Frank; Vernon Henderson; Peter Mieszkowski. 1974. "Public Goods, Efficiency, and Regional Fiscal Equalization." *Journal of Public Economics* 3: 99-112.

Inman, Robert P. and Daniel L. Rubinfeld. 1997. "Rethinking Federalism." *Journal of Economic Perspectives* 11 (Autumn): 43-64.

Jenkins, H.P. 1951 "Fiscal Equity in the Unequal Treatment of Unequals: A Suggested Test." *Journal of Political Economy* 59 (Aug.): 353-357

Peter Mieszkowski and Eric Toder. 1983. "Taxation of Energy Resources" in C. McLure and P. Mieszkowski, eds. *Fiscal Federalism and the Taxation of Natural Resources*, (Lexington Books).

Musgrave, Richard A. 1961. "Approaches to a Fiscal Theory of Political Federalism." in *Public Finances: Needs, Sources, and Utilization.* (National Bureau of Economic Research: New York)

Musgrave, Richard A. 1997. "Devolution, Grants, and Fiscal Competition." *Journal of Economic Perspectives* 11 (Fall): 65-72.

Myers, Gordon M. 1990. "Optimality, Free Mobility, and the Regional Authority in a Federation." *Journal of Public Economics* 43: 107-121.

Oakland, William H. 1994. "Fiscal Equalization: An Empty Box?" *National Tax Journal* 47 (March): 199-209.

Oates, Wallace 1988. "On the Measurement of Congestion in the Provision of Local Public Goods." *Journal of Urban Economics*, 24: 85-94.

Poschmann, Finn. 1998. "Where the Money Goes: The Distribution of Taxes and Benefits in Canada." C.D. Howe Institute.

Roback, Jennifer. 1982. "Wages, Rents, and the Quality of Life." *Journal of Political Economy* 90 (December): 1257-1278.

Rosen, Sherwin. 1979. "Wages-based Indexes of Urban Quality of Life." in P. Mieszkowski and M. Straszheim, eds. *Current Issues in Urban Economics*, Baltimore: John Hopkins Univ. Press.

Scott, A.D. 1950. "A Note on Grants in Federal Countries." *Economica* 17 (Nov.): 416-422.

Scott, A.D. 1952. "Federal Grants and Resource Allocation." *Journal of Political Economy* 60 (Dec.): 534-536.

Shaw, Paul R. 1986. "Fiscal versus Traditional Market Variables in Canadian Migration." *Journal of Political Economy* 94 (June): 648-666.

Smart, Michael. 1998. "Taxation and Deadweight Loss in a System of Intergovernmental Transfers." *Canadian Journal of Economics* 31 (Feb.). 189-206.

Stiglitz, Joseph E. 1977. "The Theory of Local Public Goods." in M. Feldstein and R. Inman, eds. "*Economics of Public Services* (Toronto: Macmillan).

Tiebout, Charles M. 1956. "A Pure Theory of Local Expenditures." *Journal of Political Economy* 64 (May): 416-424.

Weingast, Barry R., Kenneth A. Shepsle, and Christopher Johnsen. 1981. "The Political Economy of Benefits and Costs: A Neoclassical Approach to Distributive Politics." *Journal of Political Economy* 89 (August): 642-664.

Watson, William G. 1986. "An Estimate of the Welfare Gain from Fiscal Equalization" *The Canadian Journal of Economics* 19 (May): 298-308.

Wildasin, David E. 1980. "Locational Efficiency in a Federal System." *Regional Science and Urban Economics* 10 (November): 453-471.

Wildasin, David E. 1986. *Urban Public Finance.* Chur, Switzerland: Harwood Academic Publishers.

Wilson, L.S. 2003. "Equalization, Efficiency and Migration: Watson Revisited." *Canadian Public Policy* 29: 385-396.

Winer, Stanley L.; Denis Gauthier.1983. *Internal Migration and Fiscal Structure.* Ottawa: Economic Council Canada.

TABLE 1: MEASURABLE NET FISCAL BENEFITS OF RESIDING IN CANADIAN PROVINCES, RELATIVE TO THE NATIONAL AVERAGE: 2001

		Measurable Locational Benefits			
Province	Population	Federal Transfer Differential (1)	Federal Tax Deficit due to Wage Level (2)	Source-Based Revenue Differential (3)	Net Fiscal Benefit (1)+(2)+(3)
Newfoundland	522033	2125	606	-487	2243
PEI	136663	1858	808	-637	2029
Nova Scotia	932454	1174	682	-536	1321
New Brunswick	749801	1442	694	-65	2070
Quebec	7396331	31	139	-390	-221
Ontario	11896663	-417	-250	-415	-1082
Manitoba	1151439	1121	459	220	1800
Saskatchewan	1000221	566	581	722	1869
Alberta	3058017	-345	70	2088	1812
BC	4076264	-294	-220	346	-168
Territories	99134	15578	-564	-785	14229

Measured in 2001 Canadian Dollars. Population from CANSIM Table 54-0001. Total federal transfers from CANSIM 384-0011. Federal tax differential based on a marginal tax rate of 24.9 percent and log wage differences from table 2 using an earnings base of $16980. Source-based revenues the sum of corporate income taxes, mining and logging taxes, natural resources taxes and licences, and investment income from CANSIM 385-0002. Federal transfer and source-based revenue differentials averaged over 1998 to 2003. See text for further detail.

TABLE 2: WAGE DIFFERENCES ACROSS PROVINCES: COMPOSITION AND LOCATION EFFECTS, 2001

Province	Total: Location + Composition (1)	Location Effects (2)	Composition (Predicted) Effects (3)	Subcategories of Composition (Predicted) Effects: Education & Experience (4)	Industry & Occupation (5)	Immigration, Language & Ethnicity (6)
Newfoundland	-0.149 (0.010)	-0.152 (0.010)	0.003 (0.004)	-0.030 (0.003)	-0.009 (0.004)	0.042 (0.003)
PEI	-0.202 (0.016)	-0.209 (0.039)	0.008 (0.003)	-0.017 (0.003)	-0.021 (0.002)	0.045 (0.003)
Nova Scotia	-0.143 (0.007)	-0.173 (0.019)	0.030 (0.003)	-0.002 (0.003)	-0.006 (0.003)	0.038 (0.003)
New Brunswick	-0.163 (0.007)	-0.177 (0.020)	0.013 (0.003)	-0.020 (0.003)	-0.010 (0.003)	0.043 (0.003)
Quebec	-0.028 (0.004)	-0.031 (0.014)	0.003 (0.005)	-0.009 (0.003)	-0.002 (0.003)	0.014 (0.004)
Ontario	0.063 (0.003)	0.060 (0.013)	0.003 (0.003)	0.009 (0.003)	0.009 (0.003)	-0.015 (0.003)
Manitoba	-0.132 (0.006)	-0.112 (0.018)	-0.019 (0.003)	-0.013 (0.003)	-0.015 (0.003)	0.008 (0.003)
Saskatchewan	-0.180 (0.007)	-0.145 (0.021)	-0.035 (0.003)	-0.015 (0.003)	-0.044 (0.003)	0.024 (0.003)
Alberta	-0.005 (0.004)	-0.014 (0.015)	0.009 (0.003)	-0.002 (0.003)	0.003 (0.003)	0.008 (0.003)
BC	0.033 (0.004)	0.053 (0.014)	-0.019 (0.003)	0.008 (0.003)	-0.009 (0.003)	-0.019 (0.003)
Territories	0.141 (0.020)	0.127 (0.042)	0.014 (0.004)	-0.022 (0.003)	0.054 (0.002)	-0.018 (0.005)

Robust standard errors in parentheses. Wage data are taken from the Census 2001 PUMFI. Wage estimates are based on the average logarithm of hourly wages for full-time workers ages 25 to 55. Education: highest grade, years of univeristy, other years, 9 indicators of highest degree, and 12 field of study indicators. Experience: quartic in potential experience and experience interacted with years of schooling. Industry: 13 indicators; occupation: 25 indicators. Immigration, time since immigration, citizenship status, visible minority indicators interacted immigration status, mother tongue interacted with official languages spoken. Composition effects based on all individual ages 25 to 55, regardless of employment. Further detail provided in the Data Appendix.

TABLE 3: RELATIVE NET FISCAL BENEFITS AND POSSIBLE EQUITY AND EFFICIENCY JUSTIFICATIONS: 2001

		Possible Justifications					
		Equity 1: Predicted Income from Composition Effects		Equity 2: Real Income Level Adjusted for Cost of Living		Public-Good Externality: Local & Prov Expenditures	
Province	Measurable Net Fiscal Benefit (1)+(2)+(3)	All Chars. (4a)	Excluding Ind & Occ (4b)	Housing Cost Base (5a)	Incl. Urban CPI (5b)	Raw Expenditures (6a)	Estimated Externality (6b)
Newfoundland	2243	70	265	1344	-386	652	-42
PEI	2029	178	655	-679	-1293	-272	-253
Nova Scotia	1321	705	846	-372	-1318	-1108	-397
New Brunswick	2070	306	530	75	-427	-1119	-469
Quebec	-221	77	114	675	816	748	207
Ontario	-1082	75	-146	-233	-257	-395	0
Manitoba	1800	-440	-111	378	480	221	-109
Saskatchewan	1869	-780	223	428	171	293	-97
Alberta	1812	210	142	30	746	-53	-179
BC	-168	-441	-237	-944	-995	171	58
Territories	14229	325	-903	3550		-3517	-2178

Measured in 2001 Canadian Dollars. Predicted income based off of predicted wages using an income base of $22982. Local and provincial expenditures based off of provincial and local government expenditures in CANSIM 385-0002 and 385-0003 averaging from 1999 to 2003. Estimated externality corrects for net fiscal benefit differences and uses a congestion parameter (alpha) of 0.75. See text for further detail.

TABLE 4: RELATIONSHIP BETWEEN FEDERAL GRANTS AND NET FISCAL BENEFITS WITH POSSIBLE EQUITY AND LOCAL PUBLIC-GOOD EXTERNALITY MEASURES, 2001

(Each entry corresponds to a separte univariate regression)

Speci	Independent Variable	Dependent Variable: Federal Transfer (1)	Dependent Variable: Meas. Net Fiscal Benefit (2)
A.	Local Wage Level (Location Effect Adjusted for Obs. Characteristics)	-0.43 (0.06) Adj. R^2 = 0.79	-0.76 (0.13) Adj. R^2 = 0.61
B.	Predicted Income All Characteristics	0.07 (0.60) Adj. R^2 = -0.12	-0.22 (1.18) Adj. R^2 = -0.12
C.	Predicted Income: Excluding Ind & Occ	1.69 (0.37) Adj. R2= 0.40	3.09 (1.18) Adj. R^2 = 0.33
D.	Predicted Income: Language, Immigration & Ethnicity Only	1.48 (0.29) Adj. R2= 0.61	2.62 (0.80) Adj. R2= 0.46
E.	Real Income Level (Housing Cost Only)	0.45 (0.24) Adj. R^2 = 0.08	0.58 (0.54) Adj. R^2 = -0.04
F.	Real Income Level (Housing + Urban CPI)	-0.01 (0.20) Adj. R^2 = -0.12	0.36 (0.50) Adj. R^2 = -0.07
G.	Percent Provincial Pop. Growth, 1991-2001	-70.25 (20.12) Adj. R^2 = 0.59	-64.61 (54.57) Adj. R^2 = 0.06
H.	Local and Provincial Govt Spending per Capita	0.08 (0.34) Adj. R^2 = -0.12	0.24 (0.74) Adj. R^2 = -0.11
I.	Estimate of Local Public Good Externality	-1.39 (1.09) Adj. R^2 = 0.04	-4.02 (1.69) Adj. R^2 = 0.23

Robust standard errors in parentheses. Regressions using 10 provinces and 1 combined territory, weighted by population. Territories excluded. "Adj. R^2" refers to the adjusted R-squared.

TABLE 5: NET FISCAL BENEFITS ACROSS PROVINCES AND THEIR EFFECTS ON PRICES AND EMPLOYMENT, 2001

Bene-fit Rank	Province	Wage (Location Effect) (1)	Hous. Cost (2)	Inferred Land Rent (3)	Net Fiscal Benefit (4)	*Predicted Long-Run Effects of Net Fiscal Benefits*			
						Wage (5)	Hous. Cost (6)	Land Rent (7)	Employ-ment (8)
1	Newfoundland	-0.15	-0.68	-2.39	0.10	-0.03	0.24	1.01	0.33
2	New Brunswick	-0.16	-0.41	-1.29	0.09	-0.03	0.22	0.93	0.30
3	PEI	-0.22	-0.41	-1.13	0.09	-0.03	0.21	0.91	0.29
4	Saskatchewan	-0.21	-0.63	-2.06	0.08	-0.03	0.19	0.84	0.27
5	Alberta	-0.07	-0.22	-0.72	0.08	-0.03	0.19	0.81	0.26
6	Manitoba	-0.19	-0.52	-1.66	0.08	-0.03	0.19	0.80	0.26
7	Nova Scotia	-0.11	-0.16	-0.39	0.06	-0.02	0.14	0.58	0.19
8	BC	0.06	0.36	1.30	-0.01	0.00	-0.02	-0.09	-0.03
9	Quebec	-0.06	-0.23	-0.80	-0.01	0.00	-0.03	-0.11	-0.04
10	Ontario	0.05	0.07	0.15	-0.05	0.02	-0.11	-0.47	-0.15

All quantities expressed in log terms except for net fiscal benefits, measured as a fraction of average income. Housing-cost and gross real income measures explained in the Appendix. Wage, housing-cost, land-rent, and employment effects based off of model in Albouy (2009) using Canadian parameters in Albouy and Leibovici (2009) and using an elasticity of employment with respect to transfers of 3.23 based on Wilson (2003).

TABLE 6: ESTIMATED PRICE, EMPLOYMENT, AND WELFARE EFFECTS OF NET FISCAL BENEFITS, OR ITS COMPONENTS, ACROSS ALL PROVINCES, 2001

	Federal Transfers Only (1)	Federal Taxes Only (2)	Source-Based Taxes Only (3)	Federal Transfers & Fed Taxes (4)	Fed Tran & Source-Based Taxes (5)	Fed Taxes & Source-Based Taxes (6)	Total Net Fiscal Benefit (7)
Average Percent Effects (Mean Absolute Values)							
Net fiscal benefit differential: E|dτ/m|	0.018	0.011	0.027	0.028	0.034	0.030	0.042
Wage effect: E|dw|	0.006	0.003	0.009	0.009	0.011	0.010	0.013
Home-good price effect: E|dp|	0.041	0.025	0.063	0.065	0.079	0.069	0.097
Land rent effect: E|dr|	0.176	0.108	0.270	0.281	0.340	0.295	0.418
Employment effect: E|dN|	0.057	0.035	0.087	0.091	0.110	0.095	0.135
Deadweight Loss from Locational Inefficiency							
As a percent of income, E(DWL/Nm)	0.105%	0.027%	0.212%	0.233%	0.271%	0.257%	0.413%
Total DWL (Billions per year, 2001$)	1.1	0.3	2.2	2.4	2.8	2.7	4.3
Per Capita (per year, 2001$)	36.7	9.5	74.0	81.5	94.7	89.7	144.4

Territories excluded. Net fiscal benefit differential measured as a fraction of average income. Other price changes in terms of log changes. Price effects based on calibrated model similar to Albouy (2009) Employment elasticity with respect to net fiscal benefit based on Wilson (2003). See text for formulas and other details.

Figure 1a: Differentials Predicted by Characteristics

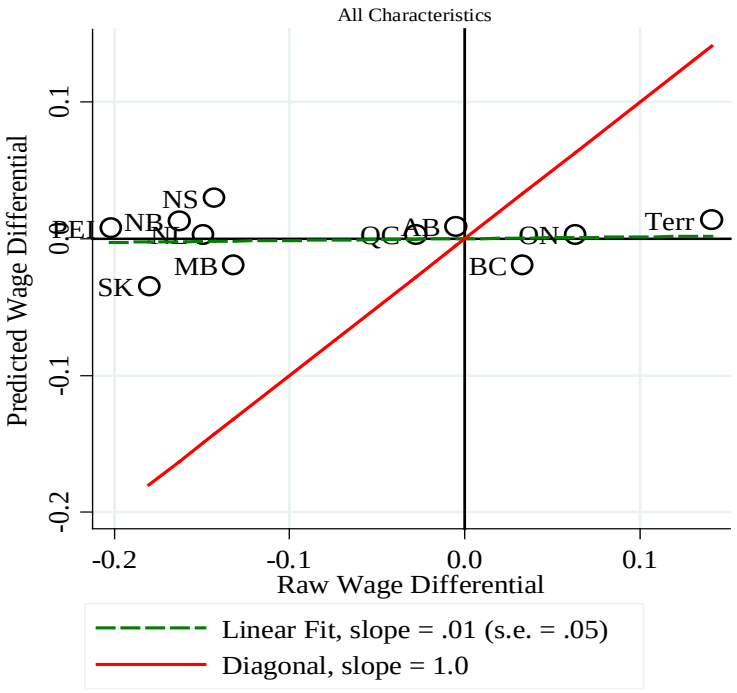


Figure 1b: Differentials Predicted by Characteristics

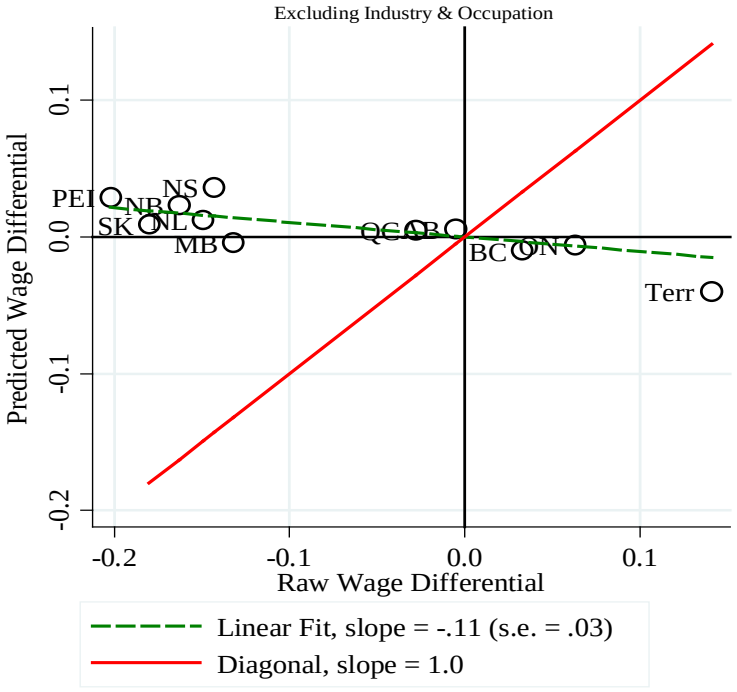


Figure 2: Interaction of Federal Transfers, Federal Taxes, and Source-Based Revenues across Provinces, 2001

Figure 2A: Federal Tax Differential Deficit

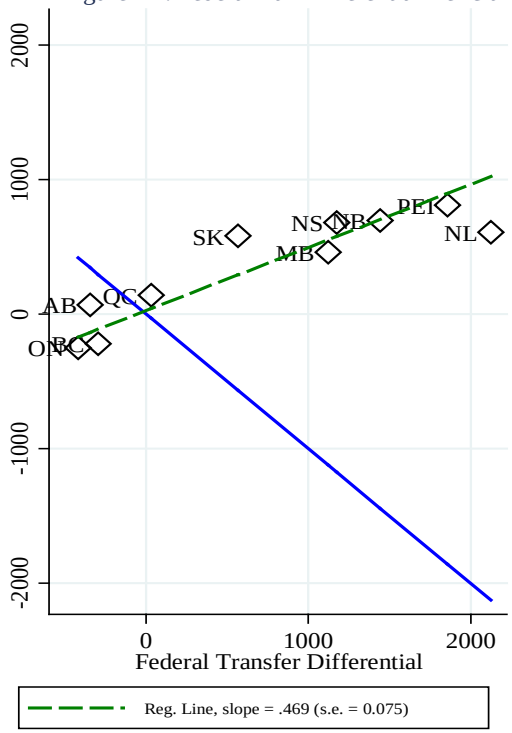


Figure 2B: Source-Based Tax Revenue

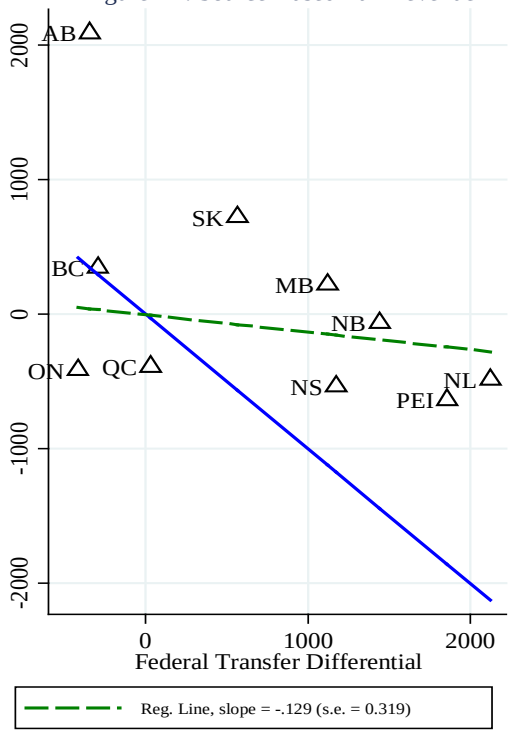
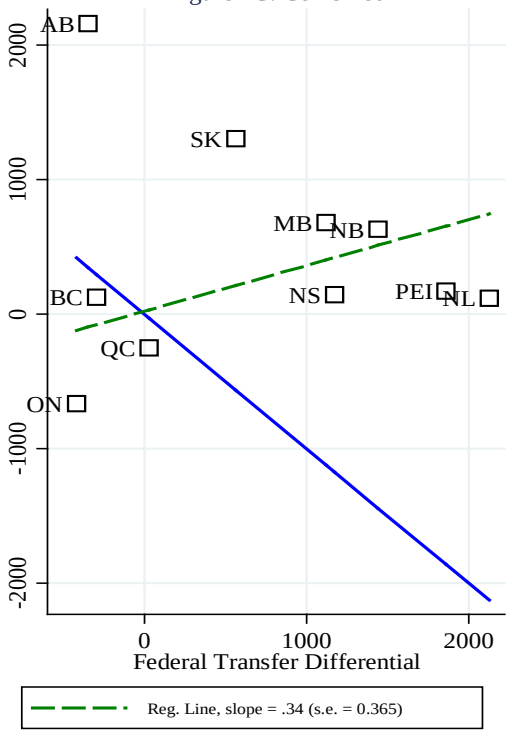
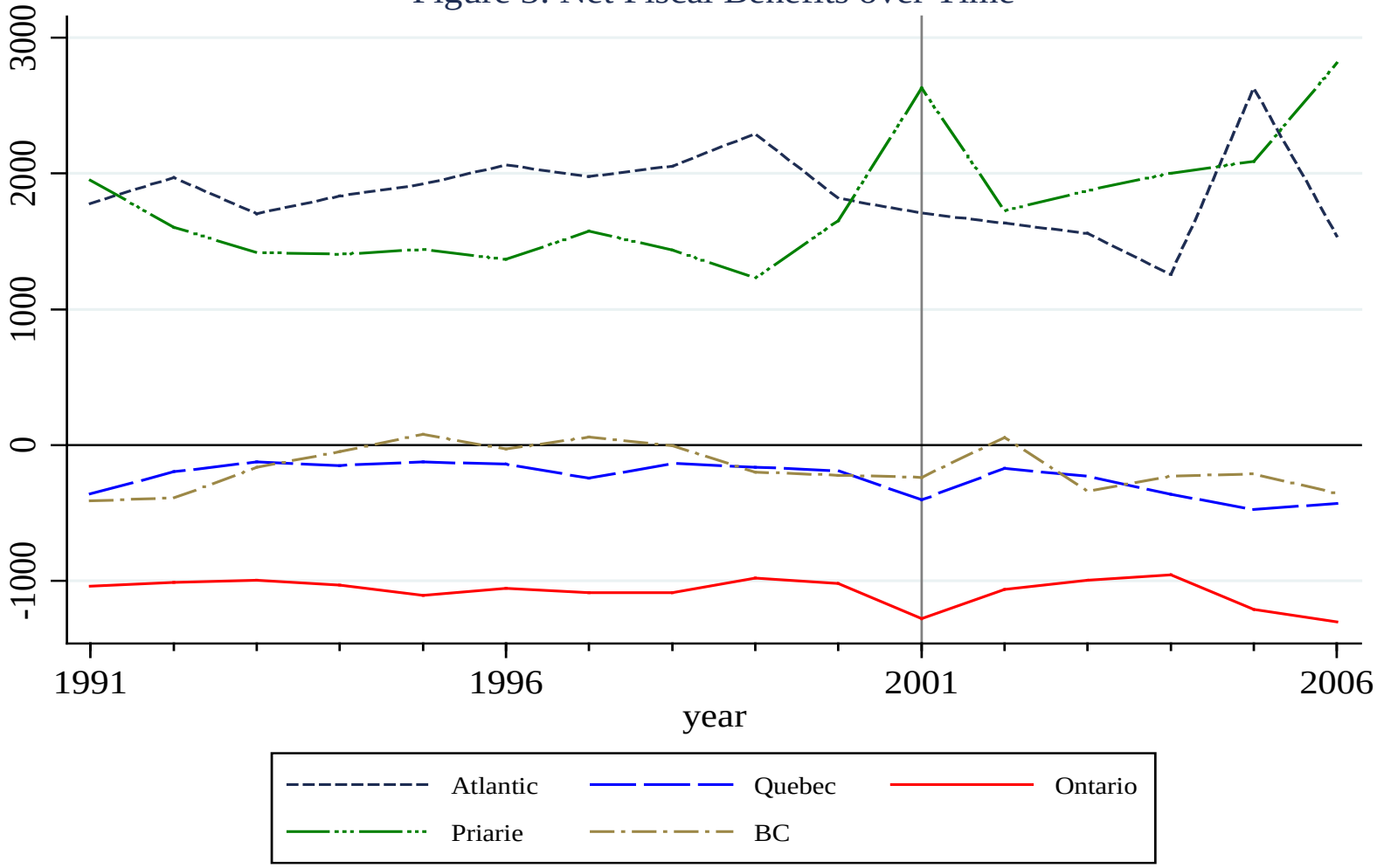


Figure 2C: Combined



Regression lines are population weighted; standard errors are robust. Solid line represents perfect offset.

Figure 3: Net Fiscal Benefits over Time



Appendix

A Theoretical Details and Derivation of Efficiency Conditions

A.1 Set-up

The total population is distributed across the regions according to the constraint $\sum_j \mathbf{N}^j = \mathbf{N}^{TOT}$, where, $\mathbf{N}^{TOT} = (N_1^{TOT}, ..., N_E^{TOT})$. Assume that capital is fixed in the economy at the level K^{TOT}. Consumption bundles within each region are described by the vectors $\mathbf{x}^j = (x_1^j, ..., x_E^j)$, and $\mathbf{y}^j = (y_1^j, ..., y_E^j)$. We use F_X to denote the production function for tradable goods, the quantities K_X^j, L_X^j and $\mathbf{N}_X^j = (N_{1X}^j, ...N_{EX})$ to denote the capital, land, and labor used to produce the traded good, and X^j the amount of the traded good produced in region j. Notation for the non-traded good and government-provided good is similar, leading to the following production constraints for each city j

$$F_X(K_X^j, L_X^j, \mathbf{N}_X^j; A_X^j) \geq X^j$$
$$F_Y(K_Y^j, L_Y^j, \mathbf{N}_Y^j; A_Y^j) \geq Y^j$$
$$F_G(K_G^j, L_G^j, \mathbf{N}_G^j; A_G^j) \geq G^j$$

In addition there are J local resource constraints

$$K^j \geq K_X^j + K_Y^j + K_G^j$$
$$L^j \geq L_X^j + L_Y^j + L_G^j$$
$$\mathbf{N}^j \geq \mathbf{N}_X^j + \mathbf{N}_Y^j + \mathbf{N}_G^j$$

although federally, capital and land are mobile, so that local resources are simply limited by the two aggregate constraints

$$K^{TOT} \geq \sum_j K^j$$
$$\mathbf{N}^{TOT} = \sum_j \mathbf{N}^j$$

In addition, we may write a plethora of non-negativity constraints, the most interesting ones being

$$K^j \geq 0, \mathbf{N}^j \geq \mathbf{0}$$

for each j. Finally there are two consumption constraints, a global one for the tradable goods, and J local ones for non-tradable goods.

$$\sum_j X^j \geq \mathbf{N}^j \cdot \mathbf{x}^j + x^F$$
$$Y^j \geq \mathbf{N}^j \cdot \mathbf{y}^j + y^{jF}$$

where x_F and y^{jF} are goods appropriated by the federal government.

A.2 Pareto Efficient Allocations under Perfect Mobility

Pareto efficient allocations are solved for using a planner's problem under the constraint of perfect mobility. The perfect mobility case corresponds best with the market economy over the very long run, and avoids problems of redistribution within types across different regions. With multiple types, we maximize the utility of one type in a single region, chosen arbitrarily, guarantee that all others of that type in other regions get the same utility, and that all other types achieve an arbitrary level of utility regardless of where they live. This leads to the program

$$\max U_1\left(x_1^1, y_1^1, \frac{G^1}{(N^1)^\alpha}; Q^1\right)$$

subject to the constraints

$$U_1\left(x_1^j, y_1^j, \frac{G^j}{(N^j)^\alpha}; Q^j\right) \geq U_1\left(x_1^1, y_1^1, \frac{G^1}{(N^1)^\alpha}; Q^1\right)$$

for all j and that

$$U_e\left(x_e^j, y_e^j, \frac{G^j}{(N^j)^\alpha}; Q^j\right) \geq \bar{U}_e$$

for all j and each e.

Combining as many constraints as possible, and leaving out the non-negativity constraints, produces a combined Lagrangian

$$\begin{aligned}\mathcal{L}() = &\sum_j \sum_e \eta_e^j U_e\left(x_e^j, y_e^j, \frac{G^j}{(N^j)^\alpha}; Q^j\right) + \pi_X\left[\sum_j F_X(K_X^j, L_X^j, \mathbf{N}_X^j; A_X^j) - \sum_j \mathbf{N}^j \cdot \mathbf{x}^j - x^F\right] \\ &+ \sum_j \pi_Y^j\left[F_Y(K_Y^j, L_Y^j, \mathbf{N}_Y^j; A_Y^j) - \mathbf{N}^j \cdot \mathbf{y}^j - y^{jF}\right] + \sum_j \pi_G^j\left[F_G(K_G^j, L_G^j, \mathbf{N}_G^j; A_G^j) - G^j\right] \\ &+ \sum_j \pi_K^j\left(K^j - K_X^j - K_Y^j - K_G^j\right) + \kappa\left(K^{TOT} - \sum_j K^j\right) + \sum_j \pi_L^j\left(L^j - L_X^j - L_Y^j - L_G^j\right) \\ &+ \sum_j \boldsymbol{\pi}_N^j \cdot \left(\mathbf{N}^j - \mathbf{N}_X^j - \mathbf{N}_Y^j - \mathbf{N}_G^j\right) + \boldsymbol{\nu} \cdot \left(\mathbf{N}^{TOT} - \sum_j \mathbf{N}^j\right)\end{aligned}$$

where the multipliers follow an obvious notation, with $\boldsymbol{\pi}_N^j = (\pi_{N1}^j, .., \pi_{NE}^j)$, and $\boldsymbol{\nu} = (\nu_1^j, ..., \nu_E^j)$.[31]

There are a large number of first-order Karuch-Kuhn-Tucker conditions, not all of which can

[31] The first term of the Lagrangian comes from defining $\eta_1^1 = 1 - \sum_{j>1} \eta_1^j$.and simplifying

$$U_1\left(x_1^1, y_1^1, \frac{G^1}{(N^1)^\alpha}; Q^1\right) + \sum_{j>1} \eta_1^j\left[U_1\left(x_1^j, y_1^j, \frac{G^j}{(N^j)^\alpha}; Q^j\right) - U_1\left(x_1^1, y_1^1, \frac{G^1}{(N^1)^\alpha}; Q^1\right)\right] + \sum_j \sum_{e>1} \eta_e^j U_e\left(x_e^j, y_e^j, \frac{G^j}{(N^j)^\alpha}; Q^j\right)$$

be explored here. For each of the goods

$$\frac{\partial \mathcal{L}}{\partial x_e^j} = \eta_e^j \frac{\partial U^j}{\partial x} - \pi_X N_e^j \leq 0$$
$$\frac{\partial \mathcal{L}}{\partial y_e^j} = \eta_e^j \frac{\partial U^j}{\partial y} - \pi_Y^j N_e^j \leq 0$$
$$\frac{\partial \mathcal{L}}{\partial G^j} = \sum_e \eta_e^j \frac{\partial U^j}{\partial g} (N^j)^{-\alpha} - \pi_G^j \leq 0$$

which hold with equality when the related quantities are positive. For the the allocation of factors within regions, the conditions have the form

$$\frac{\partial \mathcal{L}}{\partial N_X^j} = \pi_X \frac{\partial F_X^j}{\partial N_{Xe}} - \pi_{Ne}^j \leq 0, \ \frac{\partial \mathcal{L}}{\partial N_Y^j} = \pi_{Ye}^j \frac{\partial F_Y^j}{\partial N_{Ye}} - \pi_{Ne}^j \leq 0$$
$$\frac{\partial \mathcal{L}}{\partial K_Y^j} = \pi_X \frac{\partial F_X^j}{\partial K_X} - \pi_K^j \leq 0, \ \frac{\partial \mathcal{L}}{\partial L_Y^j} = \pi_Y^j \frac{\partial F_Y^j}{\partial N_Y} - \pi_L^j \leq 0$$

Assuming all goods are produced within regions, we get the classical tangency result for private goods and a generalized Samuelson Rule for local-government goods:

$$\frac{N_e^j}{\eta_e^j}\pi_X = \frac{\partial U_e^j}{\partial x}, \frac{N_e^j}{\eta_e^j}\pi_Y^j = \frac{\partial U_e^j}{\partial y} \Rightarrow \frac{\pi_Y^j}{\pi_X} = MRS_{yx}^j = \frac{\partial U_e / \partial y^j}{\partial U_e / \partial x^j} = \frac{\partial F_X^j / \partial N_{Xe}}{\partial F_Y^j / \partial N_{Ye}} = MRT_{yx}^j$$
$$\frac{\pi_G^j}{\pi_X} = \frac{1}{(N^j)^\alpha} \sum_e N_e^j \frac{\partial U^j / \partial g}{\partial U^j / \partial x} \Rightarrow \frac{\pi_G^j}{\pi_X} = (N^j)^{1-\alpha} \overline{MRS}_{Gx}^j = MRT_{Gx}^j$$

The equations imply that within each region, standard allocative, production, and match efficiency conditions should hold.

The most interesting conditions relate to the mobile production factors, particularly labor:

$$\frac{\partial \mathcal{L}}{\partial K^j} = \pi_K^j - \kappa \leq 0$$
$$\frac{\partial \mathcal{L}}{\partial N_e^j} = -\alpha \sum_e \eta_e^j \frac{\partial U^j}{\partial g} \frac{G^j}{(N^j)^\alpha} - \pi_X x_e^j - \pi_Y^j y_e^j + \pi_{Ne}^j - \nu_e \leq 0$$

With sufficient Inada conditions applied to the utility function, all regions will produce home and government goods, with labor in each sector. Some regions may not have production of tradable goods (e.g. resort regions), but this is ignored for now since it adds little to the analysis. Positive agglomeration spillovers may be contained in π_{Ne}^j as there is no assumption of constant returns to scale.

Using the within-region factor equations, the condition for capital reduces to

$$\frac{\partial F_X^j}{\partial K_X} = \frac{\partial F_X^{j'}}{\partial K_X}$$

in any two regions j and j' with capital. Substituting in $\partial\mathcal{L}/\partial G^j = 0$, which assumes that $G^j > 0$ and is set efficiently, the equation for labor, assuming $N_e^j > 0$ becomes

$$\pi_{Ne}^j - \pi_X x_e^j - \pi_Y^j y_e^j - \alpha \pi_G^j \frac{G^j}{N^j} = \nu_e$$

Dividing by π_X and substituting in production conditions, this expression becomes

$$\frac{\partial F_X^j}{\partial N_{Xe}} - x_e^j - MRT_{yx}^j y_e^j - \alpha MRT_{Gx}^j \frac{G^j}{N^j} = \frac{\nu_e}{\pi_X}$$

Since the right-hand side does not depend on j the left-hand side must be equal across all cities with $N_e^j > 0$. The first term accounts for the marginal productivity of labor. The next two terms gives the resource cost of the private consumption (perfectly congestible) that goes to residents of each region. In regions with greater quality of life or uncongested local-government goods, these terms will be smaller, since less consumption is required to compensate residents of type e for living in city j. The term starting with α gives the degree of congestion of the public caused by the new inhabitant: if $\alpha = 0$ this term vanishes.

A.3 Market Equilibrium and Optimal Fiscal Transfers

In the market environment, factors are perfectly mobile across sectors within region, and labor and capital are perfectly mobile across regions. All input and goods markets are perfectly competitive, and the government is efficient and pays factors their marginal product. Take x to be the numeraire good, with a price $p_X = 1$, and let p_Y^j be the market price of home goods. The budget constraint of a worker of type e in region j is given by

$$x_e^j + p^j y_e^j + T_e^j = w_e^j + R_e^j + I_e^j + F_e^j$$

where T_e^j are local taxes to pay for G^j. w_e^j are local wages, R_e^j are incomes from land, I_e^j are incomes from capital, and F_e^j are net fiscal transfers, which can include federal income taxes. All income sources are super-scripted to indicate their possible dependence on location.

With perfectly competitive markets we have that

$$\frac{\partial F_X^j}{\partial N_{Xe}} = p^j \frac{\partial F_Y^j}{\partial N_{Ye}} = w_e^j$$

This can be related to the conditions in the planner's problem through $MRT_{yx}^j = p^j$ and defining $p_G^j \equiv MRT_{Gx}^j$. Putting these into the population condition implies

$$w_e^j - x_e^j - p^j y_e^j - \alpha p_G^j \frac{G^j}{N^j} = \frac{\nu_e}{\pi_X}$$

Substituting in the budget constraint

$$T_e^j - F_e^j = \alpha p_G^j \frac{G^j}{N^j} + R_e^j + I_e^j + \frac{\nu_e}{\pi_X}$$

This condition says that local tax levels, net of fiscal transfers, i.e. total payments to both levels of government, should equilibrate congestion of government-good consumption, and any place-based income differentials from land and capital income. The constant term implies that this can differ across types but not across regions.

Example 1 *Boadway-Flatters (1982) Model*

In this article there is no private home-good sector, and no differences in Q^j, A_X^j, or A_Y^j across locations, only L^j. G^j is produced out of X^j, which can be simulated here by assuming that $p_G^j = 1$. Production exhibits constant returns to scale in all factors, implying falling returns to scale in N and K.

Case 1 *Lump-Sum Taxes and Local Rent Sharing*

In this first case, labor is homogenous and there is no capital. Local government goods are paid with a local uniform head tax, and residents inherit land in the location that they move to, sharing it equally with all other residents (although they don't live on it).

$$T^j = G^j/N^j$$
$$R^j = r^j L^j/N^j$$

where $r^j = \partial F_X^j/\partial L_X = (X^j - N_X^j \partial F_X^j/\partial N_X)/L^j$. Substituting in and rearranging

$$F^j - F^{j'} = (1-\alpha)\left(\frac{G^j}{N^j} - \frac{G^{j'}}{N^{j'}}\right) - \left(R^j - R^{j'}\right)$$

for any two cities j and j'. Efficient federal transfers subsidize federal externalities, which increase with the level of per-capita government-good provision, and completely tax away differences in locally appropriated land rents.

Case 2 *Source-Based and Residence-Based Taxes*

Labor is still homogenous, but capital is reintroduced, and property is owned uniformly regardless of location. Source-based taxes on capital and land are given by τ_K^j, τ_L^j, and a residence-based tax on labor is τ_N^j. In addition, there is a property-tax rate, τ_P^j on income from land and capital.

$$I^j = \frac{1}{N^{TOT}}\sum_j \left(1-\tau_K^j\right) iK^j = \frac{1}{N^{TOT}} i\left(K^{TOT} - \sum \tau_K^j K^j\right)$$
$$R^j = \frac{1}{N^{TOT}}\sum_j \left(1-\tau_L^j\right) r^j L^j$$
$$T^j = \tau_N^j w^j + \tau_P^j (I^j + R^j)$$
$$G^j = \tau_K^j iK^j + \tau_L^j r^j L^j + \tau_N^j w^j N^j + \tau_P^j (I^j + R^j) N^j$$

where $r^j = \partial F_X^j/\partial L_X = (X^j - K_X^j \partial F_X^j/\partial K_X - N_X^j \partial F_X^j/\partial N_X)/L^j$. Because these taxes are uniform within regions, they do not distort production efficiency within regions. However, they do

distort the allocation of mobile resources across regions. If $\tau_K^j \neq \tau_K^{j'}$ then the allocation of capital will be distorted as

$$i = \frac{\partial F_X^j}{\partial K_X}\left(1-\tau_K^j\right) = \frac{\partial F_X^{j'}}{\partial K_X}\left(1-\tau_K^{j'}\right)$$

The allocation of labor will be distorted unless federal transfers are set so that

$$\begin{aligned} F^j - F^{j'} &= \left(T^j - T^{j'}\right) - \alpha\left(\frac{G^j}{N^j} - \frac{G^{j'}}{N^{j'}}\right) \\ &= (1-\alpha)\left(\frac{G^j}{N^j} - \frac{G^{j'}}{N^{j'}}\right) + \left[T^j - \frac{G^j}{N^j} - \left(T^{j'} - \frac{G^{j'}}{N^{j'}}\right)\right] \end{aligned}$$

Substituting in for T^j and G^j inside the square brackets:

$$F^j - F^{j'} = (1-\alpha)\left[\frac{G^j}{N^j} - \frac{G^{j'}}{N^{j'}}\right] - \left[\frac{\tau_K^j i K^j + \tau_L^j r^j L^j}{N^j} - \frac{\tau_K^{j'} i K^{j'} + \tau_L^{j'} r^{j'} L^{j'}}{N^{j'}}\right]$$

which is the result that fiscal externalities are subsidized, and that all source-based revenues are redistributed.

Case 3 *Worker Heterogeneity*

In this case the location condition for workers becomes

$$F_e^j - F_e^{j'} = \left[T_e^j - \frac{G^j}{N^j} - \left(T_e^{j'} - \frac{G^{j'}}{N^{j'}}\right)\right] + (1-\alpha)\left(\frac{G^j}{N^j} - \frac{G^{j'}}{N^{j'}}\right)$$

or just

$$F_e^j = \left(T_e^j - \frac{G^j}{N^j}\right) + (1-\alpha)\left(\frac{G^j}{N^j}\right) + F_e$$

where F_e satisfies the overall federal budget constraint.

With worker heterogeneity, residence-based taxes and total revenues are given by the following formulas

$$\begin{aligned} T_e^j &= \tau_N^j w_e^j + \tau_P^j (I_e^j + R_e^j) \\ G^j &= \tau_K^j i K^j + \tau_L^j r^j L^j + \sum_e \left(\tau_N^j w_e^j N_e^j + \tau_P^j (I^j + R^j) N_e^j\right) \\ &= \tau_K^j i K^j + \tau_L^j r^j L^j + \tau_N^j \bar{w}^j N^j + \tau_P^j (\bar{I}^j + \bar{R}^j) N^j \end{aligned}$$

where $\bar{w}^j = (1/N^j)\sum_j N_e^j w_e^j$. Substituting in we get

$$F_e^j = F_e + (1-\alpha)\frac{G^j}{N^j} - \left\{\frac{\tau_K^j i K^j + \tau_L^j r^j L^j}{N^j} + \tau_N^j\left(\bar{w}^j - w_e^j\right) + \tau_P^j\left[(\bar{I}^j + \bar{R}^j) - (I_e^j + R_e^j)\right]\right\}$$

In addition to subsidizing fiscal externalities and taxing away source-based incomes, residents in areas where their incomes are below average are given less federal money, and residents in areas where incomes are above average receive a subsidy.

This implies that the average level of transfers that given to region j is

$$\bar{F}^j = \frac{1}{N^j}\sum_j N_e^j F_e^j = \frac{1}{N^j}\sum_j N_e^j F_e + (1-\alpha)\frac{G^j}{N^j} - \left\{\frac{\tau_K^j i K^j + \tau_L^j r^j L^j}{N^j}\right\}$$

The terms related to income from labor and property add up to zero when averaged. The transfers have to be targeted directly at the right population or they do not have the corrective effect: effectively taxes on those types who are locating for fiscal reasons are exactly canceled out by subsidies on those with above average incomes. The federal government can give differential grants according to the composition of types across locations, but this is for redistributional purposes, not for efficiency.

The case in the main text is a fairly straightforward expansion of this model, using the assumption that income from capital and land are location independent. In addition, we can redefine federal transfer differences $\tilde{F}_e^j - \tilde{F}_e = (F_e^j + \tau_w^F w_e^j) - \left(F_e + \tau_w^F \bar{w}_e\right)$ to add back in differential federal tax payments, so that they then become pure federal transfers, with federal taxes accounted for separately, and use the previously derived formulas.

B Data and Estimation

I use Canadian Census data from the 2001 Public Use Microdata Files to calculate wage and housing-cost differentials. The wage differentials are calculated for workers ages 25 to 55, who report working at least 30 hours a week, 26 weeks a year. The CMA (Census Metropolitan Area) assigned to a worker is determined by their place of residence, with non-CMA residents pooled by province into a single fictional CMA. The wage differential of an CMA is found by regressing log hourly wages on individual covariates and indicators for a worker's CMA, using the coefficients on these CMA indicators. Province-level wage levels are calculated by averaging CMA-wage effects, weighted by population. Just using province indicators would produce fairly similar results, but would control less for rural-urban disparities.

The covariates are split into three main categories, as mentioned in the text, which can be further sub-categorized.

i.a 9 indicators of educational attainment, and three variables indicating highest grade, years of university, and years of other schooling;

i.b a quartic in potential experience, and potential experience interacted with years of education;

i.c 12 indicators for major field of study;

ii.a 13 indicators of industry (1980 definition);

ii.b 25 indicators of occupation (2001 SOC);

iii.a 4 indicators of marital status (married, divorced, widowed, separated);

iii.b 5 indicators of minority status (Black, Chinese, South Asian, Aboriginal and other);

iii.c Indicators of immigrant status, time since immigration, and citizenship status;

iii.d Indicators of mother tongue (English, French, or other) and indicators for bilingualism interacted with mother tongue, and for other mother tongue interacted with speaking only French and only English;

All covariates are interacted with gender.

TABLE A1: DECOMPOSITION OF FEDERAL TRANSFER DIFFERENCES ACRSOSS CANADIAN PROVINCES: 2001

Province	Federal Transfer Differential (1)+(2)+(3)	Federal Transfer Components: Equalization Payments (1)	Federal Transfer Components: Health and Social Transfer (2)	Federal Transfer Components: Other Federal Transfers (3)
Newfoundland	2125	1678	134	312
PEI	1858	1595	127	135
Nova Scotia	1174	1033	127	14
New Brunswick	1442	1297	127	18
Quebec	31	276	-199	-46
Ontario	-417	-395	25	-46
Manitoba	1121	824	124	174
Saskatchewan	566	-123	120	569
Alberta	-345	-393	-3	50
BC	-294	-361	153	-86
Territories	15578	14560	-16	1034

Measured in 2001 Canadian Dollars. Federal transfer data from CANSIM 384-0011. Federal transfer differentials averaged over 1998 to 2003. See text for further detail.