

A Median Voter Model of the Vertical Fiscal Gap

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A median voter model is developed to explain the size of the vertical fiscal gap in a federation, i.e. the extent to which subnational governments' expenditures exceed their own-source tax revenues. In our model, individuals vote in subnational elections and in federal elections to determine tax rates and spending on public services by each level of government and transfers to the subnational governments. In the resulting political equilibrium, intergovernmental transfers from the central government are affected by the tax sensitivity of the tax bases of the central and subnational governments, the degree of inequality in the tax bases of the subnational governments, the allocation of spending responsibilities between the central and subnational governments, and whether the federal legislature is unicameral or bicameral.

1.0 Introduction

Intergovernmental grants are an important part of the fiscal architecture of most federations, but the degree to which subnational governments rely on grants from central governments varies widely across federations. See Table 1. For example, the Australian state governments are three times as reliant on intergovernmental transfers as the Canadian provinces. What accounts for this difference in reliance on intergovernmental transfers between two countries which, in other respects such as colonial history, legal systems, and economic structures, are very similar?

Questions concerning the level and pattern of intergovernmental transfers has lead to the development of a number of theoretical political economy models, including Pereira (1996), Dixit and Londregan (1998), Crémer and Palfrey (2000), Snoddon and Wen (2003), and Volden (2007). There is also a growing body of empirical research on the determinants of intergovernmental transfers in a number of different countries—Bennett and Mayberry (1979), Grossman (1994), Borck and Owings (2003), and Gamkhar and Ali (2007) for the United States; Alperovich (1984) for Israel; Pereira (1996) and Veiga and Pinho (2007) for Portugal; Bungey, Grossman, and Kenyon (1991) and Worthington and Dollery (1998) for Australia; Porto and Sanguinetti (2001) for Argentina; and Feld and Schaltegger (2005) for Switzerland—and empirical studies on the variation in the fiscal gaps among countries. See, for example, Rodden and Wibbels (2002) and Bird and Tarasov (2004).

In this paper, we develop a median voter model to explain the size of the vertical fiscal gap in a federation, which we define as the ratio of transfers received by to subnational governments to their expenditures.¹ In our model, individuals vote in subnational elections to

¹ Note that we distinguish between the notion of a vertical fiscal gap—the difference between a subnational government's expenditures and its own source tax revenues—and the notion of a vertical fiscal imbalance, which

determine subnational governments' spending on a public service and a proportional income tax rate, and they vote in federal elections which determine spending on a federal public services, the federal tax rate on income, and the federal transfers to subnational governments.

Specifically, we try to address the following questions:

- How does the allocation of spending powers and the tax assignment affect the size of the fiscal gap?
- Does income inequality, between regions and within regions, affect the size of the fiscal gap?
- When does a fiscal gap improve or distort the allocation of resources in an economy?
- Who gains and who loses from federal transfers to subnational governments?
- Do intergovernmental transfers promote national unity or do they exacerbate regional tensions?
- Does the size of the fiscal gap depend on whether the federal legislature is unicameral or bicameral?
- Does the magnitude of stimulative effect of transfers on a subnational government's spending influence the level of transfers?
- Why do the representatives of rich subnational governments support at least some level of intergovernmental transfers from the central government?

Our model can also be viewed as an extension of the Meltzer and Richard (1981) model to a federation, and we use it to investigate the question of vertical fiscal imbalance. It is also based on earlier models by Usher (1977), Bos (1979), and Wilson (1985) who showed that

we define as a misallocation in spending and taxation between the levels of government. See Dahlby (2005 and 2008) and Boadway and Tremblay (2006) on the distinction between vertical fiscal gaps and vertical fiscal imbalances.

there may be a greater demand for a public service at the federal level than at the provincial level if the national income distribution is more skewed to the right than the provincial income distribution. In these models, the “tax price” that the median voter pays for a government service is determined, in part, by the ratio of the median income to the average income in that jurisdiction. In other words, the ratio of the median to the mean income indicates how much an individual with the median income has to pay for a dollar of government spending, assuming that the revenue is collected from a non-distortionary proportional income tax. The lower this ratio, the lower the effective price paid by the median voter for public services and the higher the level of services that will be provided by the government. From these insights it is possible to infer that voters will tend to support increased block grants from the federal government to the subnational governments if voters see a lower tax price for public services financed by the federal government rather than the subnational government. This paper attempts to provide a rigorous foundation for this hypothesis.

Our paper also contributes to literature on determinants of intergovernmental transfers by explicitly modeling citizens’ incentives to support intergovernmental grants. Other theoretical models in this literature, such as Snoddon and Wen (2003) and Volden (2007), assume that central and subnational governments’ have preferences which motivate their decisions concerning the level of intergovernmental grants, but they do not show how these preferences reflect the interests of voters in the different subnational governments in a federation. Another difference is that our paper is concerned with the aggregate fiscal gap in a federation, whereas other models are mainly concerned with how grants vary between different subnational governments in the same federation. To the best of our knowledge, no one has attempted to develop a theoretical framework to examine the factors that affect the size of the

vertical fiscal gap in a federation over time or between countries. We hope that our paper will provide a framework for future empirical research on this topic.

The paper is organized as follows. Section 2.0 describes the median voter model when the federal government's legislature is unicameral. The median voter's preferences in the subnational government's elections determine its tax rate and expenditure level on subnational government public services. We also derive an expression for the impact of increases in federal transfers on the subnational government's spending. The level of intergovernmental grants, along with spending on federally-provided public services and federal tax rates are determined in the federal elections, and we derive conditions which describe the desired federal fiscal variables for a voter with a given income level in a given subnational jurisdiction. We then describe the determination of the median desired tax rates, expenditure level, and transfers. The resulting political equilibrium is quite complex, and therefore in Section 3.0 we compute the equilibrium for parameter values that roughly reflect some of the key variables in Canada. We use computations based on the model to illustrate how the size of the vertical fiscal gap is affected by the tax sensitivity of the tax bases of the central and subnational governments, the degree of inequality in the tax bases of the subnational governments, and the allocation of spending responsibilities between the central and subnational governments. In Section 4.0, we consider how the level of intergovernmental grants would be affected by different institutional structures. Specifically, we consider how the level of transfers would be determined in a bicameral federal legislature where one body, the House, is elected on the basis of population and the other elected body, the Senate, gives equal representation to each subnational governments. In Section 5.0, we use our framework in discussing the underlying

reasons for the differences in the vertical fiscal gaps in Australia and Canada. The final section contains a summary of our conclusions with regard to the questions posed above.

2.0 A Median Voter Model with a Unicameral Federal Legislature

We consider a very simple version of the Meltzer and Richard (1981) median voter model applied to a federation. There are two levels of government. At the federal level, elections are based on a national vote. Initially, it will be assumed that the federal legislature is unicameral and based on representation by population. We will call this legislature the House. There are n subnational governments, which we will call provincial governments, and the election of a unicameral provincial legislature is based on majority voting within each province. It is assumed that in the provincial election, voters take the federal expenditure level, the federal tax rate, and transfers to the provinces as given.

The utility function of individual h in province i is:

$$U_{hi} = (1 - t_i - t_0)y_h + P(g_i) + F(g_0) \quad (1)$$

where t_i is a proportional tax rate levied by province i on individual h 's income, y_h , to finance its expenditures on the provincial public service, g_i . The federal government's tax rate is t_0 and the expenditure on the public service provided by the federal government is g_0 . To keep the model simple, we assume that preferences for provincial and federal public services are the same for all individuals in all provinces and that $P' > 0$, $P'' < 0$, $F' > 0$, $F'' < 0$. The mean income in province i is y_{ai} , the median income is y_{mi} , and the distribution function of income is $H_i(y)$.

Let p_i be the population of province i and $p_0 = \sum_{i=1}^n p_i = 1$. The national population is

normalized to equal one and the population shares of the provinces are fixed, i.e. there is no inter-provincial migration due to differences in fiscal variables.

2.1 Provincial Fiscal Decisions

A provincial government finances its expenditures with its proportional income tax and from its transfer from the federal government. Province i 's budget constraint, expressed in per capita terms, is equal to:

$$t_i y_{ai} + T_0 = g_i \quad (2)$$

where T_0 is the per capita lump-sum grant that each province receives from the federal government. The per capita intergovernmental grant is the same for all provinces.² In most of our discussion, it will be assumed that intergovernmental transfers flow from the federal government to the province, i.e. $T_0 \geq 0$. However, we also consider the possibility later in this section that grants could flow from the provinces to the central government. Given the level of federal transfers and federal public services and the federal tax rate, the optimal g_i (and the provincial tax rate that is needed to finance it) for individual h will be given by the following condition:

$$P'(g_i) = \left(\frac{y_h}{y_{ai}} \right) MCF_i \quad (3)$$

where $P'(g_i)$ is the marginal benefit that an individual receives from g_i . Our assumption that the marginal utility of income is constant (and equal to one) and that the utility function is additively separable implies that the marginal benefit from any given level of the provincial

²Examples of these types of intergovernmental grants are the Canadian Social Transfer (CST) and the Canada Health Transfer (CHT). In 2007-08 the CST became an equal per capita grant of \$289 and the CHT is scheduled to become an equal per capita grant in 2014-15. See Government of Canada (2007, pp.335-336). These two transfer programs represent approximately three-quarters of the total federal transfers to the Canadian provinces. Although these transfers are nominally linked to provincial spending on education, social welfare programs, and health care, the provinces have considerable leeway in deciding how the funds will be used. In this paper we are not concerned with the other major transfer program in Canada, equalization payments, which are directed to provinces with low fiscal capacity.

public service is the same for all individuals, i.e. the marginal benefit does not vary with income. This is obviously a highly restrictive assumption, but helps to simplify the analysis.

The MCF_i is the marginal cost of public funds for province i which is defined by:

$$MCF_i = \frac{y_{ai}}{y_{ai} + t_i \frac{\partial y_{ai}}{\partial t_i}} = \frac{1}{1 + t_i \eta_i} \quad (4)$$

where $\eta_i = d\ln(y_{ai})/dt_i \leq 0$ measures the sensitivity of average income, the provincial government's tax base, to an increase in the province's tax rate. Although we do not specify the process, it is assumed that higher tax rates can lead to a reduction in average income because of disincentive effects to earn income. It is assumed that the provincial government is operating on the upward-sloping section of its Laffer curve, and therefore the elasticity of the province's tax revenues with respect to its tax rate, $1 + t_i \eta_i$, is positive.

The right-hand side of (3) represents the tax price for provincial public services, TP_{ih} , faced by individual h in province i because it measures the cost to individual h of an additional dollar spent on provincial services and financed through a provincial tax increase. The tax price of provincial public services is the product of two factors—a *redistributive factor* (y_h/y_{ai}) and a *tax distortion factor*, the MCF_i . The redistributive factor arises because, in the absence of tax distortions, the increase in per capita revenues from a tax rate increase is proportional to the average income in the province while the increase in an individual's tax burden is in proportion to his income. The redistributive effect can make the effective tax price of a dollar of provincial spending less than a dollar for an individual whose income is less than the average income. The tax distortion effect, which is measured by the province's marginal cost of public funds, implies that the effective tax price for public services can exceed a dollar if tax rates cause the tax base to shrink because of tax avoidance or tax evasion.

If preferences for g_i are “single-peaked”, the decisive voter in a two-party election will be the one who displays the median demand for g_i . Since the marginal benefit of the provincial public service is the same for all individuals, the “median voter” will be the individual with the median income, y_{mi} , in province i because he pays the median tax price. Therefore, the provision of the provincially-provided public good will be determined by the condition:

$$P'(g_i) = \left(\frac{y_{mi}}{y_{ai}} \right) \frac{1}{1 + t_i \eta_i} \quad (5)$$

In most societies, the income distribution is skewed to the right, the median income is less than the mean income, and therefore $y_{mi}/y_{ai} < 1$. One implication of this is that an increase in income inequality, as measured by a reduction in the y_{mi}/y_{ai} ratio, would lead to an increase in the provision of the public service, because the median voter would bear a lower proportion of the total cost of providing an additional unit of g_i .³

We need to consider how an increase in federal transfers affects the expenditure on the provincial public service. Taking the total differential of (2) and (5), the effect of an increase in federal transfers on a provincial government’s expenditures is given by:

$$\frac{dg_i}{dT_0} \equiv \gamma_i = \frac{1}{1 + \left(\frac{y_{ai}^2}{y_{mi}} \right) \left(\frac{P''}{\eta_i} \right) (1 + t_i \eta_i)^3} = \frac{1}{1 + \frac{y_{ai}}{\eta_i} \cdot \frac{d \ln P'}{dg_i} \cdot (1 + t_i \eta_i)^2} \quad (6a)$$

where $0 < \gamma_i < 1$ if $\eta_i < 0$. If the provincial public service were financed by a non-distortionary tax, such that $\eta_i = 0$, then $dg_i/dT_0 = 0$. *Ceteris paribus* the stimulate effect of a federal transfer will be larger if the provincial tax rate or the tax sensitivity of its tax base is higher, if average provincial income is lower, or if marginal benefit from the provincial public service declines

³ See Rodriguez (1999) and Harms and Zink (2003) for assessments of the predictive power of the median model with regard to redistribution.

relatively slowly with as service levels increase. Note that because γ_i is less than one, an increase in federal transfers also leads to a reduction in the provincial tax rate. Differentiating the provincial government's budget constraint, we obtain:

$$\gamma_i = 1 + y_{ai} \frac{dt_i}{dT_0} + t_i \frac{dy_{ai}}{dt_i} \frac{dt_i}{dT_0} \quad (6b)$$

or:

$$\frac{dt_i}{dT_0} = \frac{\gamma_i - 1}{y_{ai}(1 + t_i \eta_i)} \quad (7)$$

It is also worth pointing out that the stimulative effect of an increase in federal transfers is different from an equivalent equal per capita increase in the incomes of the residents of the subnational government.⁴ Again, taking the total differential of (2) and (5) and setting $dy_{mi} = dy_{ai} = dy_i$, we obtain:

$$\frac{dg_i}{dy_i} = \frac{y_{ai}(1 + t_i \eta_i)(1 - P')}{y_{ai}^2(1 + t_i \eta_i)^2 P'' + y_{mi} \eta_i} \quad (8)$$

Note that $dg_i/dy_i \gtrless 0$ as $P' \gtrless 1$. In other words, an equal per capita increase in the residents' incomes would increase (decrease) provision of the public good if the marginal benefit from the provincial public good is greater than (less than) one. The reason why higher personal incomes have an ambiguous effect on the provision of services in this model is that an equal per capita increase in incomes has two offsetting effects of the effective price of public services. It would increase the redistributive factor (y_{mi}/y_{ai}), thereby increasing the effective price of public services for the median voter, and it would reduce the tax distortion factor,

⁴Our model is capable of generating a "flypaper effect", i.e. the stimulative effect of a transfer on a recipient government's spending can be substantially larger than an equivalent increase in its per capita income. See Hamilton (1986), Becker and Mulligan (2003), Volden (2007) and Dahlby (2008b) on the flypaper effect arising from subnational governments' use of distortionary taxation to finance their expenditures. For an alternative political economy model of the flypaper effect, see Roemer and Silvestre (2002).

because with a higher y_{ai} , the same level of service can be provide at a lower t_i , and therefore the MCF_i will be lower. If initially $P' < 1$ because the redistributive factor outweighs the tax distortion factor, then an equal per capita increase in incomes will increase the effective price of the public service to the median voter, and he would vote for a lower level of public services. In our model, the marginal benefit for the public service is independent of income. If the marginal benefit or willingness to pay for the public service increased with income, then an increase in per capita incomes would have a greater stimulative effect on spending on the public service.

2.2 Federal Fiscal Decisions with a Unicameral Legislature

We will now consider the fiscal decisions made at the federal level based on a national election to a unicameral house of representatives. National variables are denoted by a subscript 0, and the federal government's per capita budget constraint is:

$$t_0 y_{a0} = g_0 + T_0 \quad (9)$$

where y_{a0} is the national average income defined by $y_{a0} = \sum_{i=1}^n p_i y_{ai}$. The desired levels of g_0 , t_0

and T_0 for individual h in province i will be determined by the federal budget constraint in (9) and following conditions:

$$F'(g_0) = \left(\frac{y_h}{y_{a0}} \right) \frac{1}{1 + t_0 \eta_0} \quad (10)$$

$$-y_h \frac{dt_i}{dT_0} + P' \frac{dg_i}{dT_0} = \left(\frac{y_h}{y_{a0}} \right) \frac{1}{1 + t_0 \eta_0} \quad (11)$$

where equation (10) is the federal counterpart to the condition for the optimal provision of the provincial public service and $(1 + t_0\eta_0)^{-1}$ is the federal government's marginal cost of public funds. It will also be assumed that $1 + t_0\eta_0 > 0$ and that $\eta_i \leq \eta_0 < 0$. That is, the federal income tax base is generally less tax sensitive than any province's tax base, perhaps because it is harder to evade or avoid taxes at the national level than at the provincial level.

Equation (11) determines the optimal transfer from the perspective of individual h in province i . The left-hand side is the perceived marginal benefit from increasing the federal transfer to the provincial governments, which takes the form of a tax cut and an increase in expenditure on the public good. Note that the benefit of a marginal increase in a transfer will tend to be higher for a low income individual if the expenditure stimulation effect, γ_i , is larger because a low income individual gets relatively little benefit from a tax cut and by assumption, all individuals get the same marginal benefit from an increase in the provincial public service. The right-hand side is the individual's tax price for federal public services, which represents the opportunity cost of increasing federal transfers. Note that voters with the same income, but residing in different provinces, will generally prefer different levels of intergovernmental transfers because the level of provincial public services will in general vary across provinces and therefore the marginal benefit from an increase in provincial services will be different in different provinces.⁵ In addition, the allocation of an increase in transfers between a spending increase and a tax cut will also vary across provinces.

⁵ In our model individuals vote for federal grants to fund provincial government spending because the perceived tax price of a federal transfers is lower than their provincial government's tax revenue and not out of a desire to promote "national standards". See Telford (2003) on the demand for national standards in the Canadian debates about the level of intergovernmental transfers. Our model predicts that the percentage of the population who demand higher federal grants to promote national standards in provincial social programs would be higher in provinces with lower average incomes, i.e. individuals use the rhetoric of national standards to promote their self interest.

Assuming individual h is sophisticated and recognizes that the combination of tax cut and expenditure increase in his province will be determined according to the preferences of the median voter in his province, then using (6a) and (7) the desired federal tax rate from the perspective of individual h in province i will be:

$$t_0 = -\frac{1}{\eta_0} \left[1 - \frac{y_h y_{ai} (1 + t_i \eta_i)}{y_{a0} [(1 - \gamma_i) y_h + \gamma_i y_{mi}]} \right] \quad (12a)$$

Equation (12a) together with (9) and (10) determine the optimal federal transfers to the provinces from the perspective of individual h in province i. Note that if individual h had zero income, he would like the federal tax rate to be set at the revenue-maximizing tax rate of $-1/\eta_0$, and this revenue would be spent on the federal public service and transfers to the provinces.

All individuals in province i with incomes in excess of y_{min_i} would want a federal tax rate of zero where y_{min_i} is defined by:

$$y_{min_i} = \frac{y_{a0} \gamma_i y_{mi}}{y_{ai} (1 + t_i \eta_i) - (1 - \gamma_i) y_{a0}} \quad (13)$$

Equation (12a) indicates that individuals who live in provinces with lower average incomes will desire higher federal taxes to finance higher transfers to the provinces because the tax price of federal revenue is low compared to their provincial tax price. Individuals who live in provinces where the provincial MCF is high will also favour higher federal taxes. In general, an individual's desired federal tax rate will be decreasing in the individual's income as shown below:⁶

$$\frac{dt_0}{dy_h} = \frac{y_{ai} y_{mi} \gamma_i (1 + t_i \eta_i)}{y_{a0} \eta_0 [(1 - \gamma_i) y_h + \gamma_i y_{mi}]^2} < 0 \quad (14)$$

⁶ Since the federal tax rate is bounded between 0 and 1, all individuals with incomes below some critical value y_{hmax} would want the revenue maximizing tax rate or a 100 percent tax rate and those with an income in excess of y_{hmin} would want a federal tax rate of zero. Inside these bounds, the optimal federal tax rate decreases with the individual's income.

Although the assumption of rational behaviour on the part of voters is a compelling one, it is also useful to consider two alternative assumptions about voters' expectations. First, suppose that voters naively assume that a marginal transfer will be used to cut provincial taxes, and therefore $\gamma_i = 0$. In this case, the optimal federal tax rate would be the following:

$$t_0 = -\frac{1}{\eta_0} + \left(\frac{y_{ai}}{y_{a0}} \right) \frac{(1 + t_i \eta_i)}{\eta_0} \quad (12b)$$

Note that if all of the voters were naïve tax-cutters, then all of the voters in province i would support the same federal tax rate, i.e. the optimal federal tax rate for voters in province i would be independent of the individuals' income. An interesting feature of this case is that there will be unanimity among the residents of a province regarding the optimal level of federal transfers, even though the residents of the province may have vastly different incomes, face very different tax prices for provincial public services, and desire different levels of provincial public services. Individual in provinces with lower average incomes would want higher federal tax rates. The residents of provinces where the elasticity of provincial tax revenue with respect to the provincial tax rate is lower (or in other words where the provincial MCF is higher) would also want higher federal tax rates and higher transfers.

Alternatively, if all voters believed that marginal federal transfers would be spent on increases in provincial public services and $\gamma_i = 1$, then the optimal federal tax rate would be equal to:

$$t_0 = -\frac{1}{\eta_0} + \left(\frac{y_h}{y_{mi}} \right) \left(\frac{y_{ai}}{y_{a0}} \right) \frac{(1 + t_i \eta_i)}{\eta_0} \quad (12c)$$

If this case, the optimal federal tax rate is also higher for individuals with lower incomes and higher for individuals who live in poorer provinces.

The median voter model predicts that a successful political party in a federal election will offer to levy the median desired level of federal taxation, t_0^v . This is the rate of federal taxation that would be desired by an individual with income of y_i^v in province i based on (12a) and which would satisfy the following condition:

$$\sum_{i=1}^n p_i H_i(y_i^v) = 0.5 \quad (15)$$

Figure 1 illustrates the nature of the median voter equilibrium for the case where there are three provinces with $y_{a1} < y_{a2} < y_{a3}$ and $\eta_0 < -1$. In this example, an individual in the province 1 is wants a higher federal tax rate than an individual with the same income in province 3 because the average national income is higher than the average provincial income in the province 1 and therefore the tax price of federal services tends to be lower than the tax price of provincial services in province 1. Individuals in province 3 at any given income level desire lower federal tax rates than individuals in the other provinces because the tax price of federal services is higher compared to the tax price of provincial services because they live in a high average income province. The median desired rate of federal taxation is a rate that is desired by a relatively high income individual in province 1 and a relatively low income individual in province 3.

The median desired tax rate is determined by (15) and (12a). The question remains how federal tax revenues are split between g_0 and T_0 . We have (somewhat arbitrarily) assumed that g_0 is determined by the voter with the median national income because his preferred level of spending on g_0 will be the median desired level of level of federal services *given the federal tax rate* t_0 . With this level of federal program spending and the federal tax rate, the level of transfers to the provinces will be determined as a residual by the federal budget constraint.

The median desired federal tax rate portrayed in Figure 1 and defined by (15) is part of a general political equilibrium. The positions of the desired federal tax rate curves in Figure 1 depend on the t_i s, both directly and through their effects on the y_{ai} s, the γ_i s, and the y_{a0} , which in turn depend on the equilibrium t_0 through its effect on the level of transfers. The general equilibrium properties of the model are complex, and we have relied on the numerical simulations described in the following section to develop some intuition about the properties of the equilibrium.

However, before considering the simulation results, we can derive some insights concerning the properties of the model and the direction of the transfers by assuming that the utility functions for provincial and federal public services have the following specific forms:

$$P(g_i) = \rho \ln(g_i) \quad (16)$$

$$F(g_0) = \phi \ln(g_0) \quad (17)$$

where ρ and ϕ are positive parameters which represent the strength of the preference for provincial and federal public services. With $F' = \phi g_0^{-1}$ in (10) and using the federal budget constraint in (9) we can obtain the following expression for the level of federal transfers:

$$T_0 = \frac{y_{a0}}{y_{m0}} [(y_{m0} - \phi \eta_0) t_0 - \phi] \quad (18)$$

Note that federal transfers will be positive, i.e. funds will flow from the central government to the provincial governments if the expression in square brackets in (18) is positive, or in other words:

$$T_0 \begin{matrix} > \\ < \end{matrix} 0 \quad \text{as} \quad t_0 \begin{matrix} > \\ < \end{matrix} \frac{\phi}{y_{m0} - \phi \eta_0} \quad (19)$$

In other words, for transfers flow from the central government to the provinces the equilibrium federal tax rate has to exceed a critical value given by the right-hand side of the second inequality. This condition indicates that the critical value will be larger the greater the value that citizens place on federal services, the greater the tax sensitivity of the federal tax base or the lower the median income in the federation. If the t_0^v is less than this critical value, then transfers will flow from the provincial governments to the federal government.

In almost all federations, funds flow from the federal government to the provinces, and therefore we would expect the equilibrium federal tax rate usually exceeds the critical value. However, in China up until the mid-1990s, the central government received transfers from the subnational government. Whether the Chinese example is consistent with the prediction of the model is debatable because China is obviously not a democracy. Still, the conditions in China at the time—low median income, limited ability of the central government to raise tax revenues, and (more subjectively) a high value for the services provided by the central government may have provided the conditions under which transfers to the central government from the subnational government in China were in the interest of the median Chinese “voter”. Of course, all of this is highly speculative, and in the numerical examples contained in the next section, transfers always flow from the central government to the provincial governments.

3.0 Simulation of the Political Equilibrium with Unicameral Federal Legislature

To illustrate the properties of our model, we have constructed a simple simulation model. We model a federation with three provinces where the population shares and relative average family incomes are similar to those in Ontario, Alberta/British Columbia, and the other seven provinces. In this set up, Ontario (ONT) is province 3 with 40 percent of the population

and its average family income is about 15 percent above the national average. Alberta and British Columbia (ABC) are treated as one province with a 25 percent of the population and an average family income about two percent above the national average. The remaining provinces, which we will refer to as the rest of Canada (ROC), have an average family income of 82 percent of the national average and 35 percent of the population. (Quebec would represent approximately 70 percent of the population of ROC.) Therefore, the model portrays a federation where the largest province is relatively rich, but where there is a large province that is relatively poor. The third province has close to the national average income. It is assumed that the ratio of the median to the mean income is 0.77 in all provinces, which was the approximate ratio of the median family income to the mean family income in most Canadian provinces in 2004. It was also assumed that the income distribution in each of the three provinces followed a log normal distribution. In the base case simulations, it is assumed that federal and provincial public services are “equally valuable” and that $\rho = 8$ and $\phi = 8$. Finally, we have assumed for our based case calculation that $\eta_0 = -1.2$ and $\eta_i = -1.5$ to reflect the greater tax sensitivity of the provincial tax bases compared to the federal tax base.

The column (1) in Table 2 shows the values of the key endogenous variables using the base case parameters in the absence of transfers between the two levels of government, perhaps because of a constitutional prohibition against such transfers. The federal tax rate would be 14.9 percent and the provincial tax rates would range from 17.1 percent in province 1 (ROC) to 12.4 percent in province 3 (ONT). The tax price of government services at the median income level in jurisdiction j , $TP_j = (y_m_j/y_a_j)MCF_j$, would be 0.928 at the federal level, and 1.035, 0.974, and 0.946 in provinces 1 to 3 respectively. The tax prices for provincial services are higher than the federal tax price because we have assumed that the provincial tax bases are

more tax sensitive than the federal tax base. The relatively high tax price in province 1 also reflects the fact that given its relatively low average income, it has to impose relatively high tax rates, which drives up its MCF. In our model, these tax prices reflect the marginal benefit of public services for all individuals in each province. Therefore, given these tax prices, all individuals in each province would feel that provincial public services were under-provided relative to federal services in the sense that the marginal benefit from an additional dollar spent on provincial services would exceed the marginal benefit from an additional dollar spent on federal public services. There would be a *vertical fiscal imbalance* in the federation in the sense that there would be too much federal spending relative to provincial spending in all provinces.⁷ We have adopted the following measure of the aggregate vertical fiscal imbalance, VFI, in the federation:

$$VFI = \sum_{i=1}^n p_i TP_i - TP_0 \quad (20)$$

In the absence of federal transfers, the aggregate VFI would be 0.056, indicating that if federal services were reduced by \$1 per capita and provincial services were increased by \$1 per capita there would be a per capita welfare gain of \$0.056.

Column (2) shows the computed values of the key provincial and federal fiscal variables, including intergovernmental transfers, determined according to the median voter model described in the previous section. The model predicts that the federal tax rate would increase to 16.9 percent from 14.9 percent in order to finance transfers to the provinces. These transfers would represent 14.9 percent of total federal spending and finance between 18.1 percent and 16.8 percent of provincial spending. (These figures roughly correspond to the

⁷ There would also be a horizontal fiscal imbalance because the marginal benefit of public spending would not be equalized across provinces. This issue is not addressed in this paper. See Dahlby (2008b) for a more complete discussion of this way of defining fiscal imbalance.

relative size of total federal transfers to the Canadian provinces in recent years.) Our aggregate measure of the vertical fiscal gap is $VFG = (\sum p_i g_i) / T_0$ or 0.173. Provincial tax rates would decline and provincial spending on public services would increase. The γ_i s would range from 0.302 in province 1 to 0.214 in province 3. As a result of the shift of the tax burden to the federal level of government, the tax price of federal services would increase to 0.956 from 0.928 and the tax prices of provincial public services would decline in all of the provinces. The aggregate index of VFI would decline to -0.011, indicating that in aggregate there would be slightly too much spending at the provincial level relative to spending on federal services. However, there would continue to be significant under-provision of provincial services in province 1 because the equal per capita lump-sum transfer would not address the horizontal fiscal imbalances among the provinces; i.e., the differences in their tax prices arising from differences in their per capita tax bases.

The increase in provincial government services and the reduction in federal government service, combined with the federal tax increase and the provincial tax cut, will have different effects on the level of welfare of individuals in different provinces. We have calculated the critical income levels, y_i^* , in each province at which an individual is no worse off as a result of the introduction of the intergovernmental transfers. Individuals in province i with incomes below y_i^* are made better off with the introduction of transfers. $H_i(y_i^*)$ represents the percentage of the population of province i that is made better off as a result of the introduction of intergovernmental transfers. In province 1 and province 2, everyone would be made better off with the introduction of transfers because their total tax rate would decline and they would benefit from the reduction in the VFI in the provision of provincial and federal public services. However, in province 3, only 1.5 percent of the population would benefit from the introduction

of the intergovernmental transfers. The beneficiaries in province 3 would be those with very low incomes. Most individuals in province 3 will be worse off because their combined federal and provincial tax rate would increase by 0.2 percentage points, while the expansion in provincial services would be of less value to them, compared to individuals in other provinces, because they enjoyed a relatively high level of provincial services in the absence of the transfers. These calculations indicate that the introduction of transfers could make high income individuals in the poor and (not so poor) provinces better off at the expense of poor people in the rich province. See Usher (1995) for a discussion of the perverse redistribution that can occur through intergovernmental transfers.

The transfers in column (2) would be regionally divisive, and this raises the question of whether the residents of province 3 would prefer to separate from the federation and form a separate country.⁸ We can use our model to calculate the implications of separation for province 3 and whether a majority of individuals in province 3 would be better off with separation. If province 3 formed a separate country, we assume that its tax base would still be relatively tax sensitive at $\eta_3 = -1.5$. It would have a larger, but more tax sensitive tax base, than the federal government in the “old” federation. Because of this increased tax sensitivity, the MCF for an independent ONT would be relatively high, the optimal levels of g_0 and g_3 would fall below the values in the old federation because the tax price of government services in an independent ONT would be 1.348. As a result of the higher tax price and the consequent reduction in the provision of public services, and the higher average tax base, the total tax rate would decline by 7.5 percentage points. The lower rate of taxation would increase private incomes by approximately 6.2 percent. This combination of factors would leave some high income individuals better off if province 3 separated and other low income individuals would

⁸ See Bolton and Roland (1997) for an analysis of the economics of separation.

be worse off because the cut in public services would affect them more than the gains in their disposable incomes. On balance our calculations show that 56.4 percent of the residents in province 3 would be better off if they separated from the federation if it imposes the transfers in column (2). In the absence of intergovernmental grants, the percentage that would benefit from a separate state for province 3 would drop (marginally) to 55.7 percent. Thus the intergovernmental grants would marginally exacerbate pressures for separation in province 3.

Note that these calculations of the gains from separation assume that province 3 could provide the “federal” public service (say defence activity) at the same cost as in the old federation. However, a smaller country might face high fixed costs and higher unit costs of providing the g_0 . Our calculations show that if the unit cost of providing g_0 were 10 percent higher in an independent ONT, then the percentage of its residents that would benefit from separation would drop from 53.3 percent to 41.2 percent. These results indicate how important economies of scale in the provision of public services may be in binding countries together.

In column (3), we show how the tax sensitivity of the provincial tax base affects intergovernmental transfers. In these calculations, η_i is set equal to -2.0 for all provinces instead of -1.50 as in the base case. Not surprisingly there is a larger vertical fiscal imbalance in this scenario in the absence of intergovernmental grants, viz. $VFI = 0.138$. With intergovernmental transfers, the federal tax rate is higher and the provincial tax rates are lower than with the base case scenario. Transfers represent 22.9 percent of federal spending and between 28.4 and 30.8 percent of provincial spending and the average fiscal gap is 0.294. As in the base case, the tax price of federal services increases and the tax prices of provincial services declines, and the aggregate vertical fiscal imbalance is virtually eliminated. These transfers make all of the residents of provinces 1 and 2 better off and 96.6 percent of the

residents of province 3 are also better off. Overall, 98.7 percent of the residents of the federation are better off with the level of intergovernmental grants determined by the median voter model than they would be in the absence of intergovernmental transfers. Thus in contrast to the base case scenario in column (2), the existence of an intergovernmental grant system would not be a regionally divisive issue. There would be differences of opinion regarding the level of transfers and there would still be horizontal fiscal imbalances, but virtually everyone would agree that intergovernmental transfers were an important part of fiscal architecture of the federation. This scenario shows that if the provinces' tax bases are much more tax sensitive than the federal tax base, then federal transfers to the provinces would be a very popular policy even in the rich province. Only 35.1 percent of the residents of province 3 would be better off if it were an independent country. However, if the federal government was prohibited from providing intergovernmental grants, 36.2 percent of the residents would be better off in an independent country. Thus intergovernmental transfer would reduce (marginally) the support for separatism in province 3. This scenario shows that intergovernmental grants can help bind a country together, in contrast to the scenario in column (2) where intergovernmental grants were divisive and promoted the break-up of the federation.

Column (4) shows the effect of an increase in intra-regional inequality. The ratio of the median to mean income in this scenario is 0.70 compared to 0.77 in the base case scenario in column (2). With the greater degree of inequality, the tax prices of federal and provincial government services for the voter with the median income are lower and the level of government expenditure is higher. However, there is only a slightly greater emphasis on intergovernmental transfers, compared to the base case, and these transfers almost eliminate the aggregate VFI. (In the absence of transfers, the VFI would be 0.058, only slightly higher

than the 0.056 value recorded in the base case.) A slightly higher percentage of the population in province 3 benefits from intergovernmental grants, but 54 percent of the population in province 3 would still benefit from separation if g_0 could be provided at the same unit cost. These computations seem to indicate that the nature of the political equilibrium and the relative provision of intergovernmental grants is not greatly affected by an increase in the degree of income inequality within all regions. The ratio of the median to mean income has declined in all the Canadian provinces over the last 25 years, reflecting a more unequal income distribution. However, our model predicts that this trend would not greatly affect the reliance on intergovernmental grants because it would have similar effects on the demand for both federal and provincial public services and therefore would not greatly affect the vertical fiscal imbalance in the federation.

Column (5) illustrates the effect of greater inter-regional inequality. In this scenario, the average income in province 3 is increased by 5.0 percent and the average income in province one is reduced by 8 percent so that average national income (in the absence of tax changes) would remain the same. In this scenario, the federal tax rate is lower and federal transfers are a smaller percentage of total federal spending than in the base case scenario. The aggregate VFI is reduced from 0.069 in the absence of transfers to 0.018. Given the greater degree of regional inequality, it is not surprising that transfers make virtually everyone in provinces 1 and 2 better off and virtually everyone in province 3 worse off. The percentage of the population of province 3 that would be better off in a separate country would increase to 65.9 percent, and the existence of transfers only boosts this by 0.7 percentage point. Overall, the somewhat surprising lesson from these computations is that greater inter-regional inequality does not necessarily result in greater reliance on inter-governmental grants.

The scenario in column (6) shows that reliance on intergovernmental grants would increase substantially if provincial services were much more highly valued than federal services. In this scenario, $\rho = 12$ and $\phi = 4$. The relatively high valuation of provincial services is meant to reflect, in a rough and ready way, the constitutional division of spending responsibilities in Canada where the provinces have “exclusive” jurisdiction over health, education and welfare. These are the big ticket items for most governments in modern countries, and the provincial-local government sector in Canada is responsible for 60 percent of government program spending in Canada. The calculations show that the federal grants to the provinces would increase to 57 percent of total federal spending and represent between 45.6 and 43.7 percent of provincial spending, with an average fiscal gap of 0.440. This level of transfers would eliminate the aggregate VFI which would be substantial in the absence of fiscal transfers—VFI = 0.245. The provision of transfers would make over 99.9 percent of the population in the poor province better off, but only improve the well-being of 60.5 percent of residents of province 2 because the residents of that province would face a two percentage point tax increase (compared to the no transfer case). In province 3, 23.3 percent of the population would be better off with the transfers from the federal government, but 57.5 percent of the population would be better off with a separate province. Transfer would boost the percentage that would benefit from separation from 52.9 to 57.5 percent. The conclusion that we draw from these calculations is that a strong preference for provincial public services compared to federal public services could result in a very large fiscal vertical fiscal imbalance in the absence of transfers. A majority of voters might desire relatively large transfers—creating a very large fiscal gap—in order to address this problem. However, these transfers

might strengthen support for separatism in a rich province because it would be better able to provide these more valuable provincial services on its own.

4.0 Intergovernmental Transfers with a Bicameral Federal Legislature

The previous model assumed that the federal legislature was unicameral with the geographic representation in the House based on population. However, some federations, such as the United States and Australia, have bicameral federal legislatures, where equal numbers of representatives are elected to an upper house, or Senate, from each subnational government, resulting in greater per capita representation by small subnational governments.⁹ We will now assume that the Senate and the House jointly determine the federal government's fiscal policy, and that there are an equal number of senators from each province. Each senator's desired fiscal policy will reflect the median voter's preference in his state, i.e. the preferences of the individual with the median income in his province. Substituting y_{mi} for y_h in (10) and in (12b), the Senator for province i would want the t_0 , g_0 , and T_0 to be determined by the federal budget constraint in (9) and the following conditions:

$$P'(g_0) = \frac{y_{mi}}{y_{a0}} MCF_0 \quad (21)$$

$$t_0 = -\frac{1}{\eta_0} \left(1 - \left(\frac{y_{ai}}{y_{a0}} \right) \frac{1}{MCF_i} \right) \quad (22)$$

Note that (22) is equivalent to (12b), the tax rate that would be preferred if voters thought that an additional dollar of grant would be used for tax cuts. It is reasonable to assume that

⁹ Atlas et al. (1995) in a study of the pattern of U.S. federal spending 1972-1990 found that states with greater per capita representation in the Senate and House received higher per capita federal spending. Porto and Sanguinetti (2001) found that the provinces in Argentina that were over-represented in the senate and the lower house received more resources per capita from the central government than other provinces. See also Stegarescu (no date) for a detailed empirical study of the characteristics of upper chambers and their impact on fiscal decisions in federations.

provinces with low average incomes will also tend to have high MCFs because these provinces will generally have apply higher tax rates to finance provincial public services and therefore have higher MCFs. Therefore we will assume that the provinces can be ordered as follows:

$$\frac{y_{a1}}{MCF_1} < \frac{y_{a2}}{MCF_2} < \frac{y_{a3}}{MCF_3} < \dots < \frac{y_{an}}{MCF_n} \quad (23)$$

The Senator from a province with a low y_{ai}/MCF_i ratio would want a higher federal tax rate for two reasons. First the federal tax price of funds will be lower compared to the provincial tax price if the average income in the province is lower. Second, the marginal benefit from the transfers financed by a higher federal tax rate will be of more value when the provincial MCF is high. Consequently, the federal tax rates desired by the senator from province i , t_{0i} , will be ranked as $t_{01} > t_{02} > t_{03} > \dots > t_{0n}$. In the Senate, the median desired federal tax rate will be the tax rate desired by the Senator from the province with the median provincial average income, y_{ai}^{med} . It is also reasonable to assume (if the intra-regional inequality does not vary a great deal from province to province) that this province will have the median provincial median income, y_{mi}^{med} and it will prefer the median desired level value for g_0 . Consequently, our model assumes that the Senate would support a fiscal policy that is characterized by the following conditions:

$$P'(g_0) = \frac{y_{mi}^{med}}{y_{a0}} MCF_0 \quad (24)$$

$$t_0 = -\frac{1}{\eta_0} \left(1 - \left(\frac{y_{ai}^{med}}{y_{a0}} \right) \frac{1}{MCF_i} \right) \quad (25)$$

It should be clear that the tax, expenditure, and transfers policy that would be supported by the Senate might be quite different from the tax, expenditure, and transfers policy that would be supported in the House and that the federal government's policy might be a compromise between the desired fiscal policies of the House and the Senate. The modelling the

compromise or bargain between the two houses is beyond the scope of this paper. Here we will simply note that the Senate will tend to support higher federal taxes (and presumably higher level of federal transfers) if the federation has a relative large number of low average income provinces. Therefore, we would expect that in a federation where the Senate has some influence over the federal budget, the level of federal taxation and federal transfers to the provinces will be higher if the federation has a relatively large number of poor provinces, i.e., where the y_{ai}^{med} / y_{a0} ratio is low.¹⁰

Would a Senator from an above average income province ever support positive transfers from the federal government even though an additional dollar of federal transfers might “cost” the average taxpayer in his province more than a dollar? If we substitute (25) into (19), we obtain the following condition for a provincial representative to want positive federal transfers:

$$\frac{y_{a_i}}{y_{a_0}} < \frac{ym_0}{ym_0 - \phi\eta_0} MCF_i \quad (27)$$

The right-hand side of (27) could be greater than one if a province’s marginal cost of public funds is high, and the tax sensitivity of the federal tax base and the value of federal services are relatively low. Therefore, it is possible for a province with an above average income to desire a positive level of transfers from the federal government even though, as in the case of Ontario, an additional dollar of federal transfers might “cost” the average Ontario taxpayer \$1.15.

To gain some appreciate of the effect that a bicameral federal legislature might have on the vertical fiscal gap in a federation, we have calculated the political equilibria using the same parameter values as in the base case in Table 2. The column in Table 3 labelled House Control

¹⁰ See Pereira (1996) for a formal model of the effects of “one mayor one vote” on the pattern of intergovernmental grants in Portugal.

is the same as column (2) in Table 2. It is repeated here to ease comparisons. The column labelled Bicameral Compromise represents the values of the fiscal variables if the House and the Senate agreed to split the difference between their desired tax and expenditure rates. Note that in these scenarios, the Senate's fiscal policy is based on the policy desired by the Senator from province 2 (ABC) and that province's average income is close to the national average in these simulations. In spite of this, the compromise solution would involve substantially higher federal transfers, and the VFG would 0.336 compared to 0.176 if the House controlled the federal fiscal policy. The column labelled Senate Control represents the fiscal policies that would prevail if the Senate determined the federal government's fiscal policies. In this scenario, the VFG would be 0.504. Note that with Senate Control, a significant negative fiscal imbalance could emerge as a result of the large transfers to the provinces. In summary, these calculations indicate that a bicameral federal legislature, where the Senate has some influence over fiscal policies, could result in substantially higher intergovernmental transfers even though the median average provincial income is close to the average national income.

5.0 The Vertical Fiscal Gaps in Australia and Canada

We introduced our paper with the observation that there are substantial variations in the vertical fiscal gaps across federations, and we highlighted the large difference in the vertical fiscal gaps in Australia and Canada. Does our model help to explain the differences between these two federations?

Three factors are largely responsible for the differences in the fiscal gaps in Australia and Canada—the “Quebec factor”, differences in regional representation in the federal

parliaments, and differences in the effective tax powers exercised by the Australian states and the Canadian provinces. We consider each of these factors below.

The province of Quebec has played a crucial role in asserting provincial powers in taxation and spending and resisting federal encroachment in areas of “exclusive” provincial jurisdiction through the provision of federal grants.¹¹ No state government in Australia has insisted on its need for fiscal independence in order to promote its cultural and linguistic independence to anywhere near the same degree. The Quebec factor is obviously something that is “outside” our model, and to a certain degree it has influenced the other factors, regional representation in Ottawa and the tax powers of the provinces, which play key roles in our model.

There are significant differences in the regional representation in the federal parliaments which may have influenced the size of the vertical fiscal gap in the two countries. Australia has a bicameral federal legislature. Each of the six states has 12 elected Senators, while the Northern Territory (NT) and the Australian Capital Territory (ACT) each have two. Although the federal parliament in Canada has a Senate, it has little effective power because its members are appointed by the Prime Minister. Consequently, the Senators do not have the moral authority, under most circumstances, to overturn legislation that has been passed in the House of Commons. This makes the Canadian federal parliament effectively unicameral.

The lack of effective regional representation in the Canadian federal parliament is one of the factors that has enhanced the role of the provincial governments in championing provincial concerns. This political process, involving negotiations and consultation between the federal and provincial governments, has become known as executive federalism. The level of intergovernmental grants is frequently discussed at these federal-provincial conferences. In

¹¹ See Telford (2003) on Quebec’s opposition to the use of the federal spending power in Canada.

some sense, the leaders of the provincial governments, the Premiers, have taken on the roles that are fulfilled by Senators in other federations. However, the Premiers have no constitutional powers with regard to the setting of intergovernmental grants, and therefore it is unclear whether the provinces, individually or collectively, have an influence on this aspect of federal policy.

Has the existence of a bicameral parliament in Australia affected the level of transfers to the states compared to Canada which effectively has a unicameral federal parliament? Our model predicts that transfers to subnational governments will be larger if the national parliament is bicameral with equal representation from each state and if there are a relatively large number of low income states. In particular, if the median average state income is below the national average income, the median Senator will favour higher transfers to the states than the median Representative in the House.

Figure 2 shows the average taxable income in each state in Australia in 2003. Tasmania had the lowest average taxable income, \$35,477 and the ACT had the highest, \$45,985. The national average taxable income was \$40,825. The three states with average incomes significantly below the national average—Tasmania, Queensland, and South Australia—had a combined total of 36 senate seats, and our model would predict that the Senators from these states would support relatively high transfers to the state governments. Two states, Western Australia and Victoria, had average taxable incomes slightly below the national average. In total, 60 Senators came from states that had average incomes below the national average. In contrast, only New South Wales, the Northern Territory and the ACT had average incomes that are above the national average, and they had a combined total of 16 Senators. As Figure 3 indicates, the cumulative distribution of Senate seats, ordered by

average state income, is much more pro-poor than the distribution of the population, also suggesting that the upper house would favour higher transfers than a lower house elected on the basis of population. In summary, the overwhelming major of Senators come from states that have average incomes that are below the national average, and our model would predict that the existence of a senate in Australia has increased the level of transfers relative to country, such as Canada, with a unicameral federal parliament.

While the vast majority of Senators in Australia come from states with below average incomes, our model also suggests that the crucial votes will be by Senators from the state with the median average state income, and that the pressure for high transfers will be larger when the ratio of the median average state income to the national average income is low. Western Australia has the “quasi median” average state income, in the sense that 36 Senators come from states with lower average incomes and 28 Senators come from states with higher average incomes. However, Western Australia’s average taxable income, \$40,187, was 98.4 percent of the national average in 2003, and therefore the incentives for Western Australian Senators to raise transfers to the states in order to redistribute income to their residents is not very strong.

In summary, the existence of an upper chamber in Australia, with a large majority of senators from relatively poor states, would be expected to increase the size of the vertical fiscal gap relative to Canada, but the median average state income is close to the national average, which would diminish the importance of the bicameral federal legislature for determining the size of the vertical fiscal gap in Australia.

The third factor that has undoubtedly contributed to the larger fiscal gap in Australia is that the states have more limited effective tax powers than Canadian provinces. Both the Canadian provinces and the Australian states are limited to “direct taxes”, but judicial

interpretations of this illusive concept resulted in rulings that prohibited state sales taxes in Australia but permitted provincial sales in Canada. The inability to levy sales taxes has severely restricted the revenue raising capacity of the Australian states. Furthermore, the Australian states do not levy personal or corporate income taxes while these taxes are important sources of own-source revenue for the provincial governments in Canada. The absence of state income taxes in Australia can be traced to the centralization of taxation that occurred in World War II, when the Commonwealth government took control of these fields in order to finance the war effort. After the war, the Commonwealth government retained its exclusive control over these tax fields because the state governments were reluctant to re-enter these fields by imposing their own tax rates. In Canada, similar policies were adopted to finance the war effort, and the federal government took control of the personal and corporate income tax fields. However, after the war there was strong pressure by Quebec and Ontario to levy their own income taxes, and the provinces re-entered these tax fields. The upshot of this political and fiscal history is that the Australian states do not levy sales and income taxes while the Canadian provinces do. As a result, the state governments in Australia are effectively limited to relatively distortionary forms of taxes,¹² such as excise taxes, and therefore the MCFs of the state governments would be very much higher than the Commonwealth government's MCF in the absence of a large fiscal gap.

In summary, while the Quebec factor has undoubtedly played a key role in giving provincial governments greater effective tax powers in Canada than the states exercise in Australia, the absence of an effective upper house in Canada and the willingness to exercise of

¹² By this we mean that if the Australian states were to raise similar amounts of revenue to the Canadian provinces they would have to levy very high tax rates on their limited tax bases and these high tax rates would be very distortionary.

those tax powers by all of the Canadian provinces have likely reduced the size of the vertical fiscal gap in Canada compared to Australia.

6.0 Conclusion

Our model attempts to explain how the electoral process, tax assignment, and expenditure assignment in a federation may affect the size of the vertical fiscal gap. It provides some insights to the questions that we posed in the introductory section.

How does the allocation of spending powers and the tax assignment in a federation affect the size of the fiscal gap?

Our model predicts that the fiscal gap will be larger the greater tax sensitivity of the provincial tax bases compare to the federal tax base and the greater the relative importance of provincially-provided public services compared to federal services. If the provinces' tax bases are highly mobile or if they are responsible for important public expenditures, such as health, education and welfare, then the fiscal gap will be larger.

Does income inequality, between provinces and within provinces, affect the size of the fiscal gap?

The fiscal gap might be larger the greater the degree of regional income inequality, as measured by differences in average incomes by province, but this is not always the case. Intra-provincial income inequality seems to have little effect on the size of the fiscal gap.

Does a fiscal gap improve or distort the allocation of resources in an economy?

A fiscal gap can improve the allocation of public sector spending and taxation when the provincial tax bases are much more tax sensitive than federal tax bases and when provinces provide important public services. However, a very large fiscal gap, resulting in “excessive”

provincial spending, could be generated by a democratic process especially if there are many poorer provinces that have strong representation in the central government through an upper house.

Who gains and who loses from federal transfers to subnational governments?

Individuals in low average income provinces tend to gain at the expense of individuals in high income provinces. Intergovernmental transfers can redistribute income from poor individuals in rich provinces to rich individuals in poor provinces. However, if the provincial tax bases are highly tax sensitive, almost everyone in the federation, including the most of the residents of rich provinces, can be made better off through federal transfers to the provinces.

Do intergovernmental transfers promote national unity or exacerbate regional tensions?

Intergovernmental grants can promote national unity if the tax sensitivity of the provincial tax bases is relatively high because the federation serves as a “tax cartel”. Intergovernmental grants can exacerbate regional tensions if the differences in average provincial incomes are large, leading to the “fiscal exploitation” of rich provinces.

Does size of the fiscal gap depend on whether the federal legislature is unicameral or bicameral?

A bicameral federal legislature, where each province in the upper house has the same number of representatives, will tend to provide higher intergovernmental transfers than a unicameral legislature if the median average provincial income is low compared to the national average income. That is, if there are a large number of relatively poor provinces. Executive federalism, as practiced in Canada, has an unknown effect on federal transfers, but the influence of the provincial governments may be felt through the demand for transfers expressed by the “pivotal province”. Our analysis indicates that British Columbia has played this role

during most of the last 25 years, but changes in real per capita (non-equalization) transfers are not closely linked to changes in the relative tax prices of provincial and federal services in BC.

Does the magnitude of stimulative effect of transfers on a jurisdiction's spending influence the level of transfers?

Our model predicts that the stimulative effect of transfers on spending will be larger in provinces with lower average incomes. A larger stimulative effect generally means that intergovernmental transfers provide relative greater benefits to lower income individuals.

However, it has an ambiguous effect on the desired transfer by the median voter in a province.

Why would the representatives of relative rich provinces support at least some level of intergovernmental transfers from the central government?

The representatives from a province with an average income above the national average might desire positive transfers from the federal government if the province's marginal cost of public funds is high, the tax sensitivity of the federal tax base is relatively low, and the marginal benefit from federal services is relatively low.

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Table 1 Transfers as a Percentage of Regional Government Spending

<i>Country</i>	<i>1970</i>	<i>1980</i>	<i>1990</i>	<i>1998</i>
Australia	46.4	53.3	44.6	40.7
Austria	33.0	34.7	36.1	46.5
Belgium		51.0	53.5	53.7
Canada	23.7	19.5	16.4	13.8
Germany	15.3	16.1	15.0	17.3
Spain		97.5	67.4	65.8
Switzerland	28.5	26.9	19.2	30.7
United States	27.7	26.4	21.1	25.0

Source: Bird and Tarasov (2004, Table 3, p.91)

Table 2 Calculation of the Vertical Fiscal Gap with a Unicameral Federal Legislature

Column Number	(1)	(2)	(3)	(4)	(5)	(6)
Parameter Values	Base Case ^a	Base Case ^a	Greater Sensitivity of the Provincial Tax Bases ^b	Greater Intra-Regional Inequality ^c	Greater Inter-Regional Inequality ^d	Stronger Preferences for Provincial Public Services ^e
	Transfers Prohibited	Transfers Permitted				
t_0	0.149	0.169	0.191	0.190	0.165	0.168
t_1	0.171	0.145	0.124	0.161	0.163	0.144
t_2	0.140	0.119	0.104	0.133	0.124	0.121
t_3	0.124	0.106	0.093	0.119	0.106	0.110
$T_0/(T_0 + g_0)$	--	0.149	0.229	0.154	0.115	0.571
T_0/g_1	--	0.181	0.308	0.187	0.140	0.456
T_0/g_2	--	0.172	0.292	0.177	0.130	0.437
T_0/g_3	--	0.168	0.284	0.173	0.126	0.428
VFG	--	0.173	0.294	0.178	0.132	0.440
γ_1	--	0.302	0.389	0.340	0.333	0.393
γ_2	--	0.243	0.319	0.274	0.245	0.326
γ_3	--	0.214	0.283	0.242	0.205	0.292
TP_0	0.928	0.956	0.988	0.897	0.942	0.955
TP_1	1.035	0.984	1.025	0.923	1.019	0.982
TP_2	0.974	0.938	0.972	0.874	0.947	0.941
TP_3	0.946	0.916	0.947	0.852	0.916	0.922
VFI	0.056	-0.011	-0.008	-0.014	0.018	-0.007
$H_1(y_1^*)$	--	1.00	1.00	1.00	1.00	0.999
$H_2(y_2^*)$	--	1.00	1.00	1.00	1.00	0.605
$H_3(y_3^*)$	--	0.015	0.966	0.053	0.000	0.233
H_0^*	--	0.606	0.987	0.621	0.600	0.594
Notes:						
^a $p_1 = 0.35, p_2 = 0.25, p_3 = 0.40; y_{mi}/y_{ai} = 0.77, \rho = 8, \phi = 8, \eta_0 = -1.2, \eta_i = -1.5, y_{a1}/y_{a0} = 0.82, y_{a2}/y_{a0} = 1.016, y_{a3}/y_{a0} = 1.148$ (relative average incomes in the absence of taxation)						
^b $\eta_i = -2.0 \quad i = 1, 2, 3$						
^c $y_{mi}/y_{ai} = 0.70$						
^d $y_{a1}/y_{a0} = 0.754, y_{a2}/y_{a0} = 1.016, y_{a3}/y_{a0} = 1.205$ (relative average incomes in the absence of taxation)						
^e $\rho = 12, \phi = 4$						

Table 3 Fiscal Outcomes with a Bicameral Federal Legislature

	House Control	House and Senate Compromise	Senate Control
t_0	0.169	0.187	0.207
t_1	0.145	0.119	0.091
t_2	0.119	0.098	0.076
t_3	0.106	0.088	0.068
$T_0/(T_0 + g_0)$	0.149	0.270	0.376
T_0/g_1	0.181	0.347	0.515
T_0/g_2	0.172	0.334	0.502
T_0/g_3	0.168	0.329	0.496
VFG	0.173	0.336	0.504
γ_1	0.302	0.289	0.275
γ_2	0.243	0.234	0.225
γ_3	0.214	0.208	0.201
TP_0	0.956	0.920	0.884
TP_1	0.984	0.937	0.892
TP_2	0.938	0.903	0.869
TP_3	0.916	0.887	0.858
VFI	-0.011	-0.074	-0.142

Figure 1
The Median Desired Federal Tax Rates in Three Provinces

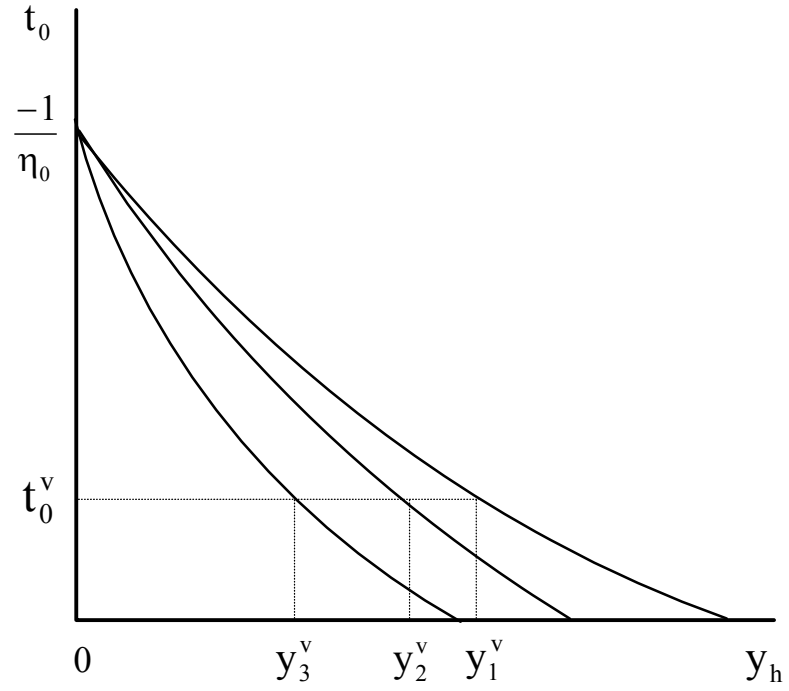
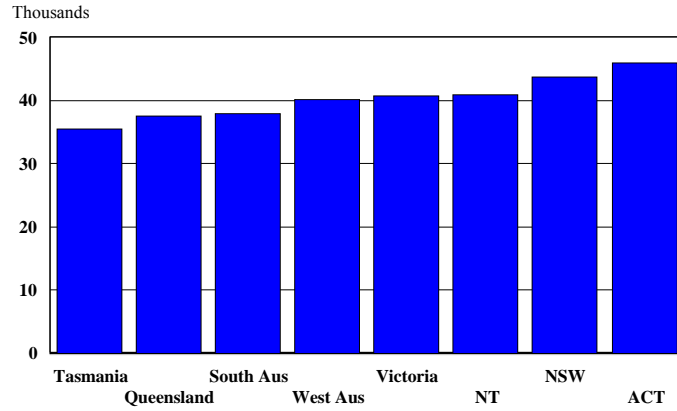
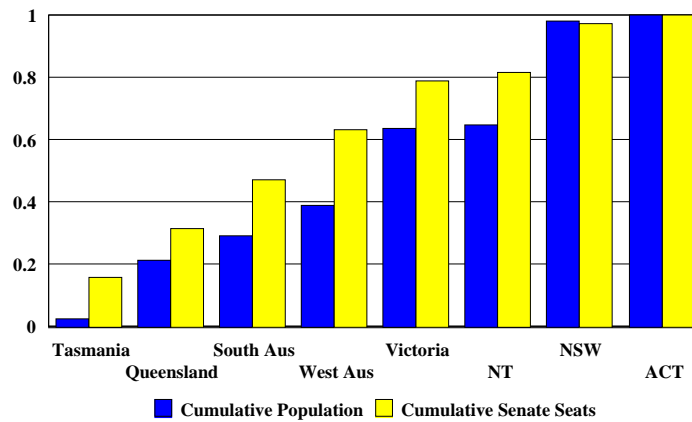


Figure 2
Average Income by State in Australia in 2003



Source: Australian Bureau of Statistics, *National Regional Profile, 2000 to 2004*

Figure 3
The Distribution of Population and Senate Seats by State in Australia in 2003



Source: Australian Bureau of Statistics, *National Regional Profile, 2000 to 2004*