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Fiscal equalization, government expenditures and endogenous growth

Philippe Cyrenne · Manish Pandey

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Abstract This paper analyzes the effect of a fiscal equalization system on the composition of government expenditures of subnational governments. We incorporate vertical equalization transfers with optimal choice of the composition of government expenditures in an endogenous growth model and show that such transfers reduce the incentives of recipient subnational governments to undertake productive expenditures. Using data for Canadian provinces, we find evidence that, after controlling for a number of determinants of government expenditures, the ratio of productive expenditures to total government expenditures was lower in equalization-receiving than non-receiving provinces.

Keywords Fiscal equalization · Government expenditures · Endogenous growth

JEL Classification H7 · E62

1 Introduction

Many national governments have instituted a fiscal transfer system to "equalize" the revenues or costs required to fund expenditures of subnational governments. The liter-

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P. Cyrenne · M. Pandey (✉)
Department of Economics, University of Winnipeg, 515 Portage Avenue,
Winnipeg, Manitoba R3B 2E9, Canada
e-mail: m.pandey@uwinnipeg.ca

P. Cyrenne
e-mail: p.cyrenne@uwinnipeg.ca

ature provides three potential justifications for such transfers: to internalize spillovers between jurisdictions, to equalize the fiscal capacity of subnational governments, and to improve the overall tax system (Oates 1988). Some countries that have had a long standing system of equalization or revenue sharing include Australia, Canada, Germany, and Switzerland.[1] In general, an equalization system involves making transfers to "have not" regions from what are called "have" regions or the national government.[2]

The economic effects of such policies have been examined from a number of perspectives. Oates (1988) addresses the issue of intergovernmental grants in the context of fiscal federalism, which is defined as an analysis of issues related to the vertical structure of the public sector. Boadway (2004) notes that the discussion of equalization in the economic literature is largely based on the work of Buchanan (1950, 1952) who examined the role of equalization in enhancing equity and efficiency in a federal state. A related literature has analyzed the impact of equalization on the tax rates chosen in recipient jurisdictions. For example, Smart (1998) argues that when recipient jurisdictions receive equalization grants based on their relative fiscal capacity, the grants may tend to increase the distortionary tax rates chosen by the recipient jurisdictions.[3]

While a number of papers have examined the impact of equalization on tax rates, to the best of our knowledge, no study has analyzed the effect of fiscal equalization on the composition of expenditures of subnational governments.[4] The argument underlying this paper is the following. Given a system of equalization, the decisions made by subnational governments are likely to be distorted in a number of ways. Apart from the distortion on the tax side, there are likely to be distortions in spending decisions made by subnational governments.[5] This effect of equalization on the composition of government spending is the central concern of this paper. In particular, we examine whether subnational governments may be induced to take actions which undermine an implicit goal of equalization, namely to provide resources to "have not" subnational governments so as to reduce their future dependency. That equalization may have such undesirable effects has been recognized by Courchene (1994).

Given that our focus is on the long-run effect of equalization on the composition of government expenditures, we use an endogenous growth model to examine this effect.

[1] "Among the worlds federations, the USA is an extreme outlier with regard to the efforts undertaken by the national government to equalize the taxing capacity of subnational jurisdictions." (Stark 2010, p. 3). Transfers from the US federal government to the states take the form of block grants or project-based transfers (Fisman and Gatti 2002). Even though the USA does not have a formal equalization system, there is redistribution between regions within the USA. Bayoumi and Masson (1995) analyze federal taxes and transfers within the USA and find that "redistributive flows from all federal sources amount to around 22 cents in a dollar" (p. 269).

[2] See Blöchliger and Charbit (2008) for a detailed overview of the types of equalization systems used by national governments.

[3] The intuition for the argument is that the transfers effectively compensate subnational governments for a portion of the dead weight loss associated with distortionary taxes, thus tending to increase the level of such taxes in recipient provinces.

[4] Most of the literature takes an optimal tax approach in which the government chooses tax rates to minimize the deadweight loss from taxation subject to a revenue or government expenditure constraint.

[5] Dahlby (2002) reviews a number of incentive effects of fiscal equalization payments and provides a simple framework to analyze whether subnational governments would under- or over-provide government investment services.

Specifically, we use the framework proposed by Barro (1990), which examines the optimal choice and composition of government expenditures in an endogenous growth model.[6] The Barro model examines the optimal decision of government expenditures on unproductive and productive services. Expenditures on unproductive services are defined as spending that is for current consumption, which may involve an expansion in the range of public services or even a replacement or a subsidy for publicly provided private goods. In contrast, government spending on productive services are resources devoted to enhancing growth and subsequent own-source revenues. In the model, government expenditures on productive services increase the productivity of capital, whereas expenditures on unproductive services provide utility in the current period. We incorporate a fiscal equalization system in the Barro model in which equalization payments decrease as total tax revenues of the subnational government increase and solve for the balanced growth path (BGP) equilibrium.[7] Along the BGP, the optimal choice of productive and unproductive public expenditures differs between equalization-receiving and non-receiving subnational governments. In particular, the model predicts that the former choose a higher ratio of government expenditure on unproductive services to total expenditure than the latter.

To examine the predictions of the model, we use data on the composition of government expenditures for Canadian provinces over the 1989–2009 period and classify expenditures as either productive or unproductive.[8] We use a regression equation in which we control for a number of determinants of government expenditures and estimate the difference in the ratios of productive and unproductive to total expenditures between equalization-receiving and non-receiving provinces.[9] Consistent with the predictions of the model, we find that the share of unproductive (productive) expenditures was higher (lower) in equalization-receiving than non-receiving provinces. Further, we examine the robustness of our result by using an alternate measure for productive expenditures, government capital expenditures by provinces. We find that the ratio of government capital expenditures to total expenditures was lower in equalization-receiving than non-receiving provinces. This again provides evidence confirming the predictions of the model.

While our analysis is based on the behavior of governments within a single country, it is clear that the issues raised here have more general applicability. For example, a much discussed issue is the merits of a fiscal equalization system for the European Monetary Union (EMU).[10] It has long been recognized that an economic union requires many instruments, both monetary and fiscal, in order to stabilize the economies of the

[6] A number of studies have used the Barro (1990) model to examine how different types of government spending might affect the long-run growth of an economy. For a recent survey of the different extensions to the Barro model, see Irmen and Kuehnel (2009). Also, see Kneller et al. (1999) and Bleaney et al. (2001) for empirical studies examining the predictions of the Barro model.

[7] The equalization function we use captures the "claw-back" feature present in the Canadian equalization system. For further details, see the discussion in Sect. 2.

[8] We follow Kneller et al. (1999) for classifying government expenditures. Further details on the classification are provided in Sect. 4.

[9] We follow the literature examining the size of governments to determine the control variables for our regressions. See Sect. 4 for details.

[10] See Fatás et al. (1998) for a discussion of this issue.

individual member countries. The introduction of a fiscal equalization system for the EMU, however, may have unintended consequences. For example, Checherita et al. (2009) in a study of a large sample of European regions during the 1995–2005 period find that net fiscal transfers used for regional redistribution impede output growth in the receiving regions, which is termed "immiserizing convergence." Our finding that fiscal transfers reduce the incentives of recipient subnational governments to undertake productive expenditures may provide some insight into the mechanism through which regional redistribution may impede growth.

Our analysis is also related to the literature that examines the effect of foreign aid on the behavior of recipient governments. For example, Chatterjee et al. (2012) examine the link between foreign aid and government spending using a panel data set of 67 countries. Similar to our findings for Canadian provinces, they find that foreign aid crowds out a large fraction of domestic government investment. Another related area of research examines what is called the "flypaper effect," which maintains that unconditional grants tend to increase public spending more than a corresponding increase in own-source revenues.[11]

This paper is organized as follows. The next section provides a brief discussion of the various types of equalization systems currently used by national governments. In Sect. 3, we build on the model developed by Barro (1990) by incorporating a common form of equalization and examine its effect on the optimal choice of productive and unproductive expenditures of a subnational government. In Sect. 4, we present some empirical evidence related to the testable implications derived from the model. Section 5 concludes the paper.

2 Equalization and intergovernmental transfers

As described by Blöchliger and Charbit (2008), many countries have a system of intergovernmental transfers. A key motivation for intergovernmental transfers is to equalize the net fiscal benefits received by citizens living in different regions of a country. Net fiscal benefits are defined as the benefits citizens receive from the consumption of public services minus the taxes they pay to provide them. Blöchliger and Charbit (2008) observe that intergovernmental transfers or fiscal equalization arrangements are features of both unitary countries (for example, Denmark, Finland, Japan, Portugal, Norway, Sweden, and Turkey) as well as federal/regional countries like Australia, Canada, Austria, Switzerland, Italy, Spain, and Germany. In some cases, these equalization systems are embedded in the constitution of the country (for example, Canada).

The discussion of fiscal equalization in the economics literature is largely based on the work of Buchanan (1950, 1952) who examined the role of equalization in enhancing equity and efficiency in a federal state. Equalization may be used to promote horizontal equity, by enabling persons in different regions with a given income to

[11] See Logan (1986) for a general model, and Hammes and Wills (1987) for an empirical study based on the Canadian experience. Also, see Baskaran (2012) for a recent review of the literature examining the "flypaper effect."

Table 1 Equalization systems

	Revenue equalization	Cost equalization
Vertical	Canada, Italy, Greece, UK	Austria, Canada, Denmark, Italy
Horizontal	Australia, Austria, Denmark, Finland	Australia, Norway, Sweden

Source Table 3 page 10 and Table 4 page 13 from Blöchliger and Charbit (2008)

obtain comparable public services at comparative tax rates (Boadway 2004, p. 214). Regarding efficiency effects, Boadway and Flatters (1982) argue that an equalization system involving the taxation of revenues earned from resources in wealthier provinces, and subsequent transfers to provinces with lower natural resource revenues, prevents excess migration from "have not" provinces to "have" provinces. They argue that this improves overall efficiency in a federal system like Canada.[12] Finally, fiscal equalization may insure regions against shocks, which have a significant effect on their government budgets.[13]

Boadway (2004) observes that fiscal equalization transfers are based on one of two measures. The first has been termed revenue equalization, in which transfers are made to equalize the revenues among subnational governments. The second type is based on cost equalization, which aims to reduce the per capita cost of providing a standard set of public services at the regional level. Blöchliger and Charbit (2008) observe that a region may have a higher per capita cost due to greater needs (a higher level of a particular service is required per capita) or higher unit cost (a service is more costly to provide in one region than another). They report that most countries use a combination of revenue and cost equalization. However, there are some "pure systems": Australia and Sweden use a cost equalization system, while Canada and Italy use a revenue equalization system.

Another key distinction between equalization systems is related to the source of the transfers made to the subnational governments. One approach is to use a horizontal equalization system, which involves zero-sum unconditional transfers from wealthier to poorer subnational governments. The other approach is a vertical system in which a higher level or national government, through its taxation power, transfers income only to those subnational governments whose fiscal capacity is below some benchmark level.[14] Examples of countries using a horizontal equalization system include Australia and Denmark, while Canada, Greece, and the UK use a vertical equalization system. Table 1 summarizes the combinations of equalization systems currently used by national governments.

The central feature of our approach is a focus on the incentive properties of the revenue equalization system. In order to effect transfers, either in horizontal or vertical systems, there must be an explicit rule or formula that is used to determine the trans-

[12] In a recent study, Albouy (2012) evaluates the equity and efficiency of the equalization system in Canada and finds that the Canadian equalization system is neither efficient nor equitable.

[13] See Boadway (2004, p. 214), Boadway and Hayashi (2004), Blöchliger and Charbit (2008, pp. 16–17).

[14] Boadway (2004, p. 213) uses the term gross transfer scheme for the latter and net transfer scheme for the former.

fers.[15] The focus of our paper is on a vertical revenue equalization system, which is the system used in Canada. In the Canadian case, the vertical equalization system features a "claw-back" mechanism, that is a system in which higher own-source revenues of receiving governments results in a reduction in the amount of the equalization or transfer it receives.[16] For example, the Canadian system is designed to address differences in the revenue raising capacity of provinces with the goal of reducing differentials in net social benefits (Boadway and Hayashi 2004). The formula for calculating the per capita equalization e_{kt} received by a province is

$$e_{\mathrm{kt}} = \max\{0, \Sigma_j \tau_t^j (b_{\mathrm{St}}^j - b_{\mathrm{kt}}^j)\}$$

where b_{kt}^j is the per capita tax base for province k, and b_{St}^j is the average of the per capita tax base for five "standard" provinces. These are calculated for 33 revenue categories, that is $j = 1, \ldots, 33$. The difference in the tax bases $(b_{\mathrm{St}}^j - b_{\mathrm{kt}}^j)$ is multiplied by the national average tax rate τ_t^j and summed to yield the overall amount of the equalization transfer.[17] As can be seen, the equalization received is a function of both the tax base of the province in question and an average tax base. Of particular note is that an increase in a province's tax base, b_{kt}^j, in relation to the average tax base reduces the amount of the equalization payment received. It is this claw-back feature of the Canadian equalization system that we examine in the following endogenous growth model.

3 Model

Using the endogenous growth framework proposed by Barro (1990), in this section we develop a model of the optimal choice of the allocation of government expenditures between productive and unproductive expenditures. To highlight the main mechanism at work, we consider the planner's problem for a subnational economy.[18] For simplicity, we abstract from the effects of labor mobility between subnational regions by assuming that there is no population growth and normalize the population of the economy to 1.

[15] In general, there are two approaches to determine the amount of the transfer: using a representative tax base system (for example Canada, Italy, Finland, and Norway) or using actual tax revenues (for example Greece, Portugal, Switzerland, and the UK). The two approaches are used for both vertical and horizontal transfer systems. See Blöchliger and Charbit (2008, p. 10) for details.

[16] For a discussion of the disincentive effect of this claw-back or base tax-back, see Boadway (2004, p. 240). Boadway argues that the base tax-back effect is a potentially more powerful disincentive and occurs when regions can directly control the size of the tax base.

[17] The "standard" is based on the provinces of Quebec, Ontario, Manitoba, Saskatchewan, and British Columbia.

[18] An alternative approach to analyze this issue would be to consider the decentralized equilibrium in our framework. In a decentralized equilibrium, the representative consumer and producer do not take into account the externality from the publicly provided investment services when making their decisions. Though the growth rate in the BGP is different in the two approaches, the mechanism for deciding between the consumption and productive services provided by the government in the decentralized equilibrium would be similar to that of the planner's problem.

Utility is derived from private consumption (c) and services provided by the government (g^u), which we will term expenditure on "unproductive" public services. Utility at time t is given by:

$$U(c_t, g_t^u) = \ln(c_t) + \phi \ln(g_t^u),$$

where the parameter $\phi > 0$ determines the importance of services provided by the government. The utility function assumes that private consumption and public services are complementary.

Following Barro (1990), the production function in per worker terms at time t is given by:

$$y_t = A k_t^{\alpha} (g_t^p)^{1-\alpha}, 0 < \alpha < 1,$$

where A is a total factor productivity, and g^p is expenditure on productive services per worker provided by the government. Government provided productive services increase the marginal product of capital per worker, k.

At time t, there are two sources of revenue for the subnational government: income tax revenues, τy_t, where τ is the average tax rate and is exogenously given, and an equalization payment received as a transfer from the federal government (e_t). Since we are interested in the planner's allocation of expenditure between productive and unproductive public services, we follow Chen (2006) and hold the average tax rate τ, and hence the size of the subnational government relative to GDP, fixed.

We assume the following functional form for equalization payments:

$$\begin{aligned} e_t &= \eta(\bar{\tau}\bar{y} - \tau y_t), \text{ if } \bar{\tau}\bar{y} > \tau y_t \\ &= 0 \text{ otherwise,} \end{aligned} \tag{1}$$

where $\bar{y}$ represents the average tax base (determined by the equalization formula), and y_t represents the tax base of the subnational economy. The equalization function captures the feature that equalization payments are a decreasing function of a receiving subnational government's tax base (discussed in Sect. 2), and hence own-source revenues τy_t. A reduction in the difference between own-source revenues τy_t and the average revenues from the comparison set $\bar{\tau}\bar{y}$ lowers the equalization payment received by the government, where the marginal decrease is determined by the parameter $\eta > 0$, the claw-back rate. This claw back of equalization payments is an important feature of the Canadian equalization system (Boadway and Hobson 1998; Dahlby 2002). The equalization function given by (1) is an example of a vertical revenue equalization system. In particular, transfers are only made to subnational governments whose own-source revenue is below the average revenues from a comparison group of subnational governments. The source of the transfers are tax revenues of the national government. In contrast, for horizontal equalization systems, the source of the transfers are taxes levied on the subnational governments whose own-source revenues are above the "average" revenues.[19]

[19] For a further discussion of equalization formulas, see Dafflon and Vaillancourt (2003).

To obtain an equilibrium with sustained growth, all variables must be linearly related to output per worker (y). To accomplish this, we assume that government expenditures on productive and unproductive services are financed only through own-source revenues.[20] Government own-source revenue is allocated between expenditure on productive and unproductive services as follows: $g_t^u = \theta \tau y_t$ and $g_t^p = (1-\theta)\tau y_t$, where θ $(1-\theta)$ is the share of unproductive services (productive services) from government tax revenues.[21] The allocation of expenditure between productive and unproductive services is optimally chosen by the planner. Substituting $g^p = (1-\theta)\tau$ into the production function yields: $y = A^{1/\alpha} k((1-\theta)\tau)^{(1-\alpha)/\alpha}$, which is a standard Ak production function.[22]

The resource constraint for the subnational economy is given by:

$$y_t + e_t = c_t + \dot{k_t} + g_t^p + g_t^u,$$

where $\dot{k_t}$ is investment per worker (change in capital per worker), and equalization payments, e_t, are additional revenues available to the subnational economy. Substituting for productive and unproductive expenditures and rearranging provides the capital per worker accumulation function:

$$\dot{k_t} = (1-\tau)y_t - c_t + e_t.$$

It should be noted that while current period equalization payments are not available for allocation between productive and unproductive government expenditures, they add to savings and hence affect k and y in the next period. Using (1) to substitute for e_t and rearranging provides:

$$\dot{k_t} = (1-\tau(1+\eta))y_t - c_t + \eta\bar{\tau}\bar{y}.$$

The planner maximizes discounted lifetime utility subject to the capital accumulation function. The planner's optimization problem for an equalization-receiving subnational economy ($e > 0$) is given by:

[20] For tractability, a number of studies that use an endogenous growth model to examine the composition of government expenditure assume linearity of government expenditures with respect to output per worker (see Barro 1990; Chen 2006; Chatterjee et al. 2012, among others). Further, given the claw-back feature of equalization revenues, allowing allocation of these revenues for current expenditures would not alter the main finding of the model.

[21] Given that equalization payments are unpredictable, they may not feature in the allocation decision of the government in the current period.

[22] Endogenous growth requires that there be no diminishing returns to k, which implies that the production function be of the Ak form (Barro 1990).

$$\max_{\{c_t,k_t,\theta\}} \int_0^\infty e^{-\rho t}(\ln c_t + \phi \ln \theta \tau y_t)\mathrm{d}t$$
$$\text{subject to : } \dot{k_t} = (1-\tau(1+\eta))A^{1/\alpha}k_t((1-\theta)\tau)^{(1-\alpha)/\alpha} + \eta\bar{\tau}\bar{y} - c_t$$
$$\text{given } k_0, \tag{2}$$

where $\rho > 0$ is the discount rate, and k_0 is the initial capital per worker. The first-order conditions that characterize the solution for the maximization problem are given by:

$$\text{with respect to } c : \frac{e^{-\rho t}}{c_t} = \lambda_t \tag{3}$$
$$\text{with respect to } \theta : \frac{\phi e^{-\rho t}}{\theta} = \lambda_t \frac{1-\alpha}{\alpha}\tau(1-\tau(1+\eta))A^{1/\alpha}k_t((1-\theta)\tau)^{\frac{1-\alpha}{\alpha}-1} \tag{4}$$
$$\text{with respect to } k : \frac{\dot{\lambda}}{\lambda} = -(1-\tau(1+\eta))A^{1/\alpha}((1-\theta)\tau)^{(1-\alpha)/\alpha} \tag{5}$$

Using (3) and (5) provides the Euler condition:

$$\frac{\dot{c}}{c} = (1-\tau(1+\eta))A^{1/\alpha}((1-\theta)\tau)^{(1-\alpha)/\alpha} - \rho = \gamma, \tag{6}$$

where γ is the growth rate along the BGP. Further, substituting λ from (3) into (4) provides the tradeoff faced by the planner for the optimal choice of θ:

$$\frac{\phi}{\theta}\frac{c_t}{k_t} = \frac{1-\alpha}{\alpha}\tau(1-\tau(1+\eta))A^{1/\alpha}((1-\theta)\tau)^{\frac{1-\alpha}{\alpha}-1}. \tag{7}$$

The ratio of private consumption to capital is the only time-varying variable in the equation. Along a BGP equilibrium, c and k will grow at the same rate and therefore along a BGP, $\frac{c_t}{k_t} = \frac{c_0}{k_0}$.

To determine the ratio of private consumption to capital in period 0, we evaluate (2) at $t = 0$:

$$\gamma k_0 = (1-\tau(1+\eta))A^{1/\alpha}k_0((1-\theta)\tau)^{(1-\alpha)/\alpha} - c_0 + \eta\bar{\tau}\bar{y}$$
$$\Rightarrow \frac{c_0}{k_0} = \frac{(1-\tau(1+\eta))y_0}{k_0} + \frac{\eta\bar{\tau}\bar{y}}{k_0} - \gamma \tag{8}$$

Evaluating the Euler condition (6) at $t = 0$ results in

$$\gamma + \rho = \frac{(1-\tau(1+\eta))y_0}{k_0}.$$

Substituting into (8) provides the ratio of c to k at $t = 0$ as

$$\frac{c_0}{k_0} = \rho + \frac{\eta\bar{\tau}\bar{y}}{k_0}.$$

Hence, the initial consumption to capital ratio does not depend on θ. Therefore, assuming that $\frac{c}{k} = B$, where B is some constant and substituting in (7) yields:

$$\frac{(1-\theta)^{2-\frac{1}{\alpha}}}{\theta} = \frac{\frac{1-\alpha}{\alpha}(1-\tau(1+\eta))A^{1/\alpha}(\tau)^{\frac{1-\alpha}{\alpha}}}{\phi B}, \tag{9}$$

This equation provides the effect of equalization payments on the optimal choice of θ, the share of government expenditure on unproductive services. The impact of equalization on the optimal choice of θ can be derived by taking logarithms of (9) and differentiating to obtain:

$$\frac{\partial\theta}{\partial\eta} = \frac{\tau}{1-\tau(1+\eta)}\left(\left(2-\frac{1}{\alpha}\right)\frac{1}{1-\theta}+\frac{1}{\theta}\right),$$

which indicates that the effect of η on θ depends on the values of θ and α, the parameter that represents the importance of capital in production. If $\alpha > \frac{1}{2-(\theta-1)/\theta}$, then $\frac{\partial\theta}{\partial\eta} > 0$, and hence, θ (the share of government expenditure on unproductive services) is increasing in η (the claw-back rate), whereas if $\alpha < \frac{1}{2-(\theta-1)/\theta}$, then $\frac{\partial\theta}{\partial\eta} < 0$ suggesting that an increase in η will reduce θ. Since $0 \leq \theta \leq 1$, for $\alpha > 0.5$ the derivative is always positive.[23] The value of the parameter used by Barro (1990) is $\alpha = 0.75$, for which the optimal share of government expenditure on unproductive services would be higher for an equalization-receiving subnational economy ($\eta > 0$) than for a non-receiving economy ($\eta = 0$).

The model illustrates that equalization payments alter the optimal allocation of a subnational government's expenditures between productive and unproductive government services. In particular, the optimal ratio of government spending on unproductive services to total spending would be higher for an equalization-receiving than a non-receiving subnational economy. In the next section, we use data on government expenditures for Canadian provinces to examine the differences in government productive and unproductive expenditures between equalization-receiving and non-receiving provinces.

4 Empirical evidence

We use data for Canadian provinces over the 1989–2009 period to examine differences in government productive and unproductive expenditures between equalization-receiving and non-receiving provinces. The data were obtained from Statistics Canada's CANSIM database and provide a detailed breakdown of government expenditure by functional categories.[24] We follow Kneller et al. (1999) to classify functional

[23] For $\theta = 1$, the derivative is positive for $\alpha > 0.5$. For lower values of θ, the derivative would be positive for lower values of α. For example, if $\theta = 0.25$, then the derivative is positive for values of $\alpha > 0.2$.

[24] Provincial government expenditure data for Canada are only available for the period between 1989 and 2009. The data were obtained form CANSIM Table 3850001. For details on consolidated federal, provincial,

Table 2 Classification of government expenditures: unproductive and productive expenditures as a share of total expenditures

Category	Mean
Total unproductive	0.155
Social services	0.144
Recreation & culture	0.011
Total productive	0.612
Health	0.287
Education	0.232
Transportation communication	0.053
General government services	0.018
Transfers other government	0.011
Housing	0.010
Total other	0.230
Debt charges	0.123
Resource & industrial development	0.055
Protection	0.034
Environment	0.010
Regional planning & development	0.005
Labor, employment & immigration	0.004

Author calculations using data obtained from the Statistics Canada's CANSIM database

categories of government expenditures into three categories: unproductive, productive, and other.[25]

Table 2 provides the classification of government expenditures into the three categories with the average share in total provincial government expenditure of each category and its components. Productive and unproductive expenditures account for about 77 % of total government expenditures, with unproductive and productive expenditures being 16 and 61 % of the total expenditures, respectively. Social services account for most of the government unproductive expenditures, while health and education expenditures are about 85 % of government productive expenditures.[26]

To examine differences in the composition of expenditure between equalization-receiving and non-receiving provinces, we estimate the following regression equation:

$$Y_{i,t} = \alpha_0 + \alpha_1 \text{Eqdum}_i + \alpha_2 \text{time} + \beta X_{i,t-1} + \beta \text{time}_{\text{dum}} + \epsilon_{i,t}, \qquad (10)$$

Footnote 24 continued
territorial, and local government revenue and expenditures, see: http://www23.statcan.gc.ca/imdb/p2SV.pl?Function=ssgetSurvey\&db=imdb\&adm=8\&dis=2\&SDDS=1735\&lang=en.

[25] Kneller et al. (1999) also include defense as a productive expenditure. However, defense expenditures are only undertaken by the federal government, and hence, these are not included in our classification. Further, three expenditures categories available in CANSIM—expenditure on research establishments, employee pension plan benefits, and changes in equity and motor vehicle accident compensation—were excluded from the analysis due to very limited information.

[26] We undertook a number sensitivity of checks for our results by redefining our classification of productive and unproductive expenditures. For example, our findings reported in this section were qualitatively similar when we reclassified Resource & industrial development and Regional planning & development as productive expenditures.

Table 3 Data summary: mean for the 1989–2009 period

Province	Eqdum	Size	$\frac{g^u}{g}$	$\frac{g^p}{g}$	$\frac{g^o}{g}$	$\frac{g^u}{g^p}$
Alberta	0	0.17	0.16	0.63	0.19	0.26
British Columbia	0	0.22	0.17	0.65	0.18	0.25
Manitoba	1	0.26	0.16	0.57	0.27	0.29
New Brunswick	1	0.30	0.12	0.65	0.23	0.18
Newfoundland and Labrador	1	0.32	0.13	0.63	0.24	0.21
Nova Scotia	1	0.27	0.12	0.63	0.24	0.19
Ontario	0	0.18	0.18	0.63	0.19	0.29
Price Edward Island	1	0.33	0.11	0.63	0.25	0.18
Quebec	1	0.28	0.26	0.55	0.19	0.47
Saskatchewan	1	0.24	0.13	0.55	0.31	0.25

Author calculations using data obtained from the Statistics Canada's CANSIM database

where for province i at time t, the dependent variable Y is alternatively the ratio of unproductive expenditures to total expenditures $\left(\frac{g^u}{g}\right)$, the ratio of productive expenditures to total expenditures $\left(\frac{g^p}{g}\right)$, the ratio of other expenditures to total expenditures $\left(\frac{g^o}{g}\right)$, or the ratio of unproductive to productive expenditures $\left(\frac{g^u}{g^p}\right)$.[27] We use data obtained from the Department of Finance, Government of Canada, to classify a Canadian province as an equalization-receiving province if it received equalization payments for more than 10 of the 21 years that we have data.[28] The dummy variable Eqdum equals 1 (0) for an equalization-receiving (non-receiving) province, and α_1 provides the difference in Y between receiving and non-receiving provinces. We include time to control for the trend growth in Y. The regression also includes time fixed effects, time_{dum}, and an i.i.d. error term ϵ.

Table 3 provides the summary statistics for the key variables used in our analysis. While seven provinces received equalization for more than 10 years over the 1989–2009 period, five provinces (Manitoba, New Brunswick, Nova Scotia, Prince Edward Island, and Quebec) received equalization payments for the entire period.[29] The Table illustrates that there are large differences in the total government expenditure to GDP ratio (Size) and the composition of government expenditures across provinces. In particular, the ratio of unproductive to productive expenditures $\left(\frac{g^u}{g^p}\right)$ ranges between 0.18 and 0.47.

[27] The ratio of unproductive expenditures to total expenditures $\left(\frac{g^u}{g}\right)$ corresponds to the parameter θ in the model in Sect. 3.

[28] Even though British Columbia received equalization in a few years over the period of our analysis, it has been classified as a non-receiving province. Similarly, Ontario received equalization payments for 1 year in 2009, but has been classified as a non-receiving province.

[29] We examined the sensitivity of our results by restricting our definition of equalization-receiving provinces to the five provinces that received equalization payments for the entire period and found that our results were qualitatively unchanged.

Table 4 Government expenditures: equalization-receiving versus non-receiving provinces

Variable	$\frac{g^u}{g}$	$\frac{g^u}{g}$ (IV)	$\frac{g^p}{g}$	$\frac{g^p}{g}$ (IV)	$\frac{g^o}{g}$	$\frac{g^o}{g}$ (IV)
Eqdum	0.043	0.035	−0.080	−0.071	0.033	0.032
	(0.007)*	(0.008)*	(0.008)*	(0.010)*	(0.007)*	(0.008)*
Time	−0.001	−0.001	0.008	0.008	−0.007	−0.007
	(0.001)	(0.001)	(0.001)*	(0.001)*	(0.001)*	(0.001)*
lnsize_{t-1}	0.108	0.162	−0.216	−0.268	0.128	0.121
	(0.020)*	(0.034)*	(0.024)*	(0.040)*	(0.028)*	(0.045)*
lnpop_{t-1}	0.044	0.044	−0.023	−0.025	−0.020	−0.020
	(0.002)*	(0.002)*	(0.002)*	(0.002)*	(0.003)*	(0.002)*
lngdppc_{t-1}	0.064	0.104	−0.206	−0.237	0.140	0.127
	(0.027)**	(0.035)*	(0.030)*	(0.038)*	(0.033)*	(0.045)*
$\text{lndependency}_{t-1}$	−0.120	−0.107	0.061	0.059	0.064	0.065
	(0.019)*	(0.019)*	(0.022)*	(0.022)*	(0.019)*	(0.021)*
lnunrate_{t-1}	0.048	0.037	0.036	0.041	−0.089	−0.089
	(0.010)*	(0.011)*	(0.012)*	(0.014)*	(0.013)*	(0.016)*
Constant	−0.629	−0.991	2.422	2.692	−0.762	−0.658
	(0.284)**	(0.339)*	(0.339)*	(0.403)*	(0.336)**	(0.430)
Observations	200	190	200	190	200	190
R^2	0.799	0.776	0.821	0.818	0.764	0.778

Results from estimating regression Eq. (10). Standard errors in parenthesis. *, **, *** Signify 1, 5 and 10 % level of significance, respectively. Robust or sandwich estimator of standard errors presented in parentheses. For IV estimation, two-period lagged values of variables are used as instruments. All regressions include time fixed effects, which are not reported here

Given that the model presented in Sect. 3 assumes a constant size of government, population, and level of development, we include as control variables (X) the logarithm of the size (ratio of total government expenditures to GDP) of the provincial government sector (lnsize), the logarithm of the provincial population (lnpop), and the logarithm of GDP per capita (lngdppc). Further, following the literature (Rodrik 1998; Alesina and Wacziarg 1998, among others) on determinants of government expenditures, we also include as control variables the logarithm of the unemployment rate (lnunrate) and the logarithm of the dependency ratio (lndependency).[30] To account for the contemporaneous endogeneity of these variables, we use their one-period lagged values. In addition, to examine the robustness of our results, we also use two-period lag values for these variables as instrumental variables.

Table 4 reports the results from estimating regression Eq. (10) with the share of unproductive $\left(\frac{g^u}{g}\right)$, productive $\left(\frac{g^p}{g}\right)$ or other expenditures $\left(\frac{g^o}{g}\right)$ as the dependent variable. Estimated parameters for most variables are statistically significant for all regressions estimated using either ordinary least squares or instrumental variables

[30] The dependency ratio is defined as the fraction of population younger than 18 years or older than 65 years.

(IV). The results suggest that all control variables are important for the determination of expenditure composition for Canadian provincial governments.

The estimated coefficients for the time trend (time) indicate that while unproductive expenditure share has not changed overtime, the productive expenditure share has increased. The estimated coefficients for lnsize indicate that provinces with higher government expenditures relative to GDP in the previous year had a higher (lower) share of unproductive and other (productive) expenditures in their total expenditures. Similarly, richer provinces, those with higher GDP per capita (gdppc), had higher (lower) shares of unproductive and other (productive) expenditures shares than poorer provinces. The estimated coefficients for the unemployment rate (lnunrate) suggest that provinces with high unemployment in the previous year had higher shares of productive and unproductive expenditures but lower expenditure share in the other category.

The estimated coefficient for Eqdum provides the difference in the conditional means between equalization-receiving and the non-receiving provinces. The positive estimate of the coefficient for Eqdum for $\frac{g^u}{g}$ and a negative estimate $\frac{g^p}{g}$ indicate that while equalization-receiving provinces had a higher unproductive expenditure share than non-receiving provinces, their productive expenditure share was lower. In other words, after controlling for other factors that affect the composition of government expenditures, we find that provinces receiving equalization have a lower (higher) proportion of government expenditures on productive (unproductive) categories. Hence, we find evidence supporting the prediction of the model that equalization-receiving provinces will have a higher share of unproductive (lower share of productive) government expenditures.

Given that we did not consider the expenditure category defined as "Other" in our model, another way of evaluating the predictions of the model for differences in the composition of expenditures between equalization-receiving and non-receiving provinces is to examine the ratio of the unproductive and productive expenditures. Table 5 presents the results of estimating regression (10) with the $\frac{g^u}{g^p}$ as the dependent variable. Consistent with the results reported for productive and unproductive expenditures, the positive estimate for the coefficient for Eqdum for both the OLS and IV models indicates that after controlling for the effects of other determinants, the ratio of unproductive to productive expenditures was higher for equalization-receiving provinces. In other words, consistent with the predictions of the model, we find evidence that equalization-receiving provinces have a higher ratio of unproductive to productive expenditures.

4.1 Robustness of empirical findings

4.1.1 Alternate measure for productive expenditures

We examine the robustness of our the empirical findings in a number of ways. The first is to consider an alternative measure for productive expenditures. Using provincial data for the period 1989 to 2009 from CANSIM, we consider the ratio of government expenditure on capital and repairs to the total government expenditures ($\frac{g^{\text{cap}}}{g}$) to con-

Table 5 Ratio of unproductive to productive expenditures: equalization-receiving versus non-receiving provinces

Variable	$\frac{g^u}{g^p}$	$\frac{g^u}{g^p}$(IV)
Eqdum	0.12	0.105
	(0.014)*	(0.017)*
time	−0.005	−0.005
	(0.001)*	(0.002)*
lnsize_{t-1}	0.277	0.403
	(0.038)*	(0.057)*
lnpop_{t-1}	0.088	0.09
	(0.004)*	(0.003)*
lngdppc_{t-1}	0.21	0.3
	(0.051)*	(0.06)*
$\text{lndependency}_{t-1}$	−0.254	−0.25
	(0.036)*	(0.037)*
lnunrate_{t-1}	0.083	0.07
	(0.02)*	(0.022)*
Constant	−1.969	−2.729
	(0.547)*	(0.619)*
Observations	200	190
R^2	0.824	0.813

Results from estimating regression Eq. (10). Standard errors in parenthesis. *, **, *** Signify 1, 5 and 10 % level of significance, respectively. Robust or sandwich estimator of standard errors presented in parentheses. For IV estimation, two-period lagged values of variables are used as instruments. All regressions include time fixed effects, which are not reported here

struct a different measure for $1-\theta$, the ratio of government productive expenditure to total government expenditures, in the model.[31] To examine whether there were differences between equalization-receiving and non-receiving provinces, we estimate regression Eq. (10) with $\frac{g^{\text{cap}}}{g}$ as the dependent variable. Table 6 presents the results. All coefficient estimates for the control variables are statistically significant indicating that variation in these variables are important in determining the ratio of government capital expenditures to total expenditures. The negative and statistically significant estimates for the coefficient for Eqdum lead us to conclude that the ratio was lower in equalization-receiving provinces. The results provide confirming evidence that government productive expenditures have been lower in equalization-receiving provinces than in non-receiving provinces.

4.1.2 Including additional control variables

As another test of the robustness of the results, we include a number of additional control variables as possible explanations of the differences in the composition of government expenditures between equalization-receiving and non-receiving provinces. Following studies examining the composition of government expenditures (for example,

[31] The data were obtained from CANSIM Tables 320002 and 290035. For details on provincial data for Capital and Repair Expenditures, see http://www23.statcan.gc.ca/imdb/p2SV.pl?Function=getSurvey\&SDDS=2803\&Item_Id=881.

Table 6 Ratio of capital expenditures to total expenditures: equalization-receiving versus non-receiving provinces

Variable	$\frac{g^{\text{cap}}}{g}$	$\frac{g^{\text{cap}}}{g}$ (IV)
Eqdum	−0.011	−0.018
	(0.006)***	(0.009)**
Time	−0.002	−0.002
	(0.001)**	(0.001)***
lnsize_{t-1}	−0.013	0.02
	(0.024)	(0.041)
lnpop_{t-1}	0.003	0.003
	(0.002)***	(0.002)***
lngdppc_{t-1}	−0.076	−0.06
	(0.032)**	(0.041)
$\text{lndependency}_{t-1}$	0.067	0.073
	(0.023)*	(0.026)*
lnunrate_{t-1}	−0.108	−0.115
	(0.01)*	(0.012)*
Constant	0.963	0.833
	(0.336)*	(0.413)**
Observations	200	190
R^2	0.708	0.693

Results from estimating regression Eq. (10). Standard errors in parenthesis. *, **, *** Signify 1, 5 and 10 % level of significance, respectively. Robust or sandwich estimator of standard errors presented in parentheses. For IV estimation, two-period lagged values of variables are used as instruments. All regressions include time fixed effects, which are not reported here

Shelton 2007), we include two measures of dependency based on age, *depyoung* the fraction of population less than 18 years of age and *depold* the fraction of population greater than 65 years of age. To control for differences in the costs of providing government services between provinces, we include *price*, the provincial consumer price index (CPI), and *govavwage*, the average wage of government employees.[32] In addition, since the costs of settlement of immigrants are largely borne by provinces, we also include controls for net migration from the province (*netmig*). Further, trade openness has been used by a number of studies on the determinants of government expenditures (for example, see Alesina and Wacziarg 1998; Rodrik 1998; Shelton 2007, among others). Given this, we include (*open*), defined at the provincial level as sum of exports and imports divided by GDP, as a control variable. We use one-period lagged values of all variables; and except *netmig*, which is allowed to take negative values, all variables are in logarithms.

Table 7 reports the results of the estimation for the ratio of productive to total expenditures $\left(\frac{g^p}{g}\right)$ and for the ratio of capital to total expenditures $\left(\frac{g^{\text{cap}}}{g}\right)$. Given that data for *open* are only available from 1990, we report estimation results with and without *open*. For all specifications, we find that after controlling for the effects of these determinants of government expenditures, equalization-receiving provinces

[32] The variable *govavwage* is defined as the total public sector wage bill divided by total number of public sector employees.

Table 7 Government expenditures: robustness

Variable	$\frac{g^p}{g}$		$\frac{g^{\text{cap}}}{g}$	
Eqdum	−0.062	−0.070	−0.017	−0.022
	(0.011)*	(0.010)*	(0.010)***	(0.010)**
Time	0.007	0.006	−0.004	−0.003
	(0.002)**	(0.001)**	(0.002)**	(0.002)
lnsize_{t-1}	−0.194	−0.171	0.028	0.033
	(0.027)*	(0.027)*	(0.026)	(0.027)
lnpop_{t-1}	−0.027	−0.033	0.012	0.010
	(0.003)*	(0.003)*	(0.003)*	(0.003)*
lngdppc_{t-1}	−0.258	−0.247	−0.095	−0.110
	(0.027)*	(0.026)*	(0.033)*	(0.032)*
lnunrate_{t-1}	0.001	0.006	−0.073	−0.067
	(0.012)	(0.012)	(0.012)*	(0.012)*
lndepyoung_{t-1}	−0.201	−0.166	0.161	0.211
	(0.045)*	(0.043)*	(0.060)*	(0.067)*
lndepold_{t-1}	−0.137	−0.139	0.029	0.027
	(0.019)*	(0.020)*	(0.025)	(0.026)
lngovavwage_{t-1}	0.021	0.014	0.030	0.026
	(0.049)	(0.044)	(0.053)	(0.052)
lnprice_{t-1}	0.009	−0.007	0.159	0.160
	(0.044)	(0.042)	(0.044)*	(0.042)*
netmig_{t-1}	0.816	1.310	−0.105	0.200
	(0.499)***	(0.511)*	(0.522)	(0.653)
lnopen_{t-1}		0.031		0.015
		(0.006)*		(0.009)***
Constant	4.14	4.204	−0.244	−0.196
	(0.485)*	(0.445)*	(0.632)	(0.633)
Observations	200	190	200	190
R^2	0.862	0.880	0.727	0.732

Results from estimating regression Eq. (10). Standard errors in parenthesis. *, **, *** Signify 1, 5 and 10 % level of significance, respectively. Robust or sandwich estimator of standard errors presented in parentheses. All regressions include time fixed effects, which are not reported here

have a lower ratio of productive to total government expenditures.[33] In other words, the results are robust to inclusion of these additional control variables.

5 Conclusion

Using an endogenous growth model, this paper has examined the effect of the vertical equalization transfer system used in Canada on the composition of government expen-

[33] Similar to the results reported in Table 4, when all control variables are included in the regression, the estimated coefficient for Eqdum for the ratio of unproductive to total expenditures $\left(\frac{g^u}{g}\right)$ was negative and statistically significant.

ditures of provinces. The Canadian equalization system is similar to a number of other vertical equalization systems. For example, like other vertical equalization systems, the Canadian system involves transfers only to a subset of provinces based on revenues raised by the federal government on citizens in all provinces. In addition, the Canadian system uses a representative tax system to determine the amount of the transfer to the recipient provinces, which implies that increases in own-source revenues result in a reduction in the amount of the transfer.

We show that such a vertical equalization transfer system reduces the incentive for recipient provinces to undertake productive government expenditures in favor of unproductive expenditures. Using data for Canadian provinces over the 1989–2009 period, we find evidence in support of this proposition: after controlling for a number of determinants of government expenditures, equalization-receiving provinces had higher (lower) ratios of unproductive (productive) government expenditures to total expenditures.

A key lesson that emerges from our findings is that equalization systems influence the behavior of subnational governments. Both our theoretical and empirical analyses suggest that considerable attention must be paid to the design of fiscal equalization systems if the positive features of income transfers are to be achieved without sacrificing the incentives for growth-promoting expenditures by transfer-receiving subnational governments. In particular, care must be taken to ensure that the formula used to effect the transfers does not encourage recipient governments to increase their long-run dependency on the transfer system.

While our analysis focuses on vertical revenue equalization, it is clear that similar incentive effects would exist in horizontal equalization systems. In fact, any vertical or horizontal equalization system in which transfers are based on a difference between own-source revenues and revenues from a comparison or average group of states will likely result in disincentive effects for governments to spend on productive services that increase their own-source revenues. Further, similar disincentive effects for government spending would exist for equalization systems based on costs. As outlined by Blöchliger and Charbit (2008), cost equalization systems can lead to an inflation of expenditure needs among provinces or states, rent seeking, and other disincentive effects. We leave the analysis of such implications to future research.

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