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Decentralization of health care and its impact on health outcomes

Dolores Jimenez Rubio[1], Peter C. Smith[2]

[1] Department of Economics and Related Studies, University of York, UK

[2] Centre for Health Economics, University of York, UK.

Abstract: While most countries around the world are increasingly devolving responsibilities over their health care systems to the local level, the potential impact of such intervention is unclear. To date most of the literature on this topic concentrates on the effects of decentralization from a theoretical perspective. This paper uses both theoretical and empirical analyses to inform the debate about the appropriate degree of decentralization of the health system. Building on a theoretical model of local government's public finance applied to health care, the hypothesis that shifts towards more decentralization would be accompanied by improvements in population health is tested on the highly decentralized Canadian provinces during the period 1979-1995. The results of the econometric estimations suggest that in Canada decentralization did have a positive and substantial influence on the effectiveness of public policy in improving population's health.

Key words: Fiscal Decentralization, Health outcomes, Canada

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Introduction

Fiscal decentralization[1] of the public sector has become a common component of policy reform all over the world. On the one hand, major efforts to decentralize the public sector can be appreciated in a variety of industrialised countries. In the United States, for instance, the primary responsibility for a number of social programs has been shifted back to the states[2]; in the United Kingdom decentralization movements have brought about the foundation of Scotland and Wales' own parliaments; and in Italy, Spain, and other countries, there has been increasing fiscal powers for regional and local authorities. The traditional theory of fiscal federalism identifies advantages that have encouraged these reforms (*Oates*, 1999). On the other hand, a great deal of interest in the fiscal decentralization issue has also emerged in the developing world. In this case, decentralization is mainly regarded as a political alternative to the central planning failure to achieve continuous economic growth (*Akin et al*., 2001).

As maintained by the fiscal federalism theory, decentralization of public goods and services with localised effects is likely to produce efficiency gains. However, this prescription is a very general one, since what is considered as "local" is expected to vary across settings. In the health care sector, in particular, there is little guidance concerning the most efficient level of provision of health goods and services. But a trend towards health care decentralization is becoming evident in most nations. Thus, in the United States, Medicaid is one of the programs for which important allowances of federal authority have been recently devolved to the states[3]; in the United Kingdom health services are one of the basic responsibilities of the new Scottish and Welsh parliaments; in Spain and Italy, legislative powers have been combined with an augmented fiscal autonomy in the health care area. In developing countries, on the other hand, the increasing decentralization of health care services has been mostly a response to the impetus in the promotion of primary health care by international donor organisations, such as the World Health Organisation or UNICEF[4].

In spite of these tendencies, it is surprising the little attention that has been paid to the evaluation of decentralization in the health care sector, as opposed to the emerging literature on the effects of decentralization on government size, economic growth or government quality. This study attempts to rectify in part the lack of formal analysis of the effects of decentralization in health care. The purpose is to test some of the most relevant hypothesis of the fiscal federalism theory for the particular case of the health care services. In the next section we present a brief summary of the fiscal

[1] In this study decentralization is synonymous with devolution because it is merely concerned with the impact of political decentralization. Devolution is a political reform designed to promote autonomy at the local level. See Hunter JD et al. (1998, p.311-3) for a detailed classification of the different types of decentralization, namely deconcentration, delegation, and devolution.

[2] In 1996 a set of measures were passed in the United States that replaced highly regulated matching grants to the states for various welfare programmes by a system of block grants with few strings attached.

[3] Medicaid is the government health care insurance agency for low-income individuals in the United States.

[4] Policy documents from these institutions such as the Primary Health Care Declaration of Alma Ata (1978) or the Health for All by the Year 2000 (1981) emphasised the importance of primary health care and the role of community participation in planning and providing health services. Authors such as Collins and Green (1994), among others, stress the incompatibility between promotion of primary health care and centralised health systems.

federalism literature. Section two discusses the main implications for the health care sector that follow from this literature, and present some evidence on the issue. The remainder of the paper concentrates on our empirical analysis.

1. The theory of fiscal federalism

The economics literature on decentralization is usually referred to as the fiscal federalism theory. This theory basically analyses the vertical structure of the public sector, that is, the optimal assignment of functions to different levels of government, and the most appropriate fiscal instruments for carrying out these functions.

The basis for most of the conventional literature of fiscal federalism is assumed to be the study of the public sector carried out by Richard Musgrave (1958) within a welfare economics' framework. According to Musgrave's analysis, the public sector should intervene in the economy to address the market inability to: attain the most equitable distribution of income (distribution function); maintain a high level of employment and stable prices (stabilisation function); and establish an efficient pattern of resource use (allocation function). The main conclusion from Musgrave's study is that an economic case for a federal structure of the public sector exists. Thus, while the stabilisation of the economy and, to a lesser extent, the redistribution of income are assumed to be best placed at the central government's level, decentralized tiers of government are left with the primary responsibility of providing "local" public goods and services. This proposition was later formulated by Oates (1972, p.54) into the Decentralization theorem.

The Decentralization theorem basically postulates, on grounds of economic efficiency, a presumption in favour of sub national provision of local public goods and services: given that local preferences and costs of a local public good or service are likely to vary across jurisdictions, decentralization could increase economic welfare in society as a whole. The key point is that sub national governments have access to better information about local circumstances than central authorities, and therefore can use this information to tailor services and spending patterns to citizen's needs. In contrast, centralised government structures face significant informational and political constraints that are likely to prevent them from providing an efficient level of a local public good or service.

A corollary to the Decentralization theorem states that the gains in Pareto/allocative efficiency are further enhanced by the increase in competition among local governments that decentralization might bring about (*Oates*, 1972). At the same time, competition is expected to increase productive efficiency as a result of the greater experimentation and innovation in the production of public goods and services than if those goods or services were provided by the central government. As a consequence, production costs (and therefore, prices) could be lowered and the quality increased.

The literature of fiscal federalism has identified several arguments in favour of centralisation of the provision of local public goods and services. Some of these arguments contradict those above discussed. For instance, it has been argued that in decentralized settings *information* can be distorted and oversight weakened. Heavy dependence on transfers may discourage fiscal discipline at lower levels of government, as central governments are more likely to be held responsible for any services' failures.

Moreover, local governments may claim high spending needs in order to secure a higher share of central funding. On the other hand, too much financial autonomy given to local authorities may result in inefficient levels of provision under decentralization if *competition* is exercised on tax rates rather than on services. The existence of *economies of scale* and/or *externalities* in the provision of a public good has also been adduced as an economic argument for a certain central control. On the *equity* side, it has been claimed that likely differences in tax bases among jurisdictions would require central redistribution of resources from richer to poorer areas.

To provide local public goods and services, the central government transfers some taxes to local governments and grants them a certain taxing power. In addition, the central government endows lower levels of government with transfers to cover the cost of delivering local services. The theory of fiscal federalism identifies three arguments whereby central grants are necessary to guarantee an adequate provision of a local public good: vertical fiscal imbalances, horizontal fiscal imbalances and externalities[5]. At the same time, this literature recognizes the risks of an excessive dependency on transfers from the central government. First of all because, since transfers often come with strings attached, a disproportionate reliance upon them might result in an unnecessary interference from the central government. And in second place, because systems heavily dependent on grants place little pressure on local governments to manage spending efficiently. In particular, a common finding by the literature in this issue is that local spending is much more responsive to increases in intergovernmental transfers than to equal increases in private income, a phenomenon which has become known as the flypaper effect[6]. Thus, at the margin, an additional pound spent in public goods and services does not seem to be equivalent to the benefit of an equal reduction in taxation.

Although most of the literature on federalism relies upon the principles of welfare economics there is a more recent school of thought that examines the effect of federalism on government behaviour, assuming, unlike the conventional school of thought, that governments are not benevolent[7]. But in common with the traditional

[5] The *horizontal fiscal imbalances* argument emphasizes that because local jurisdictions have different tax bases at their disposal, the need to ensure that citizens have access to a roughly equal level of public services will inevitably require some degree of redistribution among jurisdictions by means of central grants. The *vertical fiscal imbalance* argument is referred to the fact that in most nations, central governments have excess of revenues, while local governments are not self sufficient to cover the costs of the services they provide. To solve this problem the central government provides local governments with transfers to help them to cover their costs. Finally, the *externality* argument stresses that some local public goods may have spill over effects that are not taken account in their provision. Central matching grants may therefore be required to ensure an efficient level of supply of the local public good.

[6] Since transfers are politically inexpensive sources of revenue for local governments, local politicians will not be encouraged to reduce taxes as a response to increases in grants, but will have more incentives to do so if local taxation revenue rises as a consequence of an increase in local income. Moreover, by breaking the links between costs and benefits, transfers make it difficult for voters to identify and punish the causes of local inefficiencies in the use of the resources.

[7] Some of the issues addressed by this new school of thought are the extent of political participation in a decentralized government (Inman and Rubinfield, 1997), the role of federalism in sustaining an efficient and growing market economy (Weingast, 1995; McKinnon, 1997; McKinnon and Nechyba, 1997; Qian and Weingast, 1997), or the role of decentralization in containing the size of the public sector (Brennan and Buchanan, 1980). For a review of both the new and the old literature on fiscal federalism see Oates (1999).

view, this new literature predicts potential economic benefits from placing fiscal responsibility into the hands of the local governments.

2. Decentralization and the health services

Economic theory only offers a limited guidance in deciding how to allocate expenditure responsibilities among different tiers of government. In principle, lower levels of government should provide local public goods, whereas national public goods, redistributive and stabilisation policies should be a responsibility of the central government. However, in reality most of the goods provided by the public sector do not correspond exactly to any of these categories, and the territorial limits are therefore difficult to specify. Health care constitutes an example of goods with a mixed nature. Thus, while health services benefits accrue basically to the individual, there are important social externalities in their provision (*Ahmad* et al., 1997). In consequence, it seems desirable that health sector decentralization coexists with a certain level of centralisation in coordinating health policy.

The potential efficiency gains from decentralizing the health services might lead to an improvement in the health of the population if decentralization of health services enables an increase in the quality of health inputs, and if these health inputs adjust to the particular preferences/needs of the local citizens. There is however little evidence that countries with a more decentralized health system have better health outcomes.

So far a few studies have attempted to measure the magnitude of the effect of public sector decentralization on health outcome indicators. These are the studies carried out by Mahal et al. (2000), Robalino et al. (2001), Yee (2001), Ebel and Yilmaz (2001), and Khalegian (2003). On the whole these studies find a positive association between fiscal decentralization and some indicator of health outcomes.

Mahal et al. (2000) use data from rural villages in India for 1994 to test the hypothesis that decentralization is positively associated with child mortality once the effect of socio economic factors, civil society organisations, and so on, are controlled for. They have used dummy variables for states that have significantly moved towards decentralization during the period 1970-94, and the frequency of local body elections during the same period as proxies for decentralization. While the estimated coefficients for decentralized states have the expected positive signs, the election frequency variable is statistically insignificant.

In the study by Robalino et al. (2001), a panel data of low and high income countries is used to test how a measure of fiscal decentralization -the proportion of sub national government spending over central government spending-, affects infant mortality rates over the period 1970-1995. After controlling by a set of structural variables (GDP per capita, corruption, ethno-linguistic fractionalisation, etc.), one of the main results of the fixed effects estimation is that decentralization is associated with lower infant mortality rates. Interestingly, the marginal benefit from decentralization is found to be greater at low-income levels.

Using a panel data of 29 Chinese provinces for the period 1980-1993, Yee (2001) examines the relationship between several indicators of health care performance - number of doctors per 10.000 people, mortality rates, hospital beds per 10.000 people,

local health care expenditures-, and various measures of decentralization. These include two indicators of fiscal decentralization –the ratio of local government expenditure to central government expenditure, and the ratio of local government expenditure to total government expenditure-, and two other indicators of political decentralization[8]. The results of the regressions, based on either fixed effects or random effects estimations, show that fiscal decentralization has been beneficial to the health sector in terms of reducing mortality rates and increasing local expenditure on health care.

Ebel and Yilmaz (2001) employ an intervention analysis to evaluate the outcomes of decentralization in terms of immunisation rates for DPT[9] and measles of children under 12 months in six developing countries[10] during the period 1970-1999. The results of the estimated fixed effects model suggest that intervention by sub national governments has been associated with an increase in the coverage of children immunised for measles.

More recently, Khalegian (2003) has examined the association between decentralization and immunisation coverage rates for DPT3 and measles of children at one year of age in 140 low and middle-income countries during the period 1980-1997. Two indicators of fiscal decentralization have been used in this study. The first one is a binary variable defined as the presence of taxing, spending, or regulatory authority on the part of sub national authorities. The second one is a combination of two variables: the share of sub national expenditures on total government expenditures, and the share of health spending on total sub national expenditures. The findings suggest that decentralization improves coverage rates only in low-income countries[11].

3. Measuring the extent of decentralization in health care

All existing empirical studies on the relationship between decentralization and health outcomes have evaluated the effect of public sector decentralization as a whole on health performance. This study departs from previous ones in examining the isolated effect of health sector decentralization on health. In doing so this work questions whether the recent trend of devolving health care responsibilities to the local level has an economic justification, independently of the decentralization status of the remaining public sector functions.

A precise measure of health care decentralization is difficult to find. Health care decentralization is a complex phenomenon encompassing a number of political, fiscal and administrative dimensions. Many of these aspects are, yet, unquantifiable, e.g., who determines the range of the services to be covered, who sets the regulatory framework, or who decides the financing mechanism of the system as a whole. The core question is

[8] The political decentralization measures are: bureaucratic distance –an index of top provincial officials proximity to the province-, and state industry decentralization –the proportion of industrial output from state owned enterprises controlled by local government on the total industrial output from all state owned enterprises in a province-. These measures were found to be statistically insignificant in explaining variations in health care performance indicators over time.

[9] A series of three vaccines against diphtheria, pertussis (whooping cough) and tetanus.

[10] These are: Argentina, Brazil, Colombia, Philippines, South Africa and Venezuela

[11] Khalegian (2003, p. 27) has pointed out that this finding "*may reflect a salutary balance between the proximity of local authorities to the community, and the preservation of central influence and bureaucratic autonomy, both of which are essential to the effective functioning of an immunisation program*".

to what extent the health care system framework is set centrally or locally (*Banting*, 2002 p.6). However, up to now the only available quantitative measure of health care decentralization is a fiscal one: the ratio of sub national health spending to the total health spending for all the levels of government. In the absence of more appropriate measures of decentralization, similar fiscal decentralization indicators (aggregated for all the public sector activities) have been widely used by the researchers in this field following Oates' pioneer work (1972). According to *Oates* (1972, p.197) the extent of fiscal activities at each level of government is a major component in determining its influence on the allocation of resources. Moreover, in contrast to dichotomous indicators of decentralization or federalism, fiscal data reflect the continuum dimension of the decentralization process. Fiscal indicators of decentralization are only a rough guide, however, in the sense that local spending decisions may not be autonomous, as discussed below.

The main source of fiscal data is the Government Finance Statistics of the International Monetary Fund (IMF). Although these statistics compile information for over 100 countries, a cross-country comparison on health care decentralization based on IMF data is limited. The reason is that there is double counting of intergovernmental transfers in the estimates of IMF health spending. Thus, health transfers from higher levels of government are included both as a spending of this level of government, and as a spending of the recipient governments. The problem arises when these transfers are actually equalisation grants provided to autonomous local governments. In this case, computing the health transfers as a spending of higher levels of government underestimates the real level of local autonomy in health care decisions.

On the other hand, global fiscal decentralisation indicators can be computed net of intergovernmental transfers. This is because in the IMF statistics there is an entry that identifies the global transfers' submissions from higher levels of government to local governments. But even so, fiscal decentralisation indicators based on IMF data may overestimate the level of real local autonomy (*Ebel and Yilmaz*, 2001; *Rodden*, 2001). Local spending statistics include not only expenditures in functions controlled exclusively by the local jurisdictions, but also expenditures in functions controlled by higher levels of government[12] (through directives, conditional grants, etc.).

Given the data limitations to make cross national comparisons, the focus of this study is on the outcomes of decentralization of health care services in one of the most decentralized countries in the world: Canada. For this country, a reasonable measure of fiscal decentralization of health care can be constructed. First of all, because the government health spending data, derived from the Canadian Institute for Health Information, (CIHI), include federal transfers to provinces only as a spending of the provincial governments. But also, because unlike other federations, since 1977 federal health transfers in Canada consist of a block funding with few conditions attached (*Banting*, 2002 p.12). Therefore, including them as a spending of provincial governments, and consequently as a positive determinant of health care decentralization does not provide a misleading picture of the autonomous decision making of Canadian local governments. In addition, both the CIHI and the Canadian statistics produce a great amount of data on government health spending, including health transfers, and health outcomes/status disaggregated at the provincial level. The next section presents

[12] This problem is specially important for developing countries where the central government plays an important role in determining how sub national expenditures are to be spent

some of the aspects of the decentralization structure in the health care sector in Canada that may be of relevance for the empirical study.

4. An overview of the Canadian decentralized system of health care

Canada is a confederation of ten provinces and three territories. Health care services are mostly publicly financed and they offer comprehensive and universal insurance to Canadian citizens. Provision is left under private control.

Since Canada became a nation, following the Constitution Act of 1867, provinces have borne the primary responsibility over health care. Thus, among other functions, provinces regulate hospitals and other health institutions, they decide the financing schedules with health professionals, and they set global budgets for hospitals. Provincial governments are also responsible for the final health care costs of their jurisdiction.

The federal government role in the system is limited to the direct provision of health services to specific sectors of the population[13], and to the management of the activities of health protection, disease prevention, and health promotion. Federal influence has been mainly exercised through financial assistance to the provinces. Adherence to some basic principles –Canada Health Act- in return for federal support has enabled the creation of a national plan for the health care system. These principles are: universal coverage; public administration[14]; coverage of all "medically necessary" services (comprehensiveness); portability of coverage outside the province; and prohibition of financial barriers to access health services, such as user fees or extra billing by physicians (accessibility). Within this broad framework, provinces have scope for determining the health policy of their insurance plans. In addition, the shift from conditional matching grants to a block funding grant for health and postsecondary services in 1977 –Established Program Financing (EPF)- gave provinces more autonomy in their health related spending decisions. On the negative side, since the introduction of the block funding the federal government has unilaterally reduced the amount of the transfer payments to the provinces. The most severe cutback to federal transfers took place in 1996 with the combination of funding for health care, postsecondary services and social services in a single block: the Canadian Health and Social Transfer (CHST)[15].

Provinces have faced the federal cutbacks by restricting coverage for new and existing treatments and services, and by discharging responsibility for some services to municipalities and to private providers[16]. Provincial governments have also responded to federal funds restrictions by devolving control of some aspects of the system to the recently created regional boards. The specific nature of devolved authority diverges considerably among provinces. However, in all the cases the level of autonomy given to

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[13] These include veterans, native Canadians living on reserves, military personnel, inmates of federal penitentiaries and the Royal Canadian Mounted Police.

[14] This principle implies the prohibition of private insurance of services already covered by provincial insurance. For-profit coverage is limited to supplementary services such as pharmaceuticals, vision care, or dental care.

[15] Some estimates show that the proportion of transfers in provincial expenditure has fallen from 26.9% at the beginning of the block funding period (1976/77) to 10.2% in 1998/99, three years after the introduction of the CHST (CIHI, 2000).

[16] Most of the reduction in public benefits has concentrated on voluntarily provided services.

the boards is still highly restricted for two reasons. Firstly**,** regions receive budgets determined by provinces on the basis of historical spending patterns and have no revenue raising powers. Secondly, regional decision-making is constrained by provincial guidelines and by provincial determination of key health services –physician services and drugs- (*Lomas et al.,* 1997).

5. A theoretical model of decentralization of health care services

The aim of this paper is to test whether a measure of health care decentralization is positively associated with a measure of health outcomes. To formalise this relationship we consider the problem faced by a benevolent policy maker who wishes to maximise the level of average health in a locality. Although some of the premises of this model may be unrealistic, it helps us to define a first best scenario that can be used as the reference for the empirical analysis. The primary assumptions of the model are:

- Individual utility (U) depends on health outcomes (H) and expenditure (X) on a private good:

  $U = U(H, X), \quad U_1>0; U_2>0; U_{11}<0; U_{22}<0$

  U (.) can be interpreted either as the preferences of the representative consumer if all the individuals are considered as identical, or as those of the median voter.

- Health outcomes depend in turn on health expenditure –local government health expenditure (Yl) and other non-local government health expenditure (Ynl)-, social capital (S), and the level of decentralization (D):

  $H = H(Y_l, Y_{nl}, S, D), \quad H_1>0; H_2>0; H_3>0; H_4 >=<0; H_{11}<0; H_{22}<0; H_{33}<0; \; H_4 >=<0$

- Local governments can identify individual's preferences over health care and the private good and use this information to maximise overall welfare.

- Local health care services are financed by means of local taxes and by transfers granted by the central government.

The initial resource constraint in the locality is given by:

$$Yl + X = I \qquad (1)$$

where:

I: total income in the locality

X: income available for spending in the private good (I – local taxes)

While local income (I) is fixed, the amount spent in the private good (X) depends on the consumer's preferences for health care. In the absence of central government's transfers, the amount of local taxes must be equal to the local spending in health care, i.e, Yl = I - X.

After central government's transfers (M) the budget constraint becomes:

$$Yl + X = I + M \qquad (2)$$

The maximisation problem faced by the local government can then be defined as follows:

$$\max_{Y_l} U\ (H\ (Y_l, Y_{nl}, S, D),\ X) \qquad (3)$$
$$s.to \qquad Y_l + X = I + M$$

Maximising U (.) with respect to H (.) and subject to (2) gives:

$$Y_l^* = f\ (I, M, Y_{nl}, S, D) \qquad (4)$$
$$\text{Now, } H^* = g\ (Y_l^*, Y_{nl}, S, D) \qquad (5)$$

$$\text{And hence, } H^* = g\ (I, M, Y_{nl}, S, D) \qquad (6)$$

Graphically, the generic model can be represented as follows:

Figure 1: Individual's optimal consumption

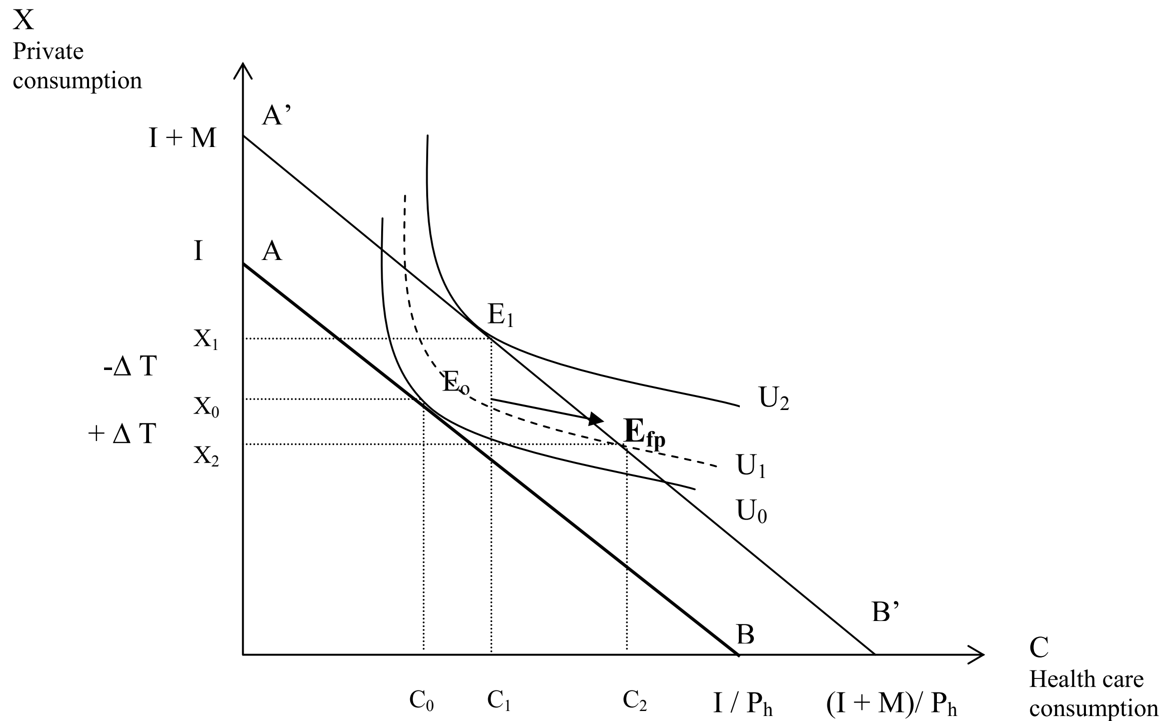

Figure 1 shows the equilibrium solution when the local governments are provided with a grant from the central government. Line AB represents the initial budget constraint of the jurisdiction, as described in equation 1. Without central government's grants, the equilibrium is achieved at point E_0. At this point, the optimal local health care spending (Yl*) will be P_h*C_0, and the optimal private consumption X_0.

After central government transfers, the budget line shifts outwards in a quantity equal to the amount of the transfers (M). Line A'B' represents the post-grant budget constraint of the locality, as shown in equation (2). If health care and the private good can be considered as normal goods, the post-grant equilibrium should be achieved at a point such as E_1, where the consumption of both goods increase (from C_0 to C_1, and from X_0 to X_1, respectively). Grants release private funds by the amount ΔT, inducing individuals to consume more of the private good in order to maximise their utility.

However, researchers often find that the post-grant equilibrium is achieved in a suboptimal point like E_{fp} ($U_2 > U_1$). This phenomenon, known as the *flypaper effect*, refers to the fact that, unlike income, grants induce an excessive increase in local government consumption[17]. As shown in figure 1, the new equilibrium point E_{fp} is characterised by an increase in both taxation and consumption by the local government[18]. At this equilibrium solution health care consumption increases (from C_0 to C_2) while private consumption decreases (from X_0 to X_2). Therefore, grants would not substitute for tax revenues collected by local authorities.

In addition to study the relationship between decentralization and health outcomes, the analytical framework previously developed allows us to examine whether decentralization stimulates the growth of the health sector through the flypaper effect. This can be done by comparing the coefficients of income and transfers after estimating equation 5 above. A greater elasticity of transfers than of income with respect to provincial expenditure would indicate the existence of the flypaper effect.

6. Data and methodology

To examine the model developed in the previous section, we use a panel of the ten provinces of Canada for the period 1979-1995. We have used infant mortality rates from the *Canadian Statistics* as the measure of health status. Infant mortality has been considered as the single most exhaustive indicator of health in a society. It reflects child's health and pregnant women's health, in addition to the state of health development within the society. Moreover, child's mortality is superior to life expectancy, our alternative measure of health status[19], for two main reasons. Firstly, because infant mortality is more reliably measured than life expectancy. Infant mortality figures are based on actual data, whereas life expectancy figures are based on

[17] For a review of the empirical literature on the flypaper effect see Hines and Thaler (1995).

[18] Note that a flypaper effect could also exist even if private consumption remains constant following an increase in grants.

[19] Alternative measures of health status for the Canadian population, such as Disability-free life expectancy or Potential years of life lost, are only available on a cross sectional basis.

extrapolations from child mortality data and assumed life tables. Secondly, because infant mortality is more sensitive to variations in underlying health[20].

Health decentralization is defined as the proportion of sub national health spending in Canada –municipal and provincial- over the total –municipal, provincial and federal-. The source of all the health spending data, as well as GDP per capita and population, is the *CIHI for Health Information* (CIHI). The remaining control variables included in the model were taken from the *Canadian Statistics*. These include an indicator of social capital –education-, and a measure of needs -low birth weight-. Low birth weight was included as a control variable because it is considered to be an important determinant of infant survival.

On the basis of the theoretical analysis, two alternative ways of examining the model are possible. Given that in both methods the results should be roughly equivalent, we explore both of them and compare the results. The first method is based on a single equation estimation of the form:

$$(1)\quad INFMORT_{it} = a_0 + a_1 INC_{it} + a_2 TRANSF_{it} + a_3\, FEDEXP_{it} + a_4\, MUNEXP_{it} + a_5\, PRIV_{it} + a_6\, DEC_{it} + a_7\, EDUC_{it} + a_8 LOWBIRTH_{it} + \lambda t + V_i + E_{it}$$

The second approach is based on the following interdependent systems of equations:

$$(2)\quad PROVEXP_{it} = a_0 + a_1 INC_{it} + a_2 TRANSF_{it} + a_3\, FEDEXP_{it} + a_4\, MUNEXP_{it} + a_5\, PRIV_{it} + a_6\, DEC_{it} + a_7\, EDUC_{it} + a_8 LOWBIRTH_{it} + \lambda t + V_i + E_{it}$$

$$(3)\quad INFMORT_{it} = a_0 + a_1\, FEDEXP_{it} + a_2\, PROVEXPHAT + a_3\, MUNEXP_{it} + a_4\, PRIV_{it} + a_5\, DEC_{it} + a_6\, EDUC_{it} + a_7\, LOWBIRTH_{it} + \lambda t + V_i + E_{it}$$

Where:
i: 1,...10 (provinces)
t: 1,...,17 (1979-1995)
INFMORT: infant mortality rate per 1.000 live births
INC: provincial income per capita
TRANSF: Per capita health care block grants from the federal government
DEC: Health care decentralization status
PRIV: private expenditure in health care per capita
FEDEXP: direct (non-grant) per capita federal expenditure in health care
PROVEXP: provincial expenditure in health care per capita
MUNEXP: municipal expenditure in health care per capita
EDUC: educational level
LOWBIRTH: proportion of low birth weights in all live births

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[20] Over the period studied, the standard deviation of infant mortality is almost as twice as the standard deviation of life expectancy (1.94 and 1.08 respectively).

PROVEXPHAT: predicted provincial expenditure in health obtained from equation (2) above
Λt: annual dummies
Vi: provincial specific effects
E_{it}: disturbance term

Table 1: Summary of statistics for estimation sample

Variable		Mean	Std. Dev.	Min	Max	Observations
lninfm	overall	2.06886	.2607877	.4700036	2.580217	N = 170
	between		.1074137	1.906789	2.226385	n = 10
	within		.2399267	.6320749	2.742288	T = 17
lngdp	overall	10.02807	.2279383	9.567257	10.56496	N = 150
	between		.2211775	9.74019	10.42448	n = 10
	within		.087366	9.786887	10.19083	T = 15
lntransf	overall	6.339942	.0583201	6.231988	6.440275	N = 170
	between		.0071422	6.326543	6.349466	n = 10
	within		.0579228	6.242225	6.434485	T = 17
lndec	overall	-.0484856	.0207085	-.1167368	-.0248861	N = 170
	between		.0191558	-.0870943	-.0309346	n = 10
	within		.0098304	-.0956373	-.0248466	T = 17
lnpriv	overall	6.36813	.1786485	5.882356	6.872811	N = 170
	between		.110883	6.221777	6.532603	n = 10
	within		.1441675	5.982165	6.716954	T = 17
lnfed	overall	4.258022	.4557322	3.302114	5.327293	N = 170
	between		.3757637	3.744291	4.963193	n = 10
	within		.2825976	3.478286	5.01284	T = 17
lnmunexp	overall	2.027083	1.370369	0	4.924714	N = 170
	between		1.367437	.0312866	3.478225	n = 10
	within		.4301824	-.3996484	4.515115	T = 17
lneduc	overall	-2.952442	.6741618	-3.99884	-1.351639	N = 170
	between		.6597834	-3.641219	-1.615566	n = 10
	within		.2457503	-3.495984	-1.944863	T = 17
lnlowb	overall	1.691759	.0860363	1.386294	1.856298	N = 158
	between		.0670302	1.584884	1.805395	n = 10
	within		.0566624	1.493169	1.915163	T-bar = 15.8
lnprov	overall	7.317093	.1558622	6.878203	7.609624	N = 170
	between		.0954203	7.19098	7.473521	n = 10
	within		.1266886	6.947964	7.52768	T = 17

The main advantage of using panel data estimation techniques is the attenuation of the problem of omitted variables. Panel data models allow to control for individual heterogeneity, that is, inherent characteristics of the population of interest that are either unobservable or non-measurable (e.g. preferences, managerial skills)[21]. Fixed effects and random effects are the two most usual panel data methods. In our case, since the data exhausts the population –provinces- and the inferences are made with respect to the sample, the fixed effects version of the panel data estimator seems to be more

[21] For a more detailed discussion of the advantages and disadvantages of panel data see Baltagi (1995, p.3-7).

appropriate. In addition, a series of year dummies has been included to account for the impact of period specific shocks (e.g. variations in local tax shares).

Reverse causation of some of the variables is a concern in each of the regression equations. In the health outcomes model INC, DEC, PRIV, TRANSF, FEDEXP, and MUNEXP are all regarded as suspected endogenous variables. It has been argued that while income leads to better health, good health may also contribute to improve living standards (*Fogel*, 1994). In this study, however, reverse causation between income and infant mortality is not likely to be crucial. DEC could be endogenously determined because one of the main arguments for DEC –allocative efficiency- is also used in many contexts to claim for the implementation of decentralization reforms. PRIV could also be endogenous because voluntary spending decisions with respect to health are based on the expectation of a high value for money (*Filmer and Prichett*, 1997). The likely endogeneity of TRANSF, FEDEXP and MUNEXP arises from the fact that larger amounts devoted to public health care might be driven amongst other things by the desire to reduce the aggregate levels of infant mortality in the population.

In the health spending model, there is a potential for causality in variables DEC, TRANSF, PRIV, and MUNEXP. Simultaneity of DEC makes sense since, by construction, an increase in provincial health expenditures automatically leads to an increase in the DEC indicator. PRIV and MUNEXP are both likely to be endogenous since, as we have seen in section 4, in the face of financial hardships provincial governments have offloaded the responsibility for some health services to the municipal and the private sectors. A further reason that may explain causality of private health expenditures is the existence of a quality effect with respect to the aggregate spending in the public sector. This is explained by the fact that an insufficient level of public spending in health may cause a poor performance of the public sector, which in turn might lead to an increased reliance in the private sector, e.g. through more consumption of drugs as a substitute for direct care. Given that intergovernmental grants are usually related to the previous spending patterns of local governments, many empirical studies analysing the impact of transfers on recipients' governments spending have considered grants as endogenous variables[22]. However, in the Canadian setting the simultaneity of transfers is not likely to be a very serious problem since from the start health transfers have been allocated to the provinces on a per capita basis. Moreover, the volume of the block transfer has been very unpredictable over the period.

If any of these variables is actually endogenous, standard OLS analysis will yield inconsistent estimates. In this situation a Two-Stages Least Squares (2SLS) would be required in order to consistently estimate the parameters of this model. In the first stage, the endogenous variable is regressed on a set of instruments. In the second stage, we apply OLS to the final equation where the endogenous variable is replaced by the corresponding "endogenity-purged" predicted value obtained in stage 1.

Instruments must satisfy two requirements: high correlation with suspected endogenous variables and no correlation with the error term. In general, the consequence of excluded instruments that are not perfectly exogenous and have little explanatory power is increased bias in the IV estimates. If the excluded instrument is exogenous but has low power, then conventional asymptotics fail (*Shea*, 1997). The

[22] The endogeneity problem of transfers is especially important under matching grant programs, since transfers are directly related to the local spending level through the matching rate.

relevance of the instruments in explaining the endogenous regressors has been checked by using the Shea R^2 statistic and the Bound R^2 statistic. As for the second of the requisites, the validity of the instruments, we have computed the C statistic in addition to the Hansen-Sargan statistic (*Baum et al*., 2003).

In the context of time series data, there is a natural source of instruments: the lagged values of explanatory variables in the system. The use of lags of the explanatory variables could be very useful for our empirical study, as it reduces the effort in finding such a large number of instruments for estimation. However, the use of internal instruments rules out autocorrelation in the error term. This is because in the presence of autocorrelation, lagged instruments are correlated with the current error term[23]. Therefore, our decision as to whether use internal instruments or not has followed the results of a test for autocorrelation.

On the other hand, when the suspected endogenous regressors are in reality exogenous applying IV is inefficient. This is a consequence of the addition in the regression equation of additional sources of uncertainty: the instruments. In consequence, we have used the Durbin-Wu-Hausman test for the adequacy of OLS and the necessity of performing IV estimation.

7. Estimation results

In table 2 we present the results from the estimation of the single equation model (Model 1), and the two-steps model (Model 2). In all the equations FEDEXP has been excluded as an independent variable given its high correlation with DEC[24]. FEDEXP has been instead used to instrument DEC.

The results for the health spending equation, the first equation of the two-stages model, are reported in columns 4 and 5 of table 2. We have first run an OLS regression equation. The Durbin Watson statistic prompted us to reject the null hypothesis of no autocorrelation of residuals. In consequence, we have not used lags of the suspected endogenous variables as instruments. Variables used to instrument DEC, TRANSF, and PRIV include[25]: FEDEXP, population and its squared value –POP and SQPOP-, population over 65 years –POP65-, the squared value of INC –SQINC-, and a measure of personal disposable income –PDI-. Only DEC turned out to be endogenous. Contrary to other studies on the impact of intergovernmental transfers in local expenditure, we have not found endogeneity of TRANSF. However, as we discussed in the previous section, this finding is reasonable for the case of Canada.

We have then run an IV regression treating DEC as endogenously determined. The value of the Hansen statistic suggests that instruments employed are adequate. Only INC appears to have a significant role in determining provincial health spending. On average it is estimated that, *ceteris paribus*, a 1 per cent increase in income leads to a

[23] If we knew that autocorrelation was of order j, a solution would be to use lags t+j+1 of the explanatory variables as instruments. However, the explanatory power of such instruments is not likely to be high.

[24] The correlation between FEDEXP and DEC is -0.9535. The high level of multicollinearity between both variables makes it difficult to estimate precisely their individual slopes. For that reason we decided to drop FEDEXP, as our main concern is on the coefficient of DEC.

[25] MUNEXP has not been instrumented because when it was included as an endogenous variable, the explanatory power of the instruments for the rest of endogenous variables was substantially reduced.

0.2 per cent increase in provincial health spending[26]. The coefficient of TRANSF is not statistically different from zero. A priori, the coefficients of INC and TRANSF are very similar in terms of their economic significance. Moreover, a formal test on the statistical equivalence between the two coefficients could not be rejected at any significant conventional level (p value = 0.2270). The existence of a roughly equivalent spending response to INC and TRANSF contradicts one of the main features of the flypaper effect: federal grants do not lead to an excessive spending propensity from provinces. In consequence, the shift from a matching grant to a block-funding grant seems to have been successful in containing health costs at both the federal and the provincial government levels in Canada.

With respect to the health outcomes equation the results for both models (Table 2, columns 1 and 2) are very similar. Given that the Durbin Watson statistic is over 2 in both estimated equations, we cannot infer autocorrelation of residuals. Therefore we have used the lags of the suspected endogenous variables as instruments, together with FEDEXP, POP and POP65. In none of the models did we find a causal relationship between INFMORT and the suspected endogenous variables - INC, DEC, PRIV, TRANSF, and MUNEXP-. In consequence, we have relied on the estimated OLS results. Since according to the Breuch-Pagan test, heteroskedasticity is a cause of concern in each of the equations, we have computed the t statistics using robust standard errors. The high R^2 and F-statistics of the OLS regression imply that both models are a good fit to the data.

The estimates for DEC are statistically significant in both models. It is estimated that, *ceteris paribus*, a 1 per cent increase in decentralization is associated with approximately a 4 per cent reduction in infant mortality. Although the estimates for PRIV are also significant in both equations, the magnitude of the effect is much lower: on average, a 1 per cent increase in private health spending is expected to lead to a 0.3 per cent increase in infant mortality. The positive estimated association between PRIV and INFMORT may reflect the fact that in provinces with poorer health care systems, people choose to spend more in private services, but because the core health services are provided publicly, a higher private spending in health may still be associated with a high infant mortality. In addition, as the estimates for DEC in the health spending equation show, health outcomes' gains arising from decentralization have not been at a cost of a higher provincial health spending.

In order to compare the spending impact on infant mortality at each level of government, we have introduced a third model (Table 2, column 3) in which we have kept PROVEXPHAT from model 2, but DEC has been replaced by FEDEXP. Like in the other health outcomes' regression equations, the tests performed in this model show no autocorrelation of residuals but heteroskedasticity. In consequence, we have used heteroskedasticity-consistent standard errors. Again the Durbin-hausman test for the endogenity of the suspected endogenous variables could not be rejected at any conventional significant level[27]. We have therefore presented the OLS estimated results.

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[26] Since we have used a log-log specification for every regression equation, the coefficients of each parameter can be interpreted directly as elasticities.

[27] For this equation DEC has been used to instrument FEDEXP. For the rest of suspected engoneous variables -INC, PRIV, TRANSF, MUNEXP- we have used their own lags as instruments as well as POP and POP65.

According to the results of this model, it is only provincial expenditure in health that is statistically significant in explaining infant mortality. It is estimated that, *ceteris paribus*, a 1 per cent increase in provincial expenditure in health care stimulates roughly a 2.3 per cent reduction in infant mortality. This result provides additional support for the negative association found between DEC and INFMORT, since only the absolute amounts of health spending at the primary level of decentralization in health (provincial level) appear to be significant in reducing INFMORT. In addition, by finding a positive association between a component of public health spending and infant mortality, this paper contrasts with other studies on the determinants of health, where public resources devoted to health care are found to be statistically insignificant in explaining health outcomes [28].

Table 2: Estimation output[a]

Regressors (ln)	Regressand: infant mortality (ln)			Regressand: provincial health expenditure per capita (ln)	
	Model 1	Model 2	Model 3	Model 2	
	OLS	OLS	OLS	OLS	2SLS[b]
INC	-.4592938 [-1.60]	----	----	.2198679*** {2.60}	.203965** {2.55}
TRANSF	.2333868 [0.16]	----	----	-.3846533 {-1.32}	-.2162545 {-0.52}
FEDEXP	----	----	.1355956 [0.92]	----	-----
PROVEXPHAT	----	-2.261679 [-1.64]	-2.67357** [-2.02]	----	----
MUNEXP	-.021673 [-0.98]	.0069601 [0.23]	.0061481 [0.20]	.0070741 {0.96}	.0129746 {1.64}
PRIV	.3446056* [1.82]	.3071002* [1.77]	.2941498 [1.63]	-.0633248 {-1.34}	-.0180762 {-0.36}
DEC	-4.802356** [-2.47]	-3.338081* [-1.71]	----	2.573491*** {3.88}	.6730359 {0.96}
EDUC	-.0988216 [-0.68]	.0296053 [0.17]	.0288092 [0.17]	.0439647 {1.16}	.0566194 {1.34}
LOWBIRTH	-.3278505 [-0.66]	-.3094528 [-0.65]	.1355956 [0.92]	.0209934 {0.48}	.0111989 {0.23}
F-statistic	21.81	21.9	22.61	----	-----
R^2	0.6914	0.6913	0.6879	----	-----
Durbin-Watson test	2.63	2.63	2.6	.78	.41
Sargan-Hansen test (p value)	----	----	----	-----	0.13171
Effective sample	1979-1995	1979-1995	1979-1995	1979-1995	1979-1995
N (cross-section)	10	10	10	10	10
N (obs)	140	140	140	140	140

*** - significant at 1%; ** - significant at 5%; * - significant at 10%
(.)- t statistics
{.}-t statistics computed with Newey-West standard errors (standard errors robust in the presence of heteroskedatsicity and autocorrelation)
[.]- t statistics computed with heteroskedasticity-robust standard errors
a- All the estimations include time and provincial dummies.
b- Excluded instruments are: FEDEXP and POP

[28] A brief summary of the recent literature about the public spending impact on health outcomes can be found in *Or* (2000).

8. Discussion

The theoretical literature on fiscal federalism predicts potential efficiency gains from placing responsibilities of local public goods at the local level. For the case of the health services, these efficiency gains are manifested in an improvement of the population's health. However, in the empirical literature little attention has been paid to the evaluation of the outcomes of decentralization in the health care public sector.

In this work we have explored the relationship between a measure of health care decentralization –the proportion of local health spending on the total health spending for all the levels of government- and an indicator of health outcomes -infant mortality- in Canada. To formalise the linkages between health care decentralization and health outcomes, we have developed a simple model that we have then estimated on the basis of panel data for the period 1979-95. In addition, this model has allowed us to test for the existence of the flypaper effect in provincial's government spending behaviour.

The empirical results of our model with respect to the outcomes of decentralization confirm the theoretical predictions for the case of Canada, i.e. decentralization of health care leads to an improvement in health outcomes (in terms of infant mortality). Moreover, the efficiency gains from the particular decentralization structure in Canada do not seem to be counteracted by the flypaper effect. However, some caution is required in interpreting these results. First of all, the indicator of health decentralization used captures only one of the multiple dimensions of the health care decentralization process: the fiscal one. Secondly, the measure of health outcomes employed does not fully reflect the underlying level of health in a society. In spite of these analytical problems, this research adds a new empirical perspective to the evaluation of the economic gains arising from decentralization in health care.

References

Ahmad E, Craig J (1997): Intergovernmental transfers. In: Fiscal Federalism in Theory and Practice, ed. Ter-Minassian, Teresa. Washington, D.C.: IMF.

Akin J, Hutchinson P, Strumpf K (2001): Decentralization and Government Provision of Public Goods: The Public Health Sector in Uganda, Carolina Population Center University of North Carolina at Chapel Hill, WP 01-35.

Armstrong P, Armstrong H (1999): Decentralized health care in Canada, BMJ 318, 1201-1204 (http://bmj.bmjjournals.com/cgi/content/full/318/7192/1201).

Baltagi B (1995): Econometric analysis of panel data, Ed. Wiley, New York.

Banting K, Corbett S (2002): Multi-level Governance and Health Care: Health Policy in Five Federations, paper presented to the Meetings of the American Political Science Association, Ontario (http://www.aiesweb.it/media/pdf/co0003/028.pdf).

Baum CF, Shaffer M, Stillman S (2003): Instrumental Variables and GMM: Estimation and Testing, Boston College, Department of Economics Working Paper No 545.

Brennan G, Buchanan J (1980): The Power to Tax: Analytical Foundations of a Fiscal Constitution, Cambridge University Press: Cambridge.

Canadian Institute for Health Information (2000): Understanding Canada's Health Care Costs, Provincial and Territorial Ministers of Health.

Commission on the Future of Health Care in Canada (2002): Federal-Provincial Relations and Health Care.

Ebel RD, Yilmaz S (2001): On the Measurement and Impact of Fiscal Decentralization, paper presented on the Symposium of Public Finance in Developing Countries: Essays in Honour of Richard M. Bird, Georgia (http://www.worldbank.org/wbi/publicfinance/documents/Seco/ebel&yilmaz.pdf).

----------------- (2001): Fiscal Decentralization: is it happening? How do we know, Georgia State University. (http://isp-aysps.gsu.edu/papers/ebel2001.pdf)

Filmer D, Pritchett L (1997): Child mortality and public spending on health: How much does the money matter?, The World Bank.

Fogel RW (1994): Economic Growth, Population Theory and Psychology: The Bearing of Long-Term Process on the Making of Economic Policy, American Economic Review 84 (3), 369-95.

Hunter DJ, Vienonen M, Cezary WW (1998): Optimal Balance of Centralized and Decentralized Management. In: Critical challenges for health care reform in Europe, ch.13. Edited by Saltman R B, Figueras J and. Sakellarides C. Buckingham, Open U.P.

Khalegian P (2003): Decentralisation and Public Services: the case of immunisation. World Bank Policy Research Working Paper 2989 (http://www.econ.worldbank.org/files/24757_wps2989.pdf)

King D (1984): Fiscal Tiers. The Economics of Multilevel Government. George Allen & Unwin, London.

Levaggi R, Zanola R (1998): The Flypaper effect: Evidence from the Italian National Health System. Department of Public Policy and Public Choice Working Paper, University of Eastern Piedmont.

Lomas J, Woods J, Veenstra G (1997): Devolving authority for health care in Canada's provinces: An introduction to the issues, CMAJ, 156 (3) 371-77.

Mahal A, Srivastava V, Sanan D (2000): Decentralization and Public Health Sector Delivery of Health and Education Services: the Indian Experience. Discussion Papers on Development Policy No 20, Bonn.

Musgrave RA (1958): The Theory of Public Finance. New York: Mc Graw Hill, ch.1.

Oates, WE (1972): Fiscal Federalism, Harcourt Brace Jovanovich: New York.

------------------ (1999): An Essay on Fiscal Federalism, Journal of Economic Literature, 37, p.1120-49.

Or Z (2000): Determinants of Health Outcomes in Industrialised Countries: A Pooled, Cross-Country, Time-Series Analysis, OECD Economic Studies No 30.

Robalino DA, Picazo OF, Voetberg A (2001): Does fiscal decentralization improve health outcomes? Evidence from a cross-country analysis. Policy Research Working Paper 2565, World Bank, Washington DC.

Rodden J (2001): Reviving Leviathan: Fiscal Federalism and the Growth of Government, unpublished, Cambridge MA: MIT (http://www-hoover.stanford.edu/RESEARCH/conferences/collective/04092002.pdf)

Shea, J. (1997): Instrument Relevance in Multivariate Linear Models: A Simple Measure. Review of Economics and Statistics, Vol. 49, No. 2, pp. 348-352.

Wooldridge JM (2002): Econometric analysis of cross section and panel data, The MIT Press, London.

Yee E. (2001): The Effects of Fiscal Decentralization on Health Care in China. Princeton University (http://www.econ.ilstu.edu/UAUJE/PDF's/issue2001/Yee.pdf).