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# Intergovernmental Transfers and Fiscal Behavior: Insurance Versus Aggregate Discipline<sup>1</sup>

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## ABSTRACT

This paper evaluates the trade-off between the advantages of risk sharing and the perils of common pool problems in federal fiscal arrangements. Under the assumption of asymmetric information we evaluate two alternative regimes of intergovernmental transfers. In one regime, the central government pre-commits to a certain level of transfers that compensate vertical fiscal imbalances and provide some limited ex-ante insurance. In the other regime, it accommodates ex-post the fiscal needs of the different provinces. In this second case, full-insurance results, but the economy is subject to a tragedy of the fiscal commons, with excessive subnational spending, insufficient local taxation, and reduced production of federal public goods. We find the range of parameters for which one or the other institutional regime will be preferable. The result is a fiscal-federalism version of the usual trade off between rules and discretion.

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Key words: Fiscal federalism, intergovernmental transfers, insurance, risk sharing, common pool.

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## 1. Introduction

The European economic unification is a process which has no historical precedent of such proportions (Eichengreen, 1993). The fact that European countries are surrendering their monetary policies to a European Central Bank has focused the attention on the need for including fiscal policy in the set of policies to be coordinated.<sup>2</sup> Following the footsteps of Europe, other processes of regional economic integration are under way, most notably, the Common Market of South America (MERCOSUR). In this case, there has been substantial (albeit bumpy) progress in coordinating trade and other sectorial policies, and discussions on monetary unification are starting.

At the same time, public sector decentralization has become one of the tenets of the sweeping wave of institutional reforms that has come to be known as the Second Generation of Reforms.<sup>3</sup> Every single country in Latin America has today a more decentralized fiscal structure than in the 1980's (Inter-American Development Bank, 1997). One of the main ideas behind this process is that decentralized fiscal decisions increase political accountability and generate packages of spending and taxing that tend to better reflect the wishes of local voters.<sup>3</sup> Nevertheless, it has been argued that decentralization can foster fiscal indiscipline (e.g. Stein 1997, Ter-Minassian 1997). Ill-designed institutional arrangements for fiscal relationships among different levels of government have originated common-pool problems, inducing an over-spending bias across jurisdictions as each sub-national unit tries to overuse the national source of funds.

Thus, the fundamental processes of *integration* and *decentralization* are changing in important ways the architecture of public decision making in the world. Some policy decisions are now taken at a higher level of aggregation (i.e. monetary policy in Europe, trade policy in South America), while others are taken by smaller political units "closer to the people" (i.e. health and education policies in many Latin American countries). Not surprisingly, these events have spurred enormous intellectual interest on the field of fiscal federalism. The central questions in terms of federal fiscal arrangements are: which level of government (or which set of voters) gets to decide which components of the total vector of public expenditures and their financing (taxes, debt)? What are the procedures for such choices? Also, in the case where expenditure and financing are not balanced at

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<sup>2</sup>This demand might be heightened by the fact that more integration leads to increased specialization, in turn leading to more asymmetric output shocks requiring insurance (Kalemli-Ozcan, Sorensen and Yosha, 2001).

<sup>3</sup>See Tommasi and Weischelbaum (1999) for an attempt at modelling the benefits of decentralization in an explicit principal-agent framework, as well as for a review of the related literature.

each level of government, how are intergovernmental transfers structured (and decided)? The concerns guiding such analyses include macroeconomic (risk sharing, aggregate fiscal solvency, behavior of fiscal variables over the cycle, dynamics of aggregate and local debt) as well as microeconomic (income distribution, efficiency) considerations.

This paper focuses on some of the macroeconomic trade-offs involved in federal fiscal arrangements; in particular, the potential trade off between providing "fiscal co-insurance" (risk sharing) and providing adequate incentives for aggregate fiscal discipline.<sup>4</sup> From a welfare point of view, objectives such as insurance and achievement of distributive objectives, have to be weighted vis a vis these potential common-pool costs. And, of course, the main challenge is to come up with (politically feasible) designs that minimize such trade-off.

More specifically, we cast the trade-off in the well-known language of rules versus discretion. As in many other areas of policy, *rules* (commitment by the federal government) can avoid certain biases (in this case, a common-pool one), while *discretion* leaves more room for adjusting to new information (in this case, shocks to local income).

Our model features a federal government that produces a federal public good (which could be interpreted as macroeconomic stability) and finances transfers to  $n$  local regions (provinces). The subnational units have stochastic income which, together with federal transfers, serves to finance local expenditures. A key assumption is that while local governments observe the realization of local income (shocks), the federal government does not. Expenditure decisions across regions are interrelated through the federal government budget constraint which gives rise to the possibility of coordination problems depending on the institutional structure under which federal and local policies are determined. In particular we evaluate two alternative regimes. In one regime, the central government pre-commits to a certain level of (lump-sum) transfers that compensate vertical fiscal imbalances and provide some limited ex-ante insurance (by increasing the expected value of local consumption, which is subject to stochastic shocks). In the other regime, it accommodates ex-post the fiscal needs of the different provinces, after local governments have made their choices. In this second case, full-insurance results, but the economy is subject to a tragedy of the fiscal commons, with excessive subnational spending and reduced production of federal public goods (such as macroeconomic stability). We find the range of parameters for which one or

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<sup>4</sup>One might argue that the first concern has been more prominent in the European discussions (see, for instance Eichengreen 1993), while the second one is a central concern in developing countries. This different emphasis might, in turn, relate to the starting point in each trajectory of institutional innovation.

the other institutional regime will be preferable. When idiosyncratic shocks are very important, it might be worthwhile to suffer from the common pool problem in order to attain ex-post insurance, while the opposite is true when the common-pool problem is relatively more important (for instance, when the country is very decentralized).<sup>5</sup>

The rest of the paper is organized as follows. In the next section we present some stylized facts. In section 3 we present the basic set up of the model. In section 4 we solve for the benchmark case with complete information and commitment. In section 5 we introduce the assumption of asymmetric information about local shocks and we solve the model both under commitment and discretion. In section 6 we perform the welfare analysis comparison that allows the choice of regimes. In section 7 we extend the model to include explicitly both national and local taxation, and we extend the previous result on those margins. Finally, in section 8 we conclude with a summary of our results and we discuss future lines of research.

## 2. Some stylized facts

As indicated in the introduction, we motivate the use of federal transfers as a risk-sharing mechanism; that is, as an instrument to smooth out asymmetric shocks affecting states within a given country. But, how important is risk-sharing in practice, and how does it take place? To what extent are shocks smoothed out using the capital market (cross-ownership of assets) or borrowing and lending? What is the role of intergovernmental transfers? Is information regarding those shocks asymmetric? Do transfers generate wrong incentives for states to overspend or to provide low tax effort? In this section we summarize some evidence

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<sup>5</sup>Several recent papers (Velasco, 1999, Aizenman, 1992, Mondino et al, 1996) address the possibility of macroeconomic imbalances arising from the interaction of decentralized fiscal authorities sharing an aggregate budget constraint; "fragmented fiscal policy" in the words of Perotti and Kontopoulos, 1999. However those papers do not address the benefits of federal arrangements in terms of risk sharing. The inclusion of this feature in our paper allows us to formalize the trade off between subnational and national stabilization, recently emphasized by Von Hagen (1998).

The design of intergovernmental transfers in terms of its risk-sharing properties has been the concern of a recent public finance literature. In particular, Lockwood (1999) provides a general analysis of the asymmetric information case. His paper does not include a federal public good and hence, does not deal with common-pool problems. It is this consideration that enables us to have a trade-off which can be exploited in the endogenous choice of the regime of intergovernmental transfers.

Several interesting papers (Wildasin, 1995; Bucovetsky, 1998; Lee, 1998) address the insurance aspects of migration, an issue that we do not touch upon in this paper.

regarding these questions, in order to motivate the theoretical analysis of the rest of the paper.

The analysis of federal transfers as a mechanism for smoothing out regional shocks has received a great deal of attention as a consequence of the establishment of the EMU. The elimination of the exchange rate as an adjustment mechanism, lead to the search for alternative stabilization mechanisms, with intergovernmental fiscal transfers as one prime candidate. Thus, various studies have tried to evaluate the extent to what these transfers help to alleviate the effects of asymmetric shocks.<sup>6</sup>

For the case of the US, initial studies by Sachs and Sala-i-Martin (1991) and the MacDougall Report (Delors, 1989) showed that the federal system provides a large offset against regional income disparities, ranging between 28 and 40% of the observed differences. A problem with those early studies was that they did not distinguish between permanent redistribution (reducing lasting income differences between regions) and tax-transfer mechanisms, providing insurance against temporary shocks. When such distinction is incorporated into the empirical analysis, several authors find that transfers smooth out a much lower proportion of the variance to transitory shocks. Von Hagen (1992) estimates it at 10%, Asdrubali et al (1996) at 13%, and Melitz and Vori (1993) between 12 and 20%.<sup>7</sup> For the case of Canada the MacDougall Report finds that the federal fiscal system reduces income differences between provinces by 32 cents per dollar. Other studies attempting to separate insurance from redistribution found that the federal fiscal system offsets between 12 and 19% of the variance of temporary shocks (Bayoumi and Masson, 1997, Goodhart and Smith, 1993, and Melitz and Zumer, 1998.). For Germany, Von Hagen and Hepp (2000) found that interstate transfers have practically no role in moderating asymmetric perturbations to state output, but they offset a good proportion of shocks to state revenues (between 38 to 56%). There are not many studies that have tackled this issue for developing countries. For the case of Argentina, Nicolini et al (2002) find a negative correlation between a special type of national transfers and shocks to local tax revenues, providing some evidence of a partial insurance mechanism.<sup>8</sup>

The partial smoothing result found in the literature is consistent with the fact that full insurance cannot be provided without inducing serious incentive prob-

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<sup>6</sup>Von Hagen (1998) and Kletzer and von Hagen (2000) are excellent surveys of such studies, which have concentrated mostly on developed countries.

<sup>7</sup>Some of these studies have also estimated how much risk sharing is provided through capital markets and through borrowing and lending, as well as how much of the variance is not smoothed out at all. Asdrubali et al (1996) found that in the U.S., 39% of shocks to gross state product are smoothed out by capital markets, 23% by credit markets, and 25% are not smoothed.

<sup>8</sup>They also find that the distribution of these transfers has responded to political factors.

lems when there is asymmetric information (AI) regarding the occurrence and magnitude of shocks. The problem of AI regarding local conditions has been a key issue in the fiscal federalism literature since Oates' (1972) seminal contribution. As a matter of fact, the whole debate over the virtues of decentralization would be a non-issue if AI was not important, since in that case a centralized system would dominate all alternative arrangements. The empirical relevance of the assumption of AI has been stressed in various contexts by analysts and policy-makers. For example, Costello (1993) has reported that "... grant design at the Community level is particularly difficult given information asymmetries between EC and national authorities...".<sup>9</sup> This informational problem is likely to be aggravated in the case of more narrowly-defined tax bases like real state taxes, where the effect of very localized shocks can have a significant impact on property valuation and on tax receipts (Bordignon et al, 2001). On top of that, Cremer et al (1996) have indicated that "... though in the EU national accounts figures of each member state are well known, this perfect observability will last until those figures are used to assess the amount of revenue is expected to supply to the confederal authority." Evidence of the possibility of manipulation of national figures has been shown by Botazzi and Manasse (1998), who describe cases of creative accounting used by European Governments to comply with the 3% Maastricht criterium for the deficit/GDP ratio.<sup>10</sup> It is likely that this problem of AI is even worst in developing countries given their less diversified regional economies and also the weakness of their systems of regional statistics.<sup>11</sup> Furthermore, many authors have argued that even beyond asymmetries in shocks, there is asymmetry in the economic (and we would add *political*) propagation mechanisms in different regions (Kletzer and von Hagen, 2000).<sup>12</sup>

Regarding the evidence on the trade-off between fiscal insurance and incentives for fiscal effort, a few studies have tried to measure this trade-off directly.

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<sup>9</sup>Informational problems are in part due to the fact that GDP volatility is caused by asymmetric shocks which are also uncorrelated over time (Helg et al, 1995).

<sup>10</sup>Similar tricks have been reported by Suits and Fisher (1985) for the states of Michigan and New York, and in Wellink (1996) for the Netherlands. Furthermore, the problem of creative accounting is a central concern in discussions regarding fiscal rules (Alesina and Perotti, 1999).

<sup>11</sup>For the case of Argentina there is not even provincial GDP data on an annual basis. For the case of China, Laffont (1995) reports the problem of asymmetry of information about local tax revenues between provinces and the central government.

<sup>12</sup>When an economic shock, say, a change in the international price of its main export, hits, there is an economic, administrative and political process which produces and distributes the impact of the disturbance on the different political actors. Even though the change in international prices is as observable to the federal government as it is to any provincial government, this inner process that propagates this shock on provincial fiscal finances and politics is filled with informational (and, as mentioned above, moral-hazard) problems.

For the case of Germany, von Hagen and Hepp (2000) and Buttner (1999) indicate that the transfer system has created negative incentives for states to collect taxes and to develop their tax bases. In particular, von Hagen and Hepp (2000) shows that since the sixties, coinciding with the expansion of the interstate transfer system, the income elasticity of state tax collection has weakened considerably. For developing countries, there is more abundant evidence regarding incentive problems induced by intergovernmental transfers. For instance, Stein (1997) shows that countries with larger vertical fiscal imbalances and more discretionary transfers, tend to have larger public sector spending. Jones et al (2000) present similar findings in a cross-section of Argentine provinces.

From this quick summary of empirical evidence, we conclude that smoothing shocks to local income is one important role of intergovernmental transfers, even though not the only one. This smoothing tends to be a partial one, partly due to informational asymmetries; and there are incentive problems inducing too much spending (specially at the local level) and/or too little subnational tax effort. In the rest of the paper we develop a model that helps us think through this complex reality.

### 3. The set-up

Assume an economy where there is a federal government (FG) and  $n$  local governments, each of which rules in a corresponding region of a federal country. Each region is inhabited by a representative individual which implies, in a rather obvious application of the median voter theorem, that preferences of the local government coincide with that of the representative agent. We assume away principal-agent problems between (local) citizens and their representatives. For models that emphasize such problems in federal contexts see Seabright (1996) and Tommasi and Weischelbaum (1999).

Preferences are defined over a private consumption good and a federal public service. Agents in each region are endowed with an exogenous level of output that behaves stochastically with a known distribution. The federal government has an exogenously given level of resources that has to allocate among lump-sum transfers to the regions and the financing of a federal public good. In this initial setting we abstract from the existence of local taxes and expenditures. Thus the “fiscal game” just refers to the determination of the level of transfers in different institutional settings and under different assumptions regarding the information about local shocks. Section 7 introduces local public goods as well as local and national taxation.

The utility function of the representative agent of region  $i$  is given by,



$$U_i = U(c_i, g_f); \quad (1)$$

where  $c_i$  is local consumption, and  $g_f$  is a Samuelsonian pure federal public good, which can also be understood as a reduced form for macroeconomic stability, i.e. low inflation, avoidance of balance of payment problems, etc.<sup>13</sup> We assume  $U(\cdot)$  is concave with the usual properties  $U_c, U_g \geq 0, U_{cc}, U_{gg} \leq 0$ . We further assume that  $U_{cg} \geq 0$  and also that  $U(\cdot)$  obeys the Inada conditions  $\lim_{c \rightarrow 0} U_c = \lim_{g \rightarrow 0} U_g = \infty$ .

The budget constraint of the local agent (local government) is,  $c_i = Y_i + d_i$ ; where  $Y_i$  is an exogenous level of local income and  $d_i$  is a transfer received from the federal government. Local income  $Y_i$  is subject to random shocks. In particular, we assume that  $Y_i = Y + \epsilon_i$ , where  $\epsilon_i$  is a stochastic variable denoting the deviation of region  $i$ 's output around its mean value  $Y$ .  $\epsilon_i$  behaves accordingly to a known common cumulative probability distribution  $F(\epsilon_i)$  with  $E(\epsilon_i) = 0$  and  $V(\epsilon_i) = \sigma^2$ , where the higher order moments of  $\epsilon_i$  are of negligible order compared to  $\sigma^2$ . Although in principle we can allow regions to differ in terms of the parameters determining the stochastic behavior of local income, in most of the analysis we present below we will assume that all regions in the country are identical from an ex-ante perspective and only differ ex-post depending on the realization of income. Thus, we will only consider ex-post redistribution through federal policy (as in Persson and Tabellini, 1996a).

The budget constraint of the federal government is given by,

$$\sum_{i=1}^n d_i + g_f = R, \quad (2)$$

where  $R \geq 0$  is an exogenous level of federal resources. Moreover, in order to concentrate our analysis on risk sharing across regions, we will assume that federal resources are constant. One way to motivate this is by assuming that the federal government, but not the regions, has access to a perfect international capital market, so that through borrowing and lending it can smooth out any fluctuation in its income.<sup>14</sup> We have, then, that aggregate wealth,  $R + \sum Y_i$ , will fluctuate as long as  $n$  is not large enough to dissipate all idiosyncratic risk affecting local income.

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<sup>13</sup>Macroeconomic setups that generate the type of common-pool problems emphasized here, have been provided in Velasco (1998), Aizenman (1998), and references there.

<sup>14</sup>This simplifying assumption captures, in a rather extreme way, the observable fact that in most nations the credit rating of subnational governments in international financial markets does not exceed the credit rating of their national government.

#### 4. The benchmark case: complete information and commitment

We start solving the model for the ideal case where the federal government observes the realization of local income in each region, and then decides its policy (the level of transfers) before local consumption choices. This solution will give us a first-best benchmark, against which we will measure the performance of different (more realistic) regimes. The problem of the federal government in this full-information / full-commitment scenario can be expressed in the following way:

$$\underset{\{d_i\}_{i=1}^n}{Max} \sum_{i=1}^n U(Y_i + d_i, R - \sum_{i=1}^n d_i) \quad (3)$$

The first order conditions are,

$$U_c(c_i, g_f) = \sum_{i=1}^n U_g(c_i, g_f) \quad (4)$$

for  $i = 1, \dots, n$ , together with  $g_f = R + \sum_{i=1}^n Y_i - \sum_{i=1}^n c_i$ .

The above expression defines implicitly the optimal level of local expenditures  $c_i^*$  and of transfers  $d_i^*$ . The optimal amount of funds to be delivered to region  $i$ , must satisfy the usual marginal condition where the gain in utility from an increment in private consumption in region  $i$  must compensate the loss in utility from the reduction in consumption of the federally provided public good in all regions. Moreover, from the properties of  $U(c, g)$ , it can be easily shown that there exists a unique symmetric (constant across income realizations) solution to the system defined by (4) given by  $c_i^* = c^*$ .<sup>15</sup> Thus, under the postulated assumptions this regime entails complete insurance against local shocks. Replacing this solution into the budget constraint of the local government  $d_i^* = c^* - Y_i$ , we find that transfers redistribute income ex-post to compensate any deviation of local income from the common level of consumption.

In order to obtain explicit solutions (to be used in later comparisons) we will use, as an example, the following constant relative risk aversion specification for the utility function,

$$U(c_i, g_f) = \frac{(c_i^\alpha g_f^{1-\alpha})^{1-\rho}}{1-\rho}. \quad (5)$$

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<sup>15</sup>This, as well as many other technical details, is shown in an Appendix, available upon request.

The first order condition (4) leads in this case to

$$g_f^* = n \frac{(1 - \alpha)}{\alpha} c^*. \quad (6)$$

Using the federal budget constraint  $g_f = R + \sum_{i=1}^n Y_i - nc^*$  we obtain the explicit solutions for local consumption

$$c^* = \alpha \frac{1}{n} (R + \sum_{i=1}^n Y_i), \quad (7)$$

and for federal expenditures,

$$g_f^* = (1 - \alpha) (R + \sum_{i=1}^n Y_i). \quad (8)$$

Replacing  $c^*$  in the local government constraint we obtain the following expression for transfers,

$$d_i^* = \alpha \frac{1}{n} (R + \sum_{i=1}^n Y_i) - Y_i \quad (9)$$

As expected with any Cobb-Douglas specification, expenditures in the private and federal public good will be, respectively, a fraction  $\alpha$  and  $(1 - \alpha)$  of total resources. To accomplish this, federal transfers (which could be either positive or negative) will compensate any deviation of local income from the targeted, common level of local consumption. Rewriting (9) in the following way,

$$d_i^* = \left[ \alpha \frac{R}{n} - (1 - \alpha) Y \right] + \left[ \alpha \frac{\sum_{i=1}^n \epsilon_i}{n} - \epsilon_i \right] Y, \quad (10)$$

we illustrate two often-mentioned determinants of intergovernmental transfers: the vertical fiscal imbalance (first term in brackets) and the ex-post horizontal fiscal imbalance (second term in brackets). From the term denoting the vertical fiscal imbalance, which is common to all regions, we learn that transfers will be positive if, on average, resources at the federal level are larger than those available at the local jurisdiction (depending also on the preference for local versus federal expenditures). This is the case in most developing countries. Alternatively, if resources at the federal level are less abundant, as in the European Union, then regions (countries) will have to pay (on average) positive contributions to the federation to finance federal programs. The second term in brackets in (10) indicates that transfers also aim at solving the ex-post horizontal fiscal imbalance

across jurisdictions, redistributing income as a function of the difference between the average realization of output and that of the specific region.

## 5. Incomplete information

In the previous section we assumed that the federal government had full information about all relevant local variables, and had perfect commitment capabilities. In this section we relax the full information assumption. Thus, assume that the FG knows the distribution of shocks to each province, but not its realization. (This assumption is motivated in Section 2).

Below we analyze two polar and rather extreme ways of "handling" this asymmetric information problem. One is that the federal government, knowing just the distribution of the shocks, commits to a specific lump-sum transfer scheme. A second alternative is to do away with FG commitment and let local governments affect the transfers to be delivered from the federal government. Although this mechanism will impinge an expansionary bias to federal grants, it will make use of the information that local jurisdictions have on the realizations of local shocks. As we will see, the two alternative institutional settings reproduce the well-know trade off between rules and discretion.

### 5.1. Non-commitment (Nash) case.

In addition to the incomplete information assumption, in this subsection we suppose that the institutional setting by which transfers are defined implies that the FG does not precommit its policy choices. In this case the action of each local government will affect the determination of transfers.<sup>16</sup>

The problem that each local government solves when deciding local expenditure is,

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<sup>16</sup>We can think of local governments financing their expenditure with their own income  $Y_i$  and with IOUs which will be picked up by the federal government. The set-up of this section is equivalent to each jurisdiction in effect deciding over the size of the transfer they receive from the central government. This assumption which might at first sight seem unrealistic, is consistent with several institutional set-ups observed in Latin America (Stein, 1997, Fernández-Arias, Stein and von Hagen, 2001); it is equivalent to the assumption in the classic piece by Weingast, Shepsle and Johnsen (1981); and it could be interpreted as a simple way of formalizing more subtle externalities, such as those that operate through interest rates (Canzoneri and Diba 1991). The set-up of our one-period game can be interpreted as a reduced form for a richer intertemporal model in which the federal government can bail-out local governmentes in trouble. For studies where bailouts are explicit modeled in the context of fiscal federalism see Wildasin (1997) and Bolton and Rosenthal (1998). In the concluding section of this paper we speculate on the impact of adding dynamics to the model.

$$\underset{d_i}{Max} \quad U(Y_i + d_i, R - \sum_{i=1}^n d_i) \quad (11)$$

taking as given the consumption choices of all other local governments.

Notice the difference between this problem and the one solved in section 4. Here each individual local government, after observing  $Y_i$ , chooses its own  $c_i$  (hence  $d_i$ ) to maximize just its utility, ignoring the effect on the other regions.

Maximization (5.1) gives rise to the following first order condition,

$$U_c(c_i, g_f) = U_g(c_i, g_f) \quad (12)$$

which holds for  $i = 1, \dots, n$ . This system of equations together with  $g_f = R + \sum_{i=1}^n Y_i - \sum_{i=1}^n c_i$  characterizes the Nash equilibrium of the game. Under the assumptions on  $U(\cdot)$ , it is easy to show that there is a unique solution to this system which entails a common level of local expenditures in all localities  $c_i^* = c^N \forall i$ . That is, in this discretionary equilibrium we also reach full insurance against local shocks. But, as we expected, this is obtained at a cost. If we compare (12) with (4), we notice the absence of the summation sign in (12) when considering the marginal cost of increasing local consumption  $c_i$ . Because of this feature, it is easy to verify that for  $n > 1$  the solution to this Nash game entails greater local consumption and a smaller provision of the federal public good than in the first best.

Using the specification of the utility function from our example (5), we obtain the first order condition,

$$g_f^N = n \frac{(1-\alpha)}{\alpha} c^N \frac{1}{n}; \quad (13)$$

which together with the budget constraint  $g_f^N = R + \sum_{i=1}^n Y_i - nc^N$  characterize the solution to the problem. To facilitate comparison we express the equilibrium values for  $g_f^N, c^N$  and  $d_i^N$  in terms of the first best quantities obtained in the previous section,

$$c_i^N = \frac{n}{\alpha(n-1)+1} c^*. \quad (14)$$

$$g_f^N = \frac{1}{\alpha(n-1)+1} g_f^*, \quad (15)$$

$$d_i^N = \frac{n}{\alpha(n-1)+1} d_i^* + \frac{(1-\alpha)(n-1)}{\alpha(n-1)+1} Y_i. \quad (16)$$

From the above we see that, as anticipated, private consumption does not vary across regions indicating that this solution reaches full insurance against regional shocks. At the same time, it is clear that for  $n > 1$  transfers and private consumption are higher in this equilibrium than in the first best. Thus, we find the typical expansionary bias both in transfers and in local expenditure that characterizes fiscal behavior in non-cooperative Nash settings. The reason for this bias is that local governments when deciding independently their level of local expenditure do not take into account the negative externality that they produce on other regions through a reduction in federal expenditures. This distortion leads to a cost in terms of consumption of the federal public good which is now lower than in the previous setting.

Notice that  $n$  could be interpreted as the degree of decentralization. Under such interpretation, we are formalizing the common intuition (see for instance Prud'homme 1995, Interamerican Development Bank 1997, and Stein 1997) that, under some institutional set-ups, decentralization could have deleterious macroeconomic effects.

Also, it is easy to see how the results of this subsection will be modified if we introduce a richer description of the size composition of local jurisdictions. One natural result that will emerge from that extension, is that the smaller "provinces" will be more prone to "overspend" and will receive proportionally larger transfers, since they internalize a smaller fraction of the costs.<sup>17</sup>

## 5.2. The case with commitment by the federal government

In this section, we assume an institutional setup in which the FG "moves first", i.e., commits to a level of transfers to each locality. In addition, as indicated above, the FG knows the main parameters of the distribution determining the value of local income in each locality, but it doesn't observe the actual realization of this variable when deciding federal policy.

The problem that the FG solves is

$$\underset{\{d_i\}_{i=1}^n}{Max} \sum_{i=1}^n E\{U(Y_i + d_i, R - \sum_{i=1}^n d_i)\}, \quad (17)$$

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<sup>17</sup>This implication is consistent with the evidence provided by Jones, Sanguinetti and Tommasi (1999) and (2000) for the case of Argentina. In turn, that finding suggests that the institutional set-up operating over the last few years in that country, might have been somewhat equivalent to the "non-commitment" case we formalize here. Also, in the "bail-out" interpretation we suggested earlier, our model predicts that it will be more likely to observe bail-outs of smaller jurisdictions; as opposed to the prediction in Wildasin (1997).

where the expectation is taken over the distribution of the  $Y_i$ 's. As this equilibrium involves uncertainty regarding the realization of local shocks, the degree of risk aversion, associated with the second derivatives of  $U(\cdot)$ , will play a critical role in the solution. Hence we need to further specify how the degree of risk aversion varies with the level of consumption, in order to fully characterize the solution. Thus, we must make additional assumptions regarding the third derivatives of the utility function. In particular, we will assume that  $U_{ccc} \geq 0$  and  $U_{ccg} \leq 0$ .<sup>18</sup>

In order to find an analytical solution to the above problem we linearize  $U(Y_i + d_i, R - \sum d_i)$  using a Taylor expansion around  $\epsilon_i = 0$ . The resulting expression is,

$$U(c_i, g_f) \approx U(Y + d_i, R - \sum_{i=1}^n d_i) + U_c(Y + d_i, R - \sum_{i=1}^n d_i) \cdot \epsilon_i + U_{cc}(Y + d_i, R - \sum_{i=1}^n d_i) \cdot \frac{\epsilon_i^2}{2}. \quad (18)$$

Plugging (18) into (17) and solving, we derive the following first order condition,

$$U_c(Y + d^C, g_f^C) = \sum_{i=1}^n U_g(Y + d^C, g_f^C) - \frac{\sigma^2}{2} \left[ U_{ccc}(Y + d^C, g_f^C) - \sum_{i=1}^n U_{ccg}(Y + d^C, g_f^C) \right] \quad (19)$$

The above equation defines implicitly the "commitment" solution  $(d^C, g_f^C)$  to the problem. The expression is similar to that obtained under full information (recall equation (4)), but with the additional variance term added on the right hand-side. From the assumptions regarding the third derivatives of  $U(\cdot)$  this last term is negative. It is easy to see that, compared to the full information equilibrium, the solution to this problem entails a higher value of average consumption, financed by larger transfers, and a lower provision of the federal public good.

The intuition of this result is straightforward. Given that now the FG's transfers cannot adjust to the realization of shocks, local consumption in each region will vary with the realization of local income. This will not be case of federal expenditures, which will have a constant value chosen by the FG. Thus, the FG will find it "optimal" to reduce the supply of the federal public good (not subject to fluctuations) so as to increase lump-sum transfers to regions in order to compensate the disutility coming from fluctuations in local income and local expenditures. Under the assumptions of this set up, this is the only ("ex-ante") insurance the FG can provide.

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<sup>18</sup>Thus we are assuming that the degree of risk aversion over private consumption falls with income and rises with consumption of the federal public good.

In the example with CRRA utility, (4.9) becomes

$$g_f^C = n \frac{(1-\alpha)}{\alpha} c^C \left[ 1 + \frac{\sigma^2(\theta-1)}{c^{C^2} + \frac{\sigma^2}{2}(\theta-1)(\theta-2)} \right], \quad (20)$$

where  $\theta = \alpha(1-\rho)$ . We see that if  $\sigma^2 = 0$ , the first order condition of the first best (full information) equilibrium (expression (6)) and of the commitment problems coincide and so will their allocations. But for the general case where  $\sigma^2 > 0$  the term in brackets will be less than 1 implying that  $g_f^C < g_f^*$  and also, on average,  $c^C > c^*$ .

We know hence that the two institutional setups under incomplete information deliver lower federal consumption and larger local consumption (and transfers) than in the first best. Coming to the comparison of transfers and public spending between the Nash and commitment case, it turns out that the result is ambiguous. In the next section we compare the solutions under commitment and discretion and make precise statements about how the level of welfare reached under the two alternative regimes varies with changes in some key parameters; in particular, with the variance of the shock, representing the potential gains from risk sharing, and with the number of localities, describing the magnitude of the common pool problem.

## 6. Choosing regimes

We want to compare welfare in the two second-best solutions, discretion and commitment, derived above. It is shown in the Appendix that when aggregate shocks are small, the welfare comparison between these two regimes can be reduced to the analysis of the intrinsic inefficiencies associated with the different allocation mechanisms.<sup>19</sup>

Intuitively the problem of choosing between regimes is illustrated in Figure 1 where indifference curves are drawn using equation (1) and the budget line corresponding to expression (2). We have shown that both Nash and Commitment provide a lower level of the public good (and higher private consumption) than that obtained in the First Best. Nash or Commitment will deliver higher welfare depending on how close are their allocations to the optimal solution. In the

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<sup>19</sup>In so far as  $\sum \epsilon_i \neq 0$ , the Nash solution differs from commitment not only by the fact that individual transfers can adjust to local shocks, but also that transfers (federal policy) can also adjust to aggregate shocks (of course this is also true in the case of the first best solution.) In the Appendix we show that when comparing welfare between these two regimes this additional feature of the solution under discretion is of second order of magnitude as long as  $\sum \epsilon_i$  is a small number.



case shown in Figure 1, point A depicts the optimal, first best, consumption allocation for the Central Planner, while point B and C illustrate alternative policy choices under Nash and Commitment problems, respectively. In this case point B is closest to A than point C, so that the Nash solution is preferred to the Commitment one.

INSERT FIGURE 1

More formally, to compare the Nash and Commitment solutions let's rewrite (19) in the following way,

$$U_c(c^C, g_f^C) = U_g(c^C, g_f^C) + (n-1)U_g(c^C, g_f^C) - \frac{\sigma^2}{2} [U_{ccc}(c^C, g_f^C) - nU_{ccg}(c^C, g_f^C)] \quad (21)$$

The above expression is similar to the one characterizing the Nash equilibrium (recall equation (12)), but with the addition of the last two terms on the right hand side, the first of which is positive (representing the fact that under commitment we do take into account the positive "externality" produced by the federal public good), while the second is negative (capturing the distortion provoked by the absence of risk sharing). Thus, if we were to evaluate the above expression at the Nash solution in the absence of aggregate risk (assuming  $\sum_i \epsilon_i = 0$ ), we would find that (in general) this solution will not satisfy the above optimality condition corresponding to Commitment. If the sign of the sum of the two additional terms is negative then it must be the case that  $c^N < c^C$  and  $g_f^N > g_f^C$  and hence welfare is higher in the Nash regime than under Commitment. By the same token both regimes will deliver the same level of welfare when the sum of those two terms equals zero, i.e., when

$$U_g(c^N, g_f^N)(n-1) = \frac{\sigma^2}{2}(U_{ccc}(c^N, g_f^N) - nU_{ccg}(c^N, g_f^N)). \quad (22)$$

The above expression suggests a positive association between  $n$  and  $\sigma^2$  along an indifference welfare frontier. As the term in brackets on the right hand side of (22) is positive (recall  $U_{ccg} \leq 0$ ), and assuming that the effect of changes in  $n$  on  $c^N$  and  $g_f^N$  are of second order,<sup>20</sup> we obtain a direct, positive association between

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<sup>20</sup>In the Appendix we provide the exact conditions that insure that such effects are of second order.

$n$  and  $\sigma^2$ . Intuitively a rise in  $n$  would increase the inefficiency coming from the common pool problem in the Nash regime (left hand side of (22)); to maintain a welfare equivalence across regimes the variance of the shock has to rise (for a given level of risk aversion) so as to reduce the level of welfare under commitment originated by the absence of risk sharing (right hand side of (22)).

Figure 2 pictures the welfare frontier curve suggested by expression (22). It should be clear that the frontier starts at a point  $\sigma^2 = 0, n = 1$ . At this point both regimes deliver the same level of welfare which equals that achieved in the first best. Beyond that point, for whatever combination of  $\sigma^2$  and  $n$  located above the curve we have that the Nash equilibrium delivers higher welfare than commitment. Intuitively, the variance of the shocks to local income is large relative to the common pool problem generated by the existence of various provinces in an uncoordinated game. Thus the gain from being able to smooth out shocks to local income through federal transfers offsets the costs implied by the resulting over-expansion in local expenditures. Of course, the opposite is true for a parameter combination in the south-east region (under the curve).

INSERT FIGURE 2

## 7. Extension: distortionary taxation

The model of the previous sections can be extended to capture other realistic features of common-pool games in federations. In this section we provide one illustration by including local and federal taxation. As indicated in the references in section 2, in some instances intergovernmental transfers induce increases in the size of government, reductions in local tax effort, as well as excessive distortionary federal taxation. These manifestations of the common-pool problem were not possible to obtain in the previous framework as total federal resources,  $R$ , were fixed. Thus the inefficiency was reflected in too much local spending and too little federal spending. In this section, federal resources are no longer fixed, there is distortionary federal taxation. Also, the "aggregate" local good is unbundled into private and local public consumption, introducing local taxation.

The following equations describe the basic features of the modified model,

$$U_i = U(c_i, g_i) \tag{23}$$

$$c_i = y_i[1 - t_f - f(t_f) - t_i - h(t_i)] \quad (24)$$

$$g_i = t_i y_i + d_i \quad (25)$$

$$t_f \sum y_i = \sum d_i. \quad (26)$$

Equation (23) says that preferences are now defined on private and local public good consumption. Equation (24) is the private sector budget constraint where we have incorporated distortionary taxation both at the federal ( $t_f$ ) and local level ( $t_i$ ). The convex functions  $f(\cdot)$  and  $h(\cdot)$  indicates the distortion produced, respectively, by federal and local taxation. These functions can be thought of as a reduced form derived from a more detailed model where output is endogenous and depends on labor supply, a decision that is affected by the marginal tax on income. The assumption that both taxes are charged over the same income base is just a simplification, but it is consistent with the actual experience of many countries (personal income tax in the US., business taxes, goods and services taxes in many developing countries like Argentina, etc.) Also, it is often the case that, for the same tax base, the tax rates applied by national and subnational administrations are quite different. In some cases, as in the examples of the US and Argentina, the national rate is higher. This can be explained by the different distortion cost that the same tax may introduce if applied locally or at the national level. For example, in case of income taxes, the high mobility of people and capital across jurisdictions within a given country acts as a limitation for the tax rate that a local government can charge without causing people and capital to migrate to other regions. Following this notion, in what follows we are going to assume that local taxation impinges higher distortion costs than national taxation ( $f(t_f) \leq h(t_i)$ , for  $t_f = t_i$ ). To assure an interior equilibrium we also assume that,

$$\begin{aligned} f(0) = h(0) = 0; f'(0) = h'(0) = 0; f'(\cdot) > 0 \text{ and } h'(\cdot) > 0, \text{ for } t_f, t_i > 0; \\ f''(\cdot) > 0, h''(\cdot) > 0, \text{ for } t_f, t_i > 0; \lim_{t_f \rightarrow 1} f'(t_f) = \infty; \lim_{t_i \rightarrow 1} h'(t_i) = \infty; \end{aligned}$$

Equation (25) denotes the local government budget constraint. Now local expenditures are financed with a distortionary local tax as well as through transfers from the federal government. Finally, equation (26) represents the federal government budget constraint. As indicated, the federal budget is no longer fixed ex-ante, but it will depend on the level of the federal tax rate.

As before, we compute the equilibrium under three alternative assumptions regarding information and interaction between the federal and the local units:

perfect information and commitment, Nash, and imperfect information and commitment.<sup>21</sup>

Under perfect information and commitment the federal government maximizes the sum of the regional utility functions subject to constraints (24)-(26) and the condition that describes how local governments select their tax/expenditure mix, which is given by

$$U_g = (1 + h'(t_i))U_c. \quad (27)$$

The first order condition that implicitly defines the optimal level of relative taxation is, then:

$$\frac{1 + h'(t_i)}{1 + f'(t_f)} = \frac{y_i}{\sum y_i} + \frac{\sum_{j \neq i} U_{c_j}(\frac{y_j}{\sum y_i})}{U_{c_i}}; i = 1, ..n \quad (28)$$

The above expression together with (24)-(26) determines the equilibrium values:  $t_f^*, t_i^*, g_i^*, d_i^*$  and  $c_i^*$ . Condition (28) indicates that in the first best, equilibrium taxes in region  $i$  will decrease (increase) relative to federal taxes when local income in region  $i$  decreases (increases) relative to aggregate income – first term on the right hand side of (28). The reduction (increase) in local taxes will be associated with an increase (reduction) in federal transfers to that region. To accomplish this the federal government will have to raise (reduce) the federal tax; but in doing that it will take into account the effect on the utility of the remaining regions – second term on the right hand side of (28).

In the Nash solution, local governments move first and then the federal government sets the federal tax to fulfill its budget constraint. The set of FOC's determining relative taxation are, in this case, the following,

$$\frac{1 + h'(t_i^N)}{1 + f'(t_f^N)} = \frac{y_i}{\sum y_i}; i = 1, ..n. \quad (29)$$

When local governments decide local taxes in a non-cooperative fashion, they will internalize the effect of their action on the aggregate level of taxation only partially. As a result, too little local tax effort and too large federal taxes are observed in this equilibrium. The second positive term in (28) is absent in (29).

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<sup>21</sup>All the details are in the Appendix.

Thus  $\frac{t_i^*}{t_f^*} \geq \frac{t_i^N}{t_f^N}$ . Moreover, it is easy to show that this common pool-problem affecting the structure of relative taxes will be more significant as the number of regions  $n$ , increases; and that the Nash solution implies a higher size of the consolidated public sector as the increase in federal taxation more than offset the decline in local taxes (shown in the Appendix).

Finally, the solution for the imperfect information / commitment regime is characterized by the following first order condition,

$$\frac{1 + h'(t_i^C)}{1 + f'(t_f^C)} = 1 - \frac{\sigma^2}{2}A, \quad (30)$$

where  $A$  is a function of second and third derivatives of the utility function. This term will in general be different from zero. In particular, it will be positive in case of a CRRA utility function where the coefficient of relative risk aversion is greater or equal than one.

In order to compare this commitment solution with the first best and the Nash regimes it is convenient to evaluate both equilibria when shocks are small ( $\epsilon_i \rightarrow 0$ ). The resulting expressions are,

$$\lim_{\epsilon_i \rightarrow 0} \frac{1 + h'(t_i^*)}{1 + f'(t_f^*)} = 1 \quad (31)$$

$$\lim_{\epsilon_i \rightarrow 0} \frac{1 + h'(t_i^N)}{1 + f'(t_f^N)} = \frac{1}{n}. \quad (32)$$

Equations (30)-(32) nicely summarize the intuition of the welfare comparison, which is analogous to the one derived in the previous sections. If, for example,  $A$  is positive, then the commitment solution under imperfect information will not coincide with the first-best, the departure from the first best equilibrium will increase with the value of the variance  $\sigma^2$ . Also, as in the Nash case, we will have less local taxation and more federal taxation than in the first-best ( $\frac{t_i^*}{t_f^*} \geq \frac{t_i^C}{t_f^C}$ ). As indicated above, the magnitude of the distance between the Nash regime and the first-best increases with  $n$ . Thus, the two second-best regimes can be ranked in terms of welfare depending on the two key parameters  $n$  and  $\sigma^2$ .

## 8. Concluding remarks

Rather than recapping the main results of the paper, we devote this final comments to suggest possible applications and extensions of this simple framework.

The welfare frontier summarized by Figure 2 can be used for cross-sectional comparison of federations. If, for a sample of federations, we have the variance of regional income shocks, as well as measures of decentralization of fiscal authority, we can suggest which is the regime more adequate in each case, and verify whether the actual choice of intergovernmental transfer mechanisms is close to the one predicted by the model. Furthermore, the set up also allows us to answer whether the existing arrangement is still the adequate one in case of expanding the federation.

This comparative static result can be used also for some open economy considerations. In particular it could be applied to the analysis of regional integration agreements (RIA). As commented in the introduction, in the last 10 to 15 years there has been tremendous surge of RIAs, one of the more striking ones is the enlargement of the EU to encompass 10 additional countries. The formation of RIAs implies that certain public goods are provided now from the centre (trade policies in the more narrow FTAs, infrastructure and macro policies in the more comprehensive ones). At the same time, incentives to play in a noncooperative way increases with the number of countries involved in the integration scheme. Individual units tend will tend underestimate the effect of their actions on the provision of regional goods. Still, individual countries are subject to idiosyncratic shocks, so transfers across countries may still be relevant to smooth out the effects of this perturbations on individual country consumption. Thus a scheme of intergovernmental transfers may still be optimal. But in an open economy framework the question arises of the role of local currency (exchange rate fluctuations) as a mechanism to moderate the effect of these shocks. This will tend to undermine the necessity of these transfers. This case of substitution is clear in the case of EU where the elimination of local currency was accompanied by the strengthening of the system of interregional transfers at the Community level.

The model also seems a useful building block for the study of a very important pitfall identified in several recent decentralization process: the problem that certain institutional arrangements may weaken the fiscal discipline of sub-national governments. The practice of coming to the rescue of provinces in financial distress may create a moral hazard problem by softening the budget constraints faced by them. This "bail-out" problem could be studied by adding a repeated dimension to our set-up. Even in the static set-up presented, one simple way of modifying it to analyze the bail-out problem, would be to replace the one-to-one mapping from local choices to outcomes by a stochastic framework, where greater current spending maps into an increased probability of future financial crises, and in the case of a financial crisis, the federal government may (depending on the institutional structure and on its decision within that structure) come up to the

rescue.

More generally, our model is a one-period one, and this imposes some limitations. An extension to an intertemporal model would be a valuable one, which could introduce some new dimensions to the analysis. On the one hand, the possibility of debt adds a very relevant dimension to resource battles in federal fiscal systems. Dynamic fiscal games, in spite of presenting some technical difficulties, have been studied for instance by Velasco (1999), Aizenman (1998), and others.<sup>22</sup> These dynamic versions of the common-pool problem permit to gain further insights, for instance by allowing the gradual build-up of debt, and entail the possibility of endogenous delays in stabilization. Our paper emphasizes the trade-off between common pool and risk-sharing, a consideration that, to our knowledge, is absent from extant dynamic models. The introduction of dynamics might smooth part of the problem by providing, in case of *temporary* shocks, the possibility of self-insurance via savings.

Also, we have modelled two stark extremes under incomplete information, leading to full insurance or (almost) no insurance. If we allow for imperfect observability, one can design optimal contracts with partial insurance. That would be the case, for instance, if the federal government observes tax revenues, but not tax effort (for instance through control of tax evasion). In such a case, the optimal contract might involve *partial* insurance to tax-base shocks.

The objective function of the federal government that we use is a utilitarian one, just the sum of provincial utilities. This can be criticized on several grounds; we could think of alternative social welfare functions, or we can think of the federal government as a non-benevolent entity. The sum of provincial utilities is one extreme of a richer set of social welfare functions, which can have a Rawlsian-type function (the utility of the worst-off province is highly weighted) at the other end. This Rawlsian bias will induce further redistribution if we have provinces which are permanently disadvantaged, a case that we have ignored in our model, but that can be easily incorporated. If we refer to provinces that are more disadvantaged by temporary shocks, increasing their weight would be somewhat equivalent to increasing the degree of risk aversion. In that case, we will have that discretion is preferred to rules for a larger set of other parameter values.

Our formulation has treated the central government as a benevolent planner. The federal fiscal history of many countries contradicts this assumption. Indeed, the fact that the central government tends to be a political actor with its own incentives may be at the crux of the poor design of federal fiscal arrangements in many countries. (See Iaryczower et al, 2001, for further references on this point).

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<sup>22</sup>Persson and Tabellini (2000, chapter 13) review dynamic debt models.

Integrating those broader *positive* issues with the normative trade-off analyzed here, should be a priority for future research.



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**FIGURE 1**

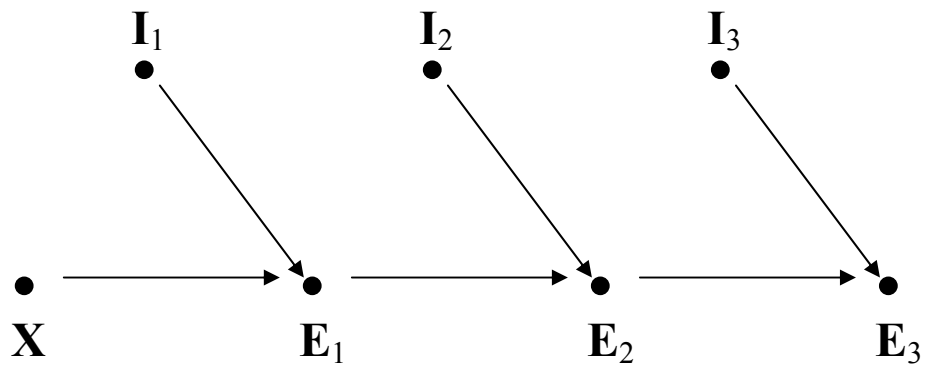


FIGURE 1: Forward-looking hypotheses (X = Independent variable; I<sub>1</sub>, I<sub>2</sub>, I<sub>3</sub> = Intervening variable; E<sub>1</sub>, E<sub>2</sub>, E<sub>3</sub> = Effects)

Source: Scharpf (1997).

**FIGURE 2**

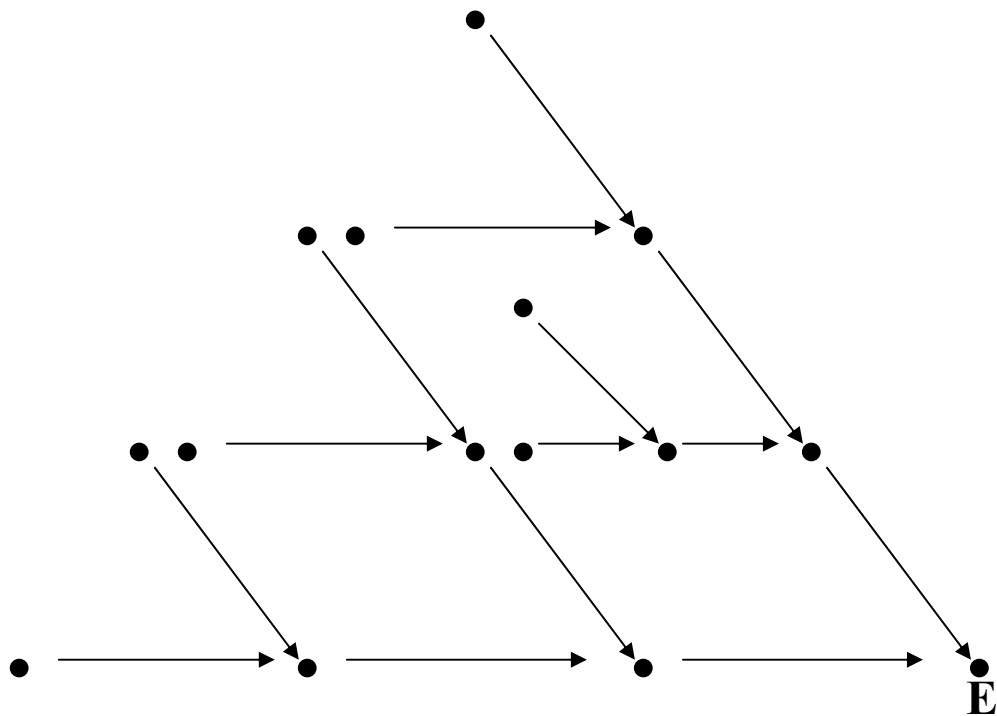


FIGURE 2: Backward-looking hypotheses (E = Effect to be explained. All other dots represent independent and intervening variables)

Source: Scharpf (1997).

**FIGURE 3**  
**The Framework**

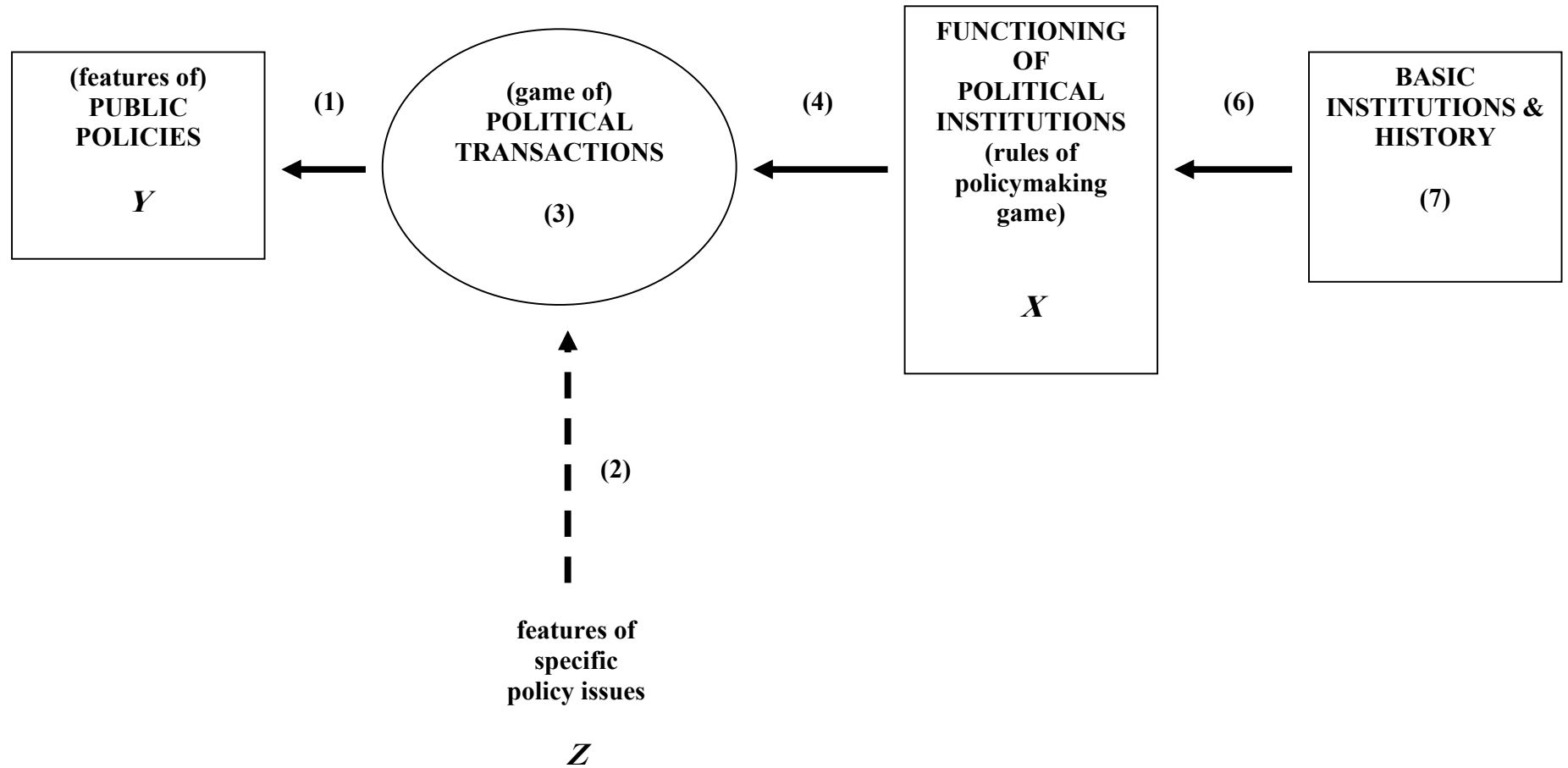


Figure 4a. Income per capita

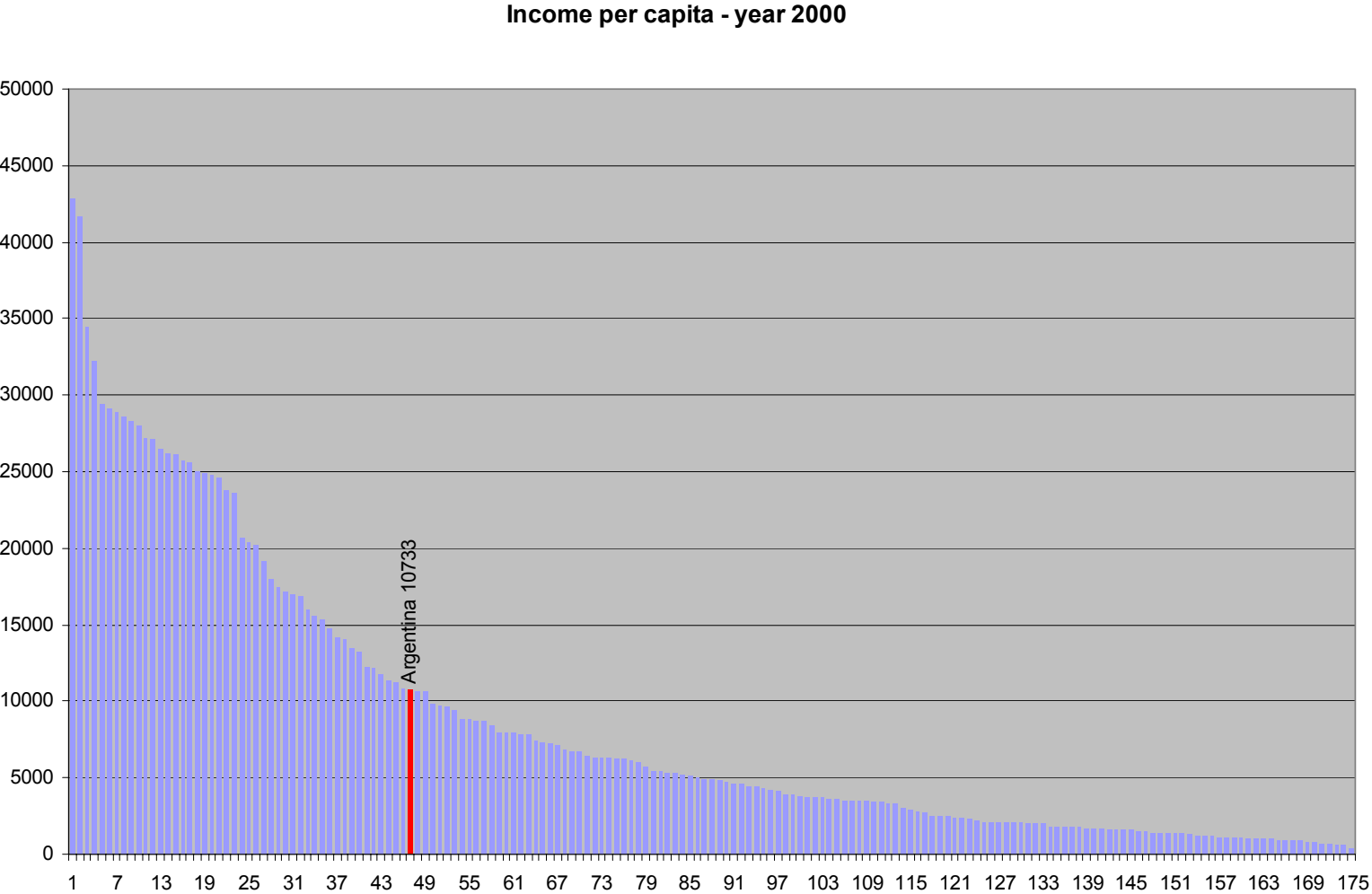


Figure 4b. Volatility of Economic Policy

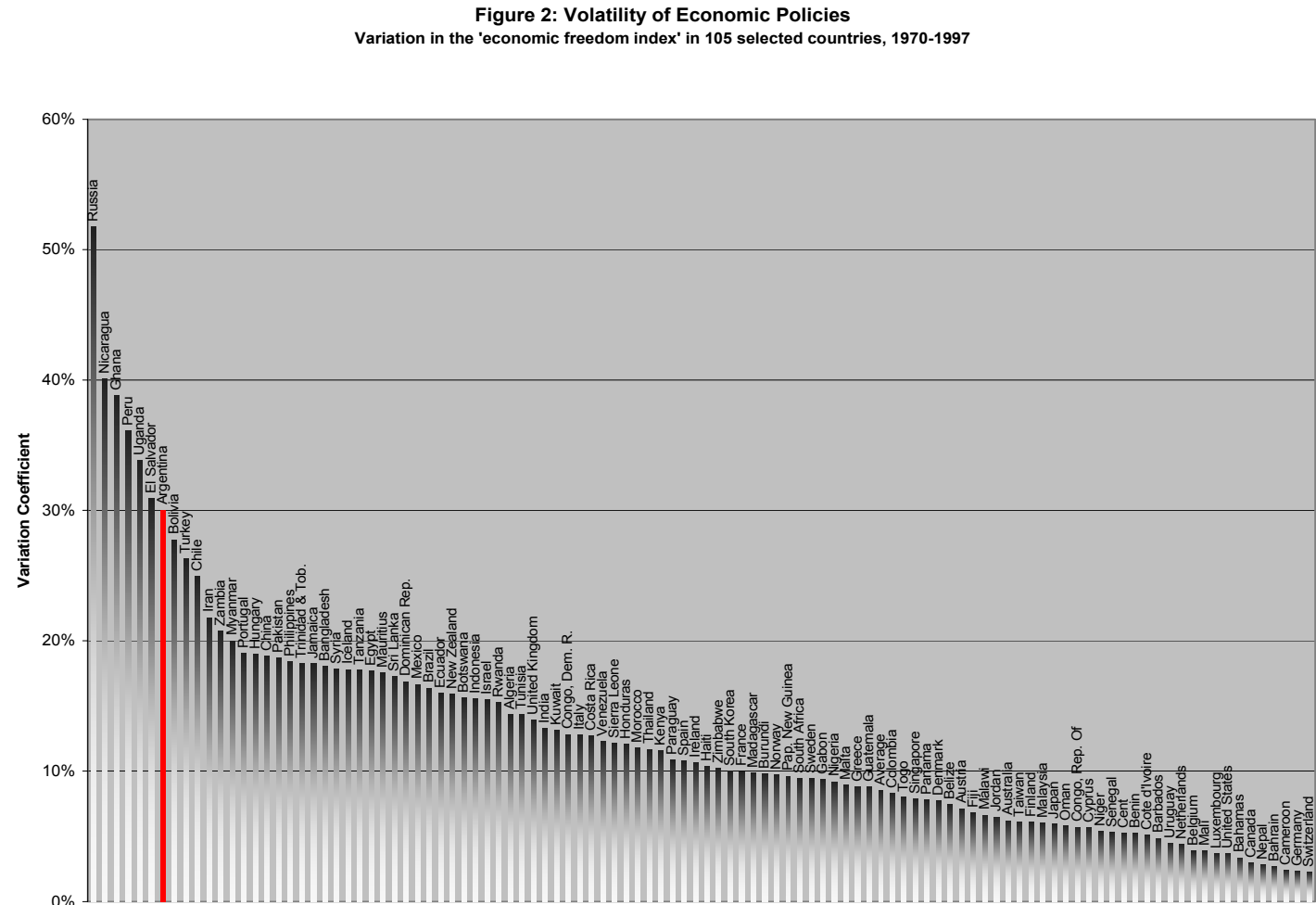
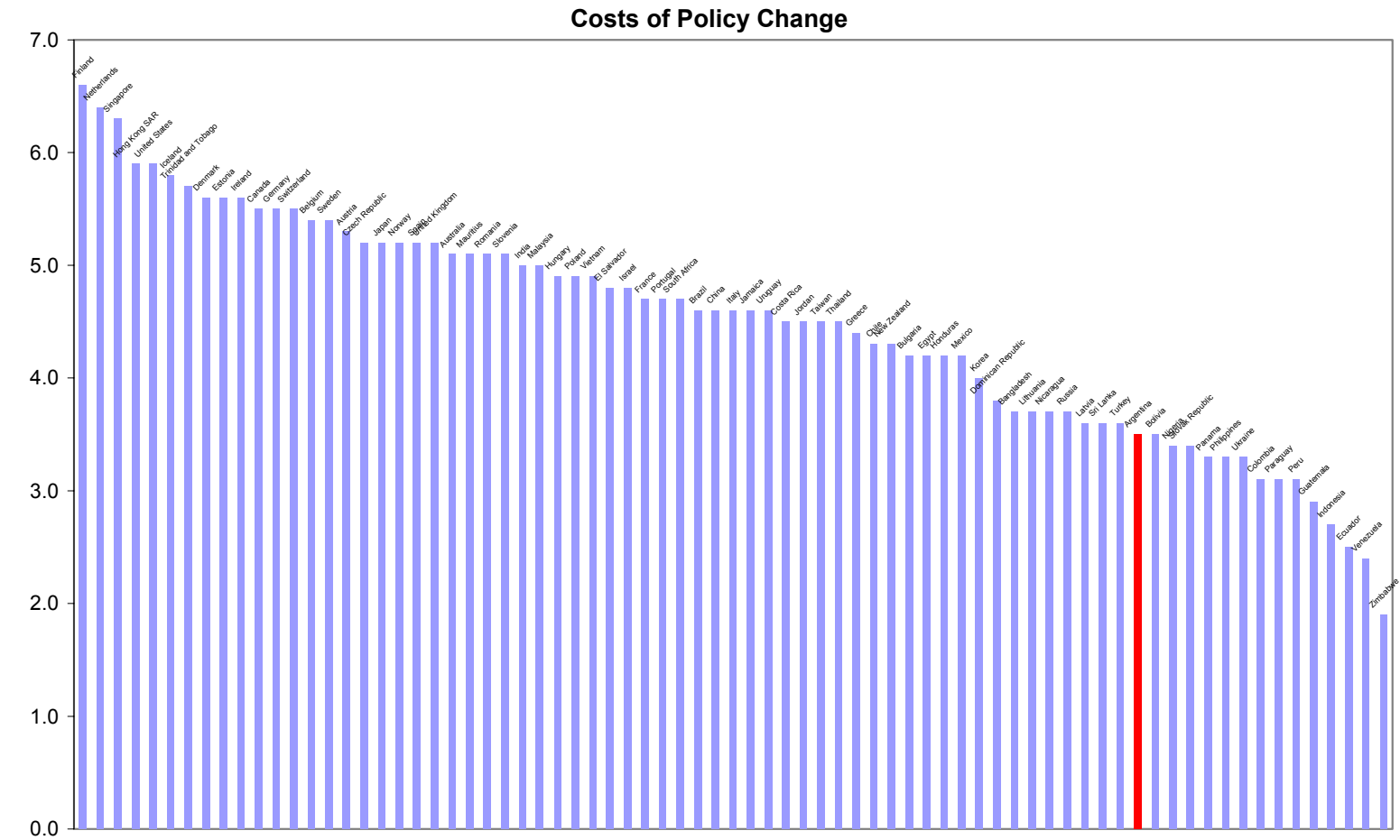


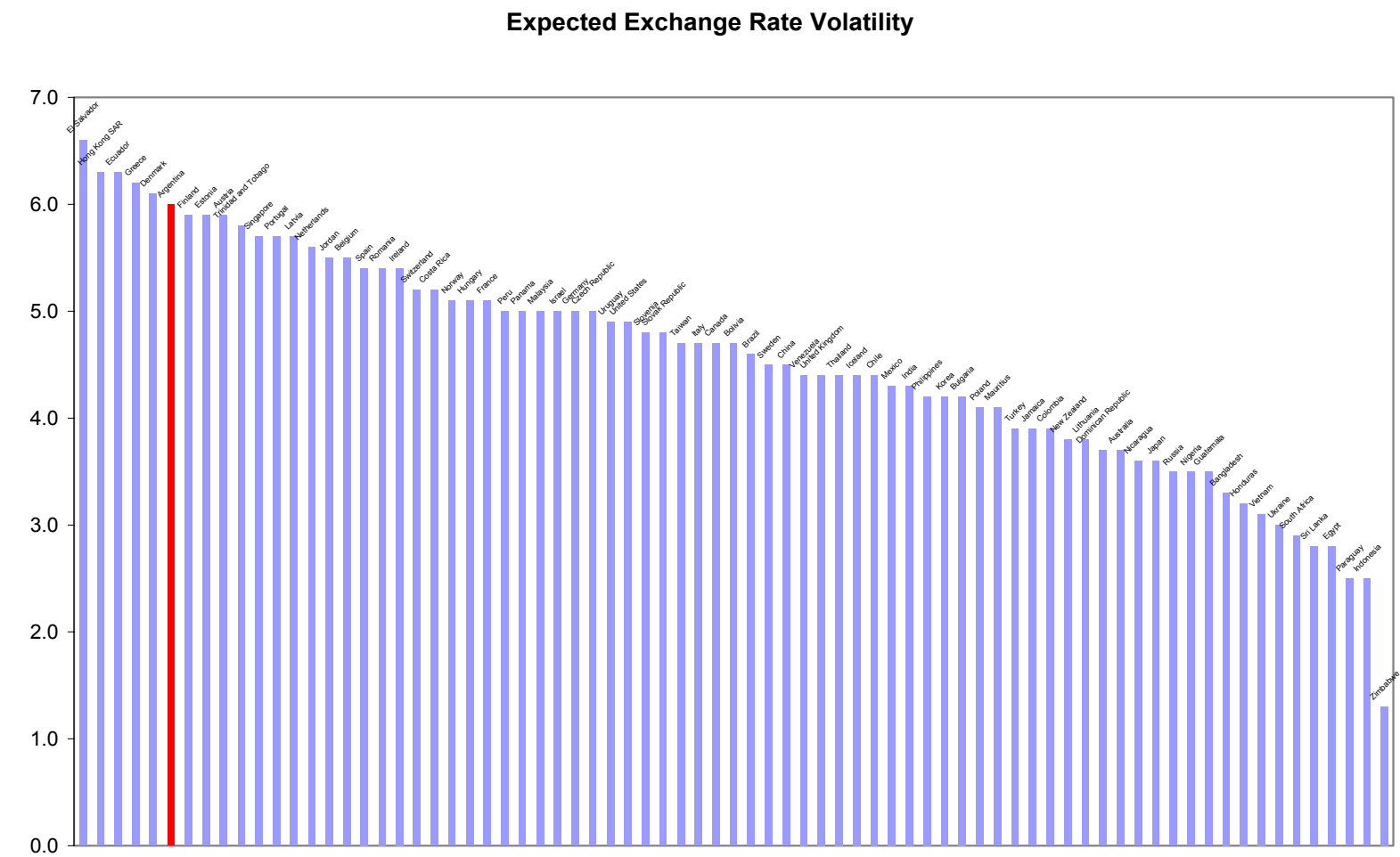
Figure 4c. Costs of Policy Change





Legal or political changes over the past five years have (1=severely undermined your firm's planning capacity, 7=had no effect)

Figure 4d. Expected Exchange Rate Volatility



Over the next two years, your country's exchange rate will be (1=very volatile, 7=very stable) [Question asked in February-April 2001]

Figure 4e. Minimum Wage Enforcement

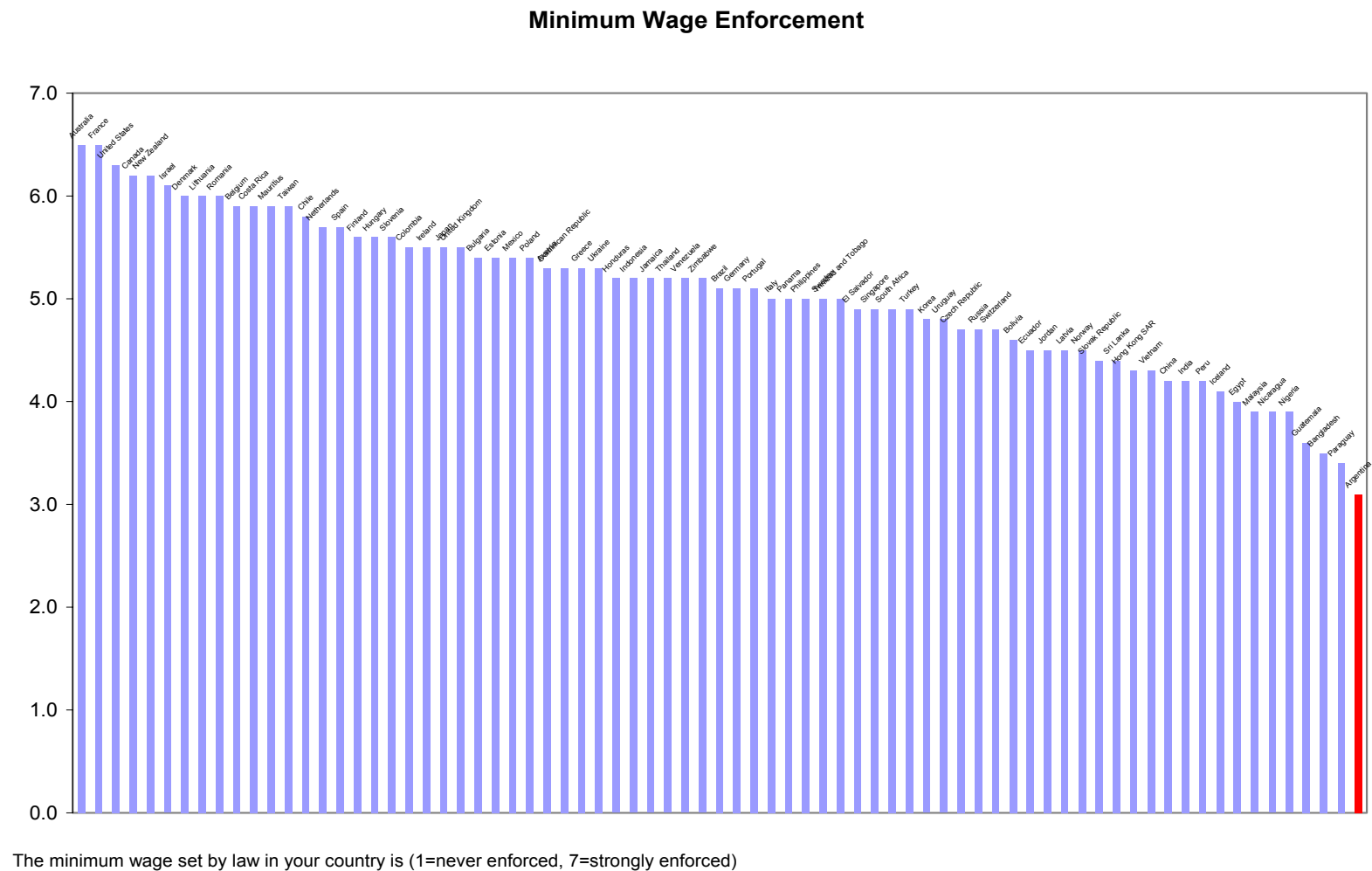


Figure 4f. Tax Evasion

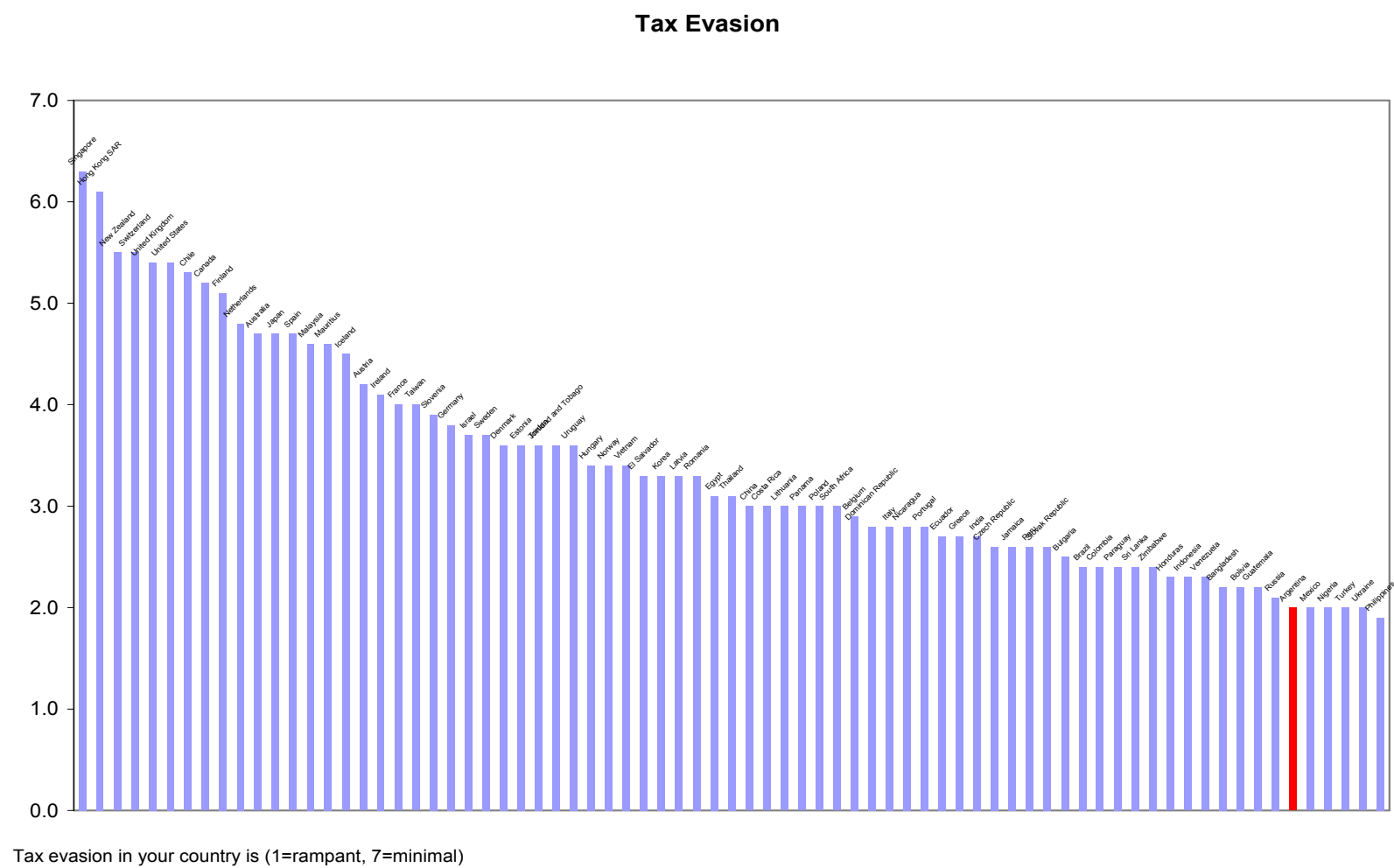
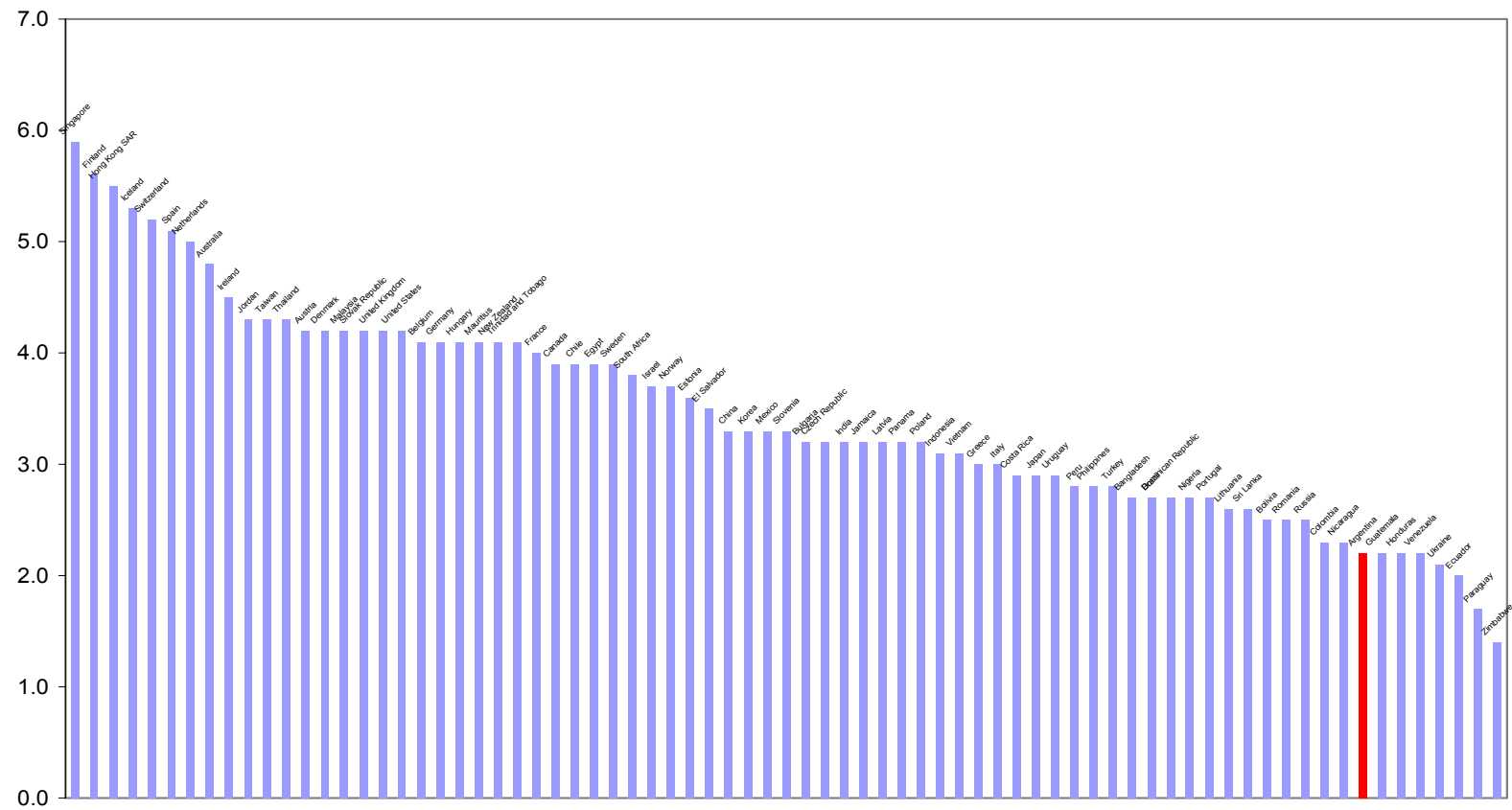
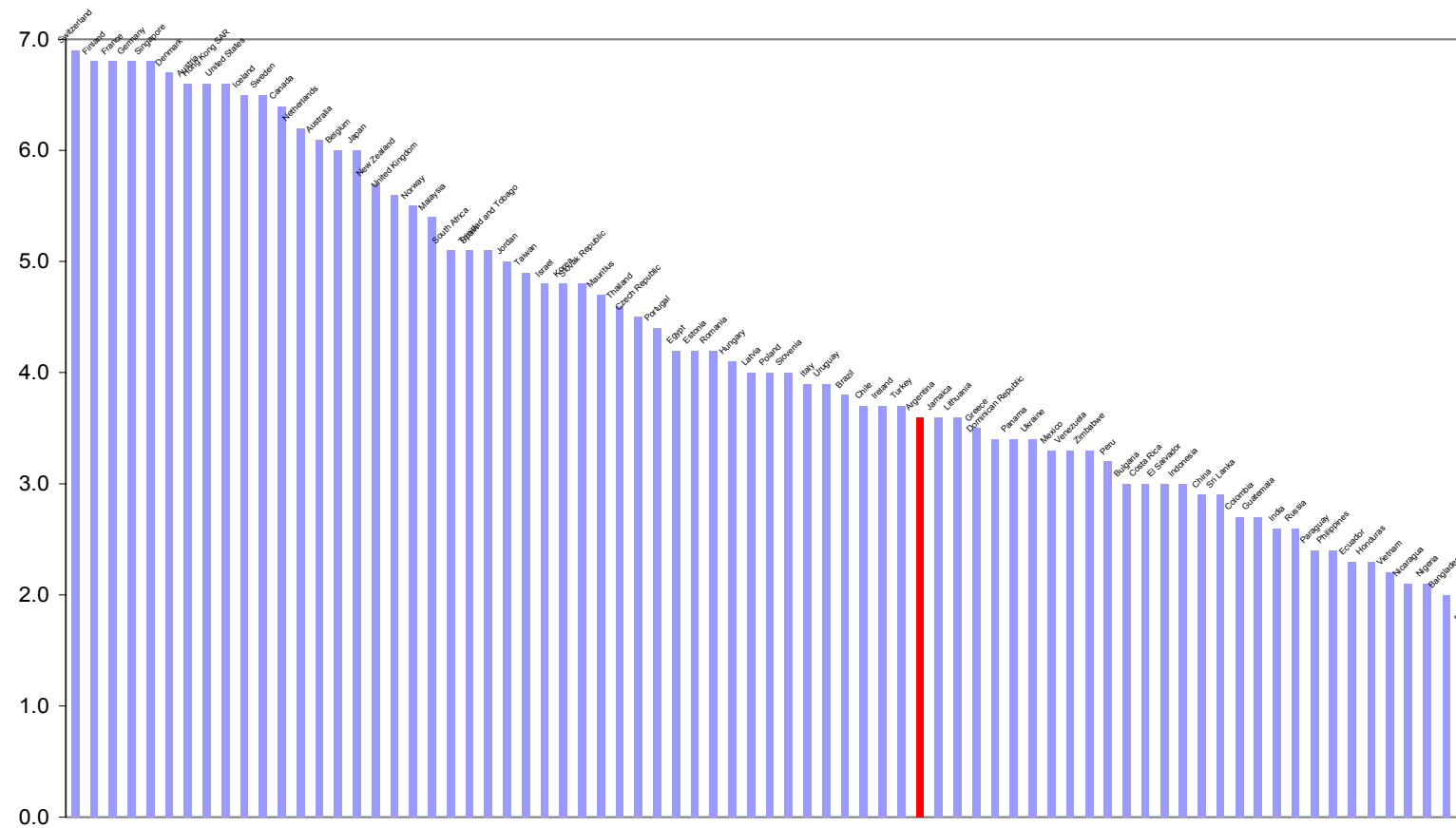


Figure 4g. Usefulness of Public Spending



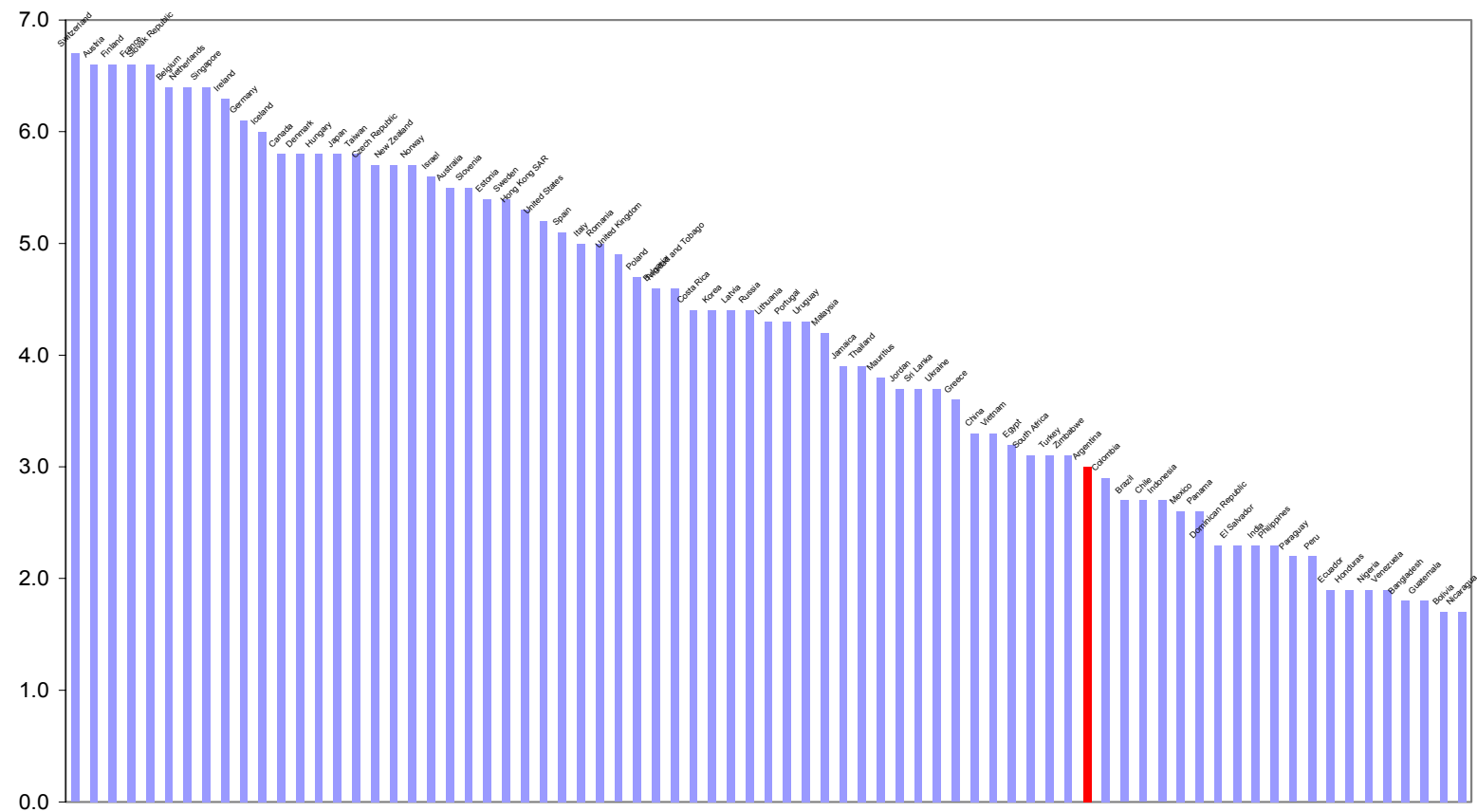
The composition of government spending in your country (1=is wasteful, 7=provides necessary goods and services not provided by the market)

**Figure 4h. Quality of Infrastructure**



General infrastructure in your country is (1=poorly developed and inefficient, 7=among the best in the world)

**Figure 4i. Quality of Public Schools**



Public (free) schools in your country are (1=of poor quality, 7=equal to the best in the world)

Figure 4j. Competence of Public Officials

