Democracy, Redistributive Taxation and the Private Provision of Public Goods

Markussen, Thomas

Discussion Papers

Department of Economics
University of Copenhagen

No. 10-09

Democracy, Redistributive Taxation and the Private Provision of Public Goods

Thomas Markussen

Øster Farimagsgade 5, Building 26, DK-1353 Copenhagen K., Denmark
Tel.: +45 35 32 30 01 – Fax: +45 35 32 30 00
http://www.econ.ku.dk

ISSN: 1601-2461 (online)

Democracy, Redistributive Taxation and the Private Provision of Public Goods

Thomas Markussen

March 5, 2010

Abstract

The paper studies in a simple, Downsian model of political competition how the private provision of public goods is affected when it is embedded in a system of democracy and redistributive taxation. Results show that the positive effect of inequality on public goods production, which Olson (1965) pointed to, is weakened and might even be reversed in this context. Also, the median voter may choose a negative tax rate, even if he is poorer than the mean, in order to stimulate public goods production. The relevance of the model is illustrated with an application to the finance of higher education.

JEL Codes: D31, D7, H2, H41, I22

Keywords: Public goods, political economy, inequality, taxation, higher education

1 Introduction[1]

One of the primary justifications for the existence of the state is its ability to produce public goods. However, not all public goods are produced by the state, nor could they be. An important example is the generation of knowledge and innovation. While the state in most countries sponsors universities and other research facilities, large amounts of formal and informal innovation with important spill-over effects nevertheless takes place in the private sector. In countries where the capacity of the state is low, the production of public goods such as infrastructure, environmental protection and even security might be fully or partly left to private agents.

This paper investigates in a simple, Downsian model of electoral competition how the private provision of public goods interacts with the institutions of democracy and taxation. We assume that a public good, such as non-excludable innovation, is produced by the private sector, but that the income derived from the good is taxed at a (positive or negative) rate determined by a democratically elected political leader. The paper studies how democracy, taxation and economic inequality affect the production of the public good. In particular, two seemingly divergent findings from the literature are brought together: on the one hand, Mancur Olson (1965) and others have argued that higher inequality increases the supply of public goods, because only the most well-endowed agents in an economy have the incentives to contribute to the production of these goods. Redistribution in favour of these agents strengthens their incentives to produce. On the other hand, Meltzer and Richard (1981), building on Romer (1975), argued that in a democracy, higher inequality leads to lower economic activity, because a poorer median voter, relative to the mean, prefers a higher tax rate, which diminishes incentives for production.[2] The present paper shows that when democracy and taxation are introduced in a public goods dependant economy, the "Olson-" and "Meltzer-Richard" effects tend to cancel out. The net effect of economic inequality on production might be either positive or negative.

The results also suggest that in a sufficiently equal, public goods dependant economy, the introduction of democracy and taxation improves welfare for both the median voter and for the wealthy elite, and increases total eco-

[1] I am grateful for very useful comments from Thomas B. Andersen, David D. Lassen, Morten Hedgaard, Tobias E. Markeprand, Finn Tarp, Jean-Robert Tyran, seminar participants at the University of Copenhagen and two anonymous reviewers. Remaining errors are my own.

[2] Several studies, including Lindert (1996), Perotti (1996) and Moene and Wallerstein (2001) have argued that the emprical support for the hypothesis that inequality leads to redistribution is weak. Harms and Zink (2003) summarize a series of theoretical arguments that rationalize these findings. However, Milanovic (2000, 2010) shows that when the theoretically relevant variables are used, the Meltzer-Richard hypothesis does find strong support in a sample of mostly developed countries.

nomic production. It might even represent a Pareto improvement. This contrasts with standard models of redistributive taxation, such as Meltzer and Richard's, where democracy and taxation always lead to lower production and is never a Pareto improvement. These results may contribute to explaining why it is easier to consolidate democracy in equal than in unequal societies.

Section 2 presents the model of public goods, democracy and redistributive taxation. Sections 3 discusses the effects of inequality on public goods production, while section 4 analyzes the effects of introducing democracy. Section 5 considers a specific type of public goods production function, namely a power function. Section 6 presents an extension of the model, where the capacity of each agent to contribute to the public goods is assumed to be limited. In section 7, the empirical relevance of the model is illustrated by applying it to the study of higher education funding. Under plausible assumptions, the model predicts that equal countries are more prone to engage in public funding of higher education than unequal ones. This conjecture is supported in an analysis of government spending on tertiary education in a broad sample of countries.

2 Model

2.1 Public goods production

Consider an economy consisting of N individuals, indexed $i = 1 \dots N$. For concreteness, think of a local, rural economy in a developing country and think of the agents as farmers or fishermen. Each agent maximizes the following utility function:

$$U_i = \frac{X_i}{\sum_{j=1}^{N} X_j} G\left(\sum_{j=1}^{N} e_j\right) - e_i = x_i G\left(\sum_{j=1}^{N} e_j\right) - e_i$$

subject to:

$$e_i \geq 0$$

where the first term represents income from a public good, $G\left(\sum_{j=1}^{N} e_j\right)$, which is converted one-to-one into utility. Assume that $G \geq 0$, $G' > 0$ and $G'' < 0$. The second term $(-e_i)$ represents the disutility derived from supplying effort to the production of this good. This could be interpreted either as disutility of labour, or as the opportunity cost of effort stemming from the possibility of producing a private good with the use of e. Assume for now that there are no binding, upper constraints on e_i. This assumption is relaxed in section 6 below. X_i represents individual $i's$ holding of some good which determines her stake in the public good. x_i is then $i's$ share of the total, fixed amount of X in the economy. This formulation of the public goods problem follows Baland and Platteau (1997). G could for example be the production of knowledge. In developing country agriculture there is often a large premium on the introduction of new crop varieties or production techniques, such as the use of chemical fertilizers. However, the profitability of new production methods depends on knowledge about how they are optimally adapted to local circumstances. This knowledge is often a public good, because production methods and outcomes are easy to observe in agriculture. When one farmer experiments with new techniques, the lessons gained from the experiment will be picked up and learned by other farmers in the area. Other important public goods could be irrigation canals or roads. X could be interpreted as agricultural land. For example, the more land a household owns, the more it will gain from an increase in knowledge about new production methods in agriculture. Also, the amount of land in a given community is more or less fixed. X could also be other things, for example the number of fishing boats in a community of fishermen. In the following, I refer to X as "assets". The equilibrium is characterized by the following set of first order conditions:

$$x_i G' \left(\sum_{j=1}^{N} e_j \right) - 1 = 0 \tag{1}$$

or

$$e_i = 0$$

for all i. Note that the first order conditions differ among individuals only by the term x_i. This means that in the unique Nash equilibrium, the individual with the highest value of x_i is the sole contributor to the public good. Denote this individual by r (for rich). r's effort level equals:

$$e_r = G'^{-1}(x_r^{-1}) = \psi(x_r^{-1}) \tag{2}$$

where we define the function ψ as the inverse of the first derivative of G. Because G is strictly concave, ψ exists and is a strictly decreasing function (by the Inverse Function Theorem, $\psi'(\Delta^{-1}) = 1/G''(\psi(\Delta^{-1})) < 0$). This implies that $\frac{\partial e_r}{\partial x_r}$, and hence $\frac{\partial G}{\partial x_r}$, are strictly positive. This is the 'Olson-effect' – the more the asset distribution is skewed towards the richest individual, the higher is the production of the public good.[3]

2.2 Democracy and redistributive taxes

Now, assume that democracy and a redistributive fiscal system are introduced. Particularly, the income generated by the public good is taxed at a

[3]Bergstrom et. al. (1986) also find that "equalizing income redistributions tend to reduce the voluntary provision of a public good" (p. 27).

uniform rate $\tau < 1$ and the revenue is distributed evenly among all agents. The total revenue from taxation is:

$$\sum_{i=1}^{N} \tau x_i G\left(\sum_{j=1}^{N} e_j\right) = \tau G\left(\sum_{j=1}^{N} e_j\right).$$

The transfer t received by each agent is therefore equal to:

$$t = \frac{\tau}{N} G\left(\sum_{j=1}^{N} e_j\right).$$

The tax rate is determined by a democratically elected political leader. Specifically, two office-motivated candidates commit credibly to policies before elections are held, and the winner implements his announced policy, τ^W. The timing is as follows:

1. Candidates A and B announce policies, τ^A and τ^B
2. Elections are held
3. Winner implements τ^W
4. Agents choose e_i and production is realized

We solve the model backwards. Assuming that the transfer, like the income from the public good, is converted one-to-one into utility, agents now maximize:

$$U_i = (1-\tau) x_i G\left(\sum_{j=1}^{N} e_j\right) + \frac{\tau}{N} G\left(\sum_{j=1}^{N} e_j\right) - e_i \tag{3}$$

For reasons parallel to those mentioned above, the wealthiest agent, r, is the only contributor to the public good. When choosing her effort level, r now faces the following first order condition:

$$\left((1-\tau) x_r + \frac{\tau}{N}\right) G'(e_r) - 1 = 0$$

Solving for e_r we find:

$$e_r = \psi\left(\left((1-\tau) x_r + \frac{\tau}{N}\right)^{-1}\right) \tag{4}$$

The derivatives of e_r with respect to x_r and τ are, respectively:

$$\frac{\partial e_r}{\partial x_r} = -(1-\tau)\, \psi'\left(\Delta^{-1}\right) \Delta^{-2} > 0 \tag{5}$$

$$\frac{\partial e_r}{\partial \tau} = \left(x_r - \frac{1}{N}\right)\psi'\left(\Delta^{-1}\right)\Delta^{-2} < 0 \tag{6}$$

where $\Delta = (1-\tau)\,x_r + \frac{\tau}{N} > 0$. Since $\psi'(\Delta^{-1}) < 0$, the derivative with respect to x_r is positive as long as τ is lower than one, which we have assumed. Thus, for a given tax-rate, the Olson-effect is still present - redistribution towards the richest agent increases public goods production. The derivative with respect to τ is negative because x_r is larger than $\frac{1}{N}$ (note that $\frac{1}{N}$ is the average value of x_i). This means that a higher tax-rate leads to lower supply of effort, as we would expect.

Rational voters take the incentive effects described by (4) into account when calculating their preferred tax-rate. Inserting (4) into (3) and rearranging, we obtain:

$$U_i = \left(x_i + (\frac{1}{N} - x_i)\tau\right) G\left(\psi\left(\left(x_r + (\frac{1}{N} - x_r)\tau\right)^{-1}\right)\right) \tag{7}$$

for $i \neq r$. The first order conditions with respect to τ are (exploiting the fact that $G'\left(\psi\left(\Delta^{-1}\right)\right) = \Delta^{-1}$):

$$\begin{aligned}\frac{\partial U_i}{\partial \tau} = &\left(\frac{1}{N} - x_i\right) G\left(\psi\left(\Delta^{-1}\right)\right)\\ &+ \left(x_r - \frac{1}{N}\right)\left(x_i + (\frac{1}{N} - x_i)\tau\right)\psi'(\Delta^{-1})\Delta^{-3} = 0\end{aligned} \tag{8}$$

This can only hold if $x_i < \frac{1}{N}$. To see this, note that the second term is always negative and the first term is positive only if $x_i < \frac{1}{N}$. The economic reason is the following: Agents with fewer assets than the average, i.e. with $x_i < \frac{1}{N}$, receive more in transfers than they pay in tax. They therefore face a dilemma: on the one hand, a higher tax rate gives them higher transfers. On the other, it also reduces the richest agents' incentive to contribute to the public good. Hence, for these agents there is an optimal tax rate which just balances these opposing forces. In contrast, agents with $x_i > \frac{1}{N}$ pay more in taxes than they receive in transfers and therefore always wish to set the tax rate as low as possible.

Assuming that $x_i < \frac{1}{N}$, equation (8) implicitly defines the optimal tax rate of agent i, τ_i^*, as a function of the agent's relative wealth, x_i. We assume that τ_i^* is a unique maximum and investigate how changes in wealth affect the preferred tax rate.[4] By the Implicit Function Theorem, we have that:

[4] The appendix shows that a sufficient, but not necessary, condition for U_i to be univer-

$$\frac{d\tau_i^*}{dx_i} = -\frac{\frac{\partial^2 U(\tau_i^*)}{\partial\tau\partial x_i}}{\frac{\partial^2 U(\tau_i^*)}{\partial\tau_i^2}} < 0 \tag{9}$$

We obtain the sign of the numerator in this expression by differentiating the left-hand side of (8) with respect to x_i:

$$\frac{\partial^2 U}{\partial\tau\partial x_i} = -G\left(\psi\left(\Delta^{-1}\right)\right) + (1-\tau)\left(x_r - \frac{1}{N}\right) G'\left(\psi(\Delta^{-1})\right)\psi'(\Delta^{-1})\Delta^{-2} < 0$$

The resulting expression is negative. The interpretation is that the marginal utility of redistribution is decreasing in wealth. Since τ_i^* is a maximum, the denominator in (9) is also negative. This means that $d\tau_i^*/dx_i$ is negative. A wealthier agent always prefers a lower tax-rate, in line with conventional thinking. Now, the fact that the preferred tax-rate is a monotonic function of x_i, in combination with the features of the political system described above, means that we can apply the median voter theorem. The two candidates announce the same policy, namely the tax rate preferred by the voter with the median value of x_i, denoted x_m. We assume, as is common in the literature and very well justified by empirics, that $x_m < \frac{1}{N}$, that is, that the median asset holding is lower than the mean. This means that an optimal tax rate exists for agent m, which implies that we have identified the 'Meltzer-Richard effect': Equation (9) implies that a wealthier median voter always prefers a lower tax-rate. By (6) this in turn means that a wealthier median voter, ceteris paribus, leads to a higher effort level supplied by r and consequently to a higher level of public goods production. In this sense, a more equal asset distribution now has a positive effect on the level of production. What remains is to investigate whether and when the Olson-effect, identified in equation (5), or the Meltzer-Richard-effect dominates. In other words, we need to check what the *net* effects of distributional changes on public goods production are.

3 The effect of inequality

Two different conceptions of inequality are in play. The Olson effect depends on the relative position of the wealthiest individual, while the Meltzer-Richard effect depends on the relative position of the median asset holder. In

sally concave in τ is that the third derivative of G is negative. As the example in section 5 shows, it is also easy to find examples of production functions with positive third derivatives where the the first order conditions define a unique, optimal tax rate as a function of wealth.

general, it is possible to make equalizing as well as dis-equalizing redistributions that make *both* the wealthiest and the median agent better (or worse) off. It is most interesting to focus on the cases where the median agent gains at the expense of the wealthiest, or vice versa. Assume, therefore, that x_r is a negative function of x_m. We use x_m as our index of inequality (a higher value indicates less inequality). The effect of changes in the relative wealth of the median agent on the supply of effort by the richest is given by:

$$\frac{de_r}{dx_m} = \frac{\partial e_r}{\partial x_m} + \frac{\partial e_r}{\partial \tau}\frac{\partial \tau}{\partial x_m} \tag{10}$$

The first term in this expression is negative, by equation (5), and represents the Olson effect. The second term is positive and represents the Meltzer-Richard effect. The equation emphasizes that the two effects tend to cancel each other, leaving public goods production less affected by distribution in a system of democracy and redistributive taxes than in anarchy. Consider again the median voter's choice of a tax rate. Before the tax system is introduced, the agents of this economy face a collective action problem. Each would be better off if they could credibly commit to supplying a positive amount of effort towards the production of the public good. Now, by assumption, the tax-system is an implementable system of transfers between agents in the economy. This means that the system serves two functions from the point of view of the median voter. First, taking production as given, it can be used to transfer income from the wealthy to himself (the *redistributive* function). Second, however, it is also a potential tool for solving the collective action problem because it can be used to compensate the richest agent for the positive externalities of her productive effort (the *compensatory* function). The median voter optimally balances the redistributive and compensatory functions of the tax system. When he has no assets, the redistributive function dominates completely. Transfers are the only source of income and he prefers a strictly positive tax rate. In general, the net transfer received by m is $\left(\frac{1}{N} - x_m\right)\tau G(e_r)$. As the wealth of the median voter approaches $\frac{1}{N}$ from below, this expression goes to zero. Therefore, the compensatory function necessarily at some point comes to dominate the redistributive, and the preferred tax rate turns negative.[5] A median voter with relative wealth equal to the mean receives no net transfers and prefers a heavy, negative tax rate in order to stimulate production. Since τ_m^* is a monotonous function of x_m, there is a unique level of median voter wealth, x_m^0, which induces the median voter to choose $\tau = 0$. This is also the unique point where public goods production under the system of democracy and redistributive taxation equals production under anarchy.

[5] The possibility of a regressive taxation scheme (i.e with $\tau < 0$) is not emprirically unrealistic. For example, Foster and Rosenzweig (2004) find that the taxation schemes of Indian *Panchayats* (local governments) are on average regressive.Wang and Piesse (2009) argue that the system of taxes and subsidies in China is regressive.

For $x_m < x_m^0$, production is lower under democracy and taxation than under anarchy. For $x_m > x_m^0$ on the other hand, production is higher under democracy and taxation. On average over the range of x_m, the relationship between inequality and public goods production is therefore less steeply positive under democracy and taxation than under anarchy. As demonstrated in the example in section 5, the effect of inequality may even be negative. Under some circumstances, transfers benefitting the median asset holder at the expense of the wealthiest individual lead to an increase in production, rather than a decrease. These result are illustrated in Figure 1 below, and summarized in Proposition 1:

Proposition 1 *In a public goods dependant economy like the one described in section 2, the introduction of democracy and redistributive taxation reduces the positive effect of inequality on the production of public goods. The effect of inequality may even turn negative.*

4 The effect of democracy

In the standard Meltzer-Richard model with private instead of public goods, the introduction of democracy and redistributive taxation always leads to a decline in economic activity and to a more equal distribution of income, as long as the median voter is poorer than the mean. This is simply because the median voter always chooses a positive tax-rate, which decreases the incentives to supply effort and redistributes income from the rich to the poor. In contrast, the effects of introducing democracy and taxation in the model described above depend on the initial level of asset inequality. If $x_m < x_m^0$, the effects from the standard model are replicated: m prefers a positive tax-rate, production falls and the distribution of income becomes more equal. However, if $x_m > x_m^0$, m sets a negative tax rate, leading to an increase in production, as illustrated in Figure 1, and an increase in income inequality. These results are summarized in Proposition 2:

Proposition 2 *When democracy and redistributive taxation are introduced in a public goods-dependant economy, like the one described in section 2, the effects on production and income distribution depend on the initial level of asset inequality. When the initial level of asset inequality is high, democracy and taxation lead to a drop in production and a more equal income distribution. When asset inequality is low, the opposite happens.*

One corollary of Proposition 2 is that the introduction of democracy and redistributive taxation improves welfare for both the median voter and the richest agent over the situation with no government intervention, if the initial asset distribution is sufficiently equal. If the poorest agent in the economy has relative wealth high enough to make him prefer the negative tax rate chosen by a median voter with $x_m > x_m^0$ over a tax rate equal to zero, then the introduction of democracy and taxation in fact represents a Pareto improvement. Baland and Platteau (1998) also make the point that regulation of public goods problems only leads to Pareto improvements if the distribution of resources complementary to the public good is sufficiently equal. The contribution of the present paper is to show that this result holds when policies are determined endogenously, rather than imposed. The possibility that democracy and redistributive taxation can lead to Pareto improvements and increase economic production stand in contrast to the standard Meltzer-Richard model (with private instead of public goods) in which democracy and redistribution never lead to Pareto improvements and always lower aggregate production when the median voter is poorer than the mean.

A further, possible corollary of Proposition 2 is that more equal societies will find it easier to consolidate democracy. Of course, the relevant alternative to democracy is not typically anarchy, but rather some form of autocracy. However, if democracy increases the legitimacy of the state, it is also likely to increase the feasibility of implementing a comprehensive system of redistribution. This view was famously expressed in the slogan used by colonists in the run up to American War of Independence: "No taxation without representation". The conjecture of a link between inequality and democratic consolidation seems to accord well with empirical evidence (Przeworski et. al. 2000). For example, differences is inequality may be part of the reason why democracy has been more stable in Western Europe than in Latin America (Acemoglu and Robinson 2006, chap. 6.5).

To summarize, the main results obtained so far are, first, that the introduction of democracy and taxation reduces, and possibly even cancels or reverses, the positive effect of inequality on public goods production, which exists in anarchy. Second, in the public goods dependant economy, the median voter may choose a negative tax rate, even if he is poorer than the mean, in order to stimulate the production of public goods. Third, for a sufficiently equal asset distribution, the introduction of democracy and taxation is a Pareto improvement over the situation with no intervention. In order to obtain closed form solutions and thereby further develop intuition for the main lessons of the model, we now consider a specific type of public goods production function.

5 A parameterized production function

Assume that G is a concave power function:

$$G\left(\sum_{j=1}^{N} e_j\right) = \left(\sum_{j=1}^{N} e_j\right)^{\alpha}, \quad 0 < \alpha < 1$$

It is easy to show that in this case the effort of the richest agent is given by:

$$e_r = \left(\alpha\left(x_r + (\frac{1}{N} - x_r)\tau\right)\right)^{\frac{1}{1-\alpha}} \tag{11}$$

The appendix shows that the equilibrium tax rate equals:

$$\tau_m^* = \frac{(1-\alpha)x_r}{x_r - \frac{1}{N}} + \frac{\alpha x_m}{x_m - \frac{1}{N}} \tag{12}$$

For $x_m = 0$, τ_m^* is strictly positive. As x_m approaches $\frac{1}{N}$ from below, the desired tax rate of the median voter goes to minus infinity, consistent with the view that the compensatory function of the tax system comes to dominate the redistributive function entirely. The wealth level that leads the median voter to prefer a zero tax rate is $x_m^0 = \frac{(1-\alpha)x_r}{Nx_r - \alpha}$. Analyzing this expression reveals that x_m^0 is decreasing in α, the elasticity of public goods production with respect to effort. The intuition is that a more effective production technology increases the incentives to subsidize production. Also, x_m^0 is decreasing in N, the size of the population. The intuition is that higher population makes it more desirable to use the fiscal system to stimulate public goods production, because a higher number agents share the burden of subsidizing the public goods producer.

Now, in order to focus sharply on cases where the median agent gains at the expense of the wealthiest, or vice versa, assume that the relationship between the wealth levels of the richest- and the median agent, respectively, takes the following, linear form:

$$x_r = \bar{x}_r - kx_m \tag{13}$$

where $1/N < \bar{x}_r \leq 1$ and $0 \leq k < \bar{x}_r/x_m - 1$ (the last condition ensures that r is indeed richer than m). This formulation implies that a dx_m increase in the relative wealth of the median voter is accompanied by a kdx_m drop in the relative wealth of the richest person. Inserting (12) and (13) into (11) and collecting terms, we obtain the following expression for effort as a function of median voter wealth:

$$e_r(x_m) = \left(\alpha^2\left(\frac{x_m(k+1) - \bar{x}_r}{Nx_m - 1}\right)\right)^{\frac{1}{1-\alpha}} \tag{14}$$

Differentiating with respect to x_m and collecting terms, we get:

$$\frac{\partial e_r}{\partial x_m} = \frac{\alpha^2}{1-\alpha}\left(\alpha^2\left(\frac{x_m\,(k+1)-\bar{x}_r}{Nx_m-1}\right)\right)^{\frac{\alpha}{1-\alpha}}\left(\frac{N\bar{x}_r-1-k}{(Nx_m-1)^2}\right) \tag{15}$$

The sign of this expression equals the sign of $N\bar{x}_r - 1 - k$. Increases in the wealth of the median voter, at the expense of the richest individual, lead to increases in public goods production if and only if k is smaller than $N\bar{x}_r - 1$. This means that the Meltzer-Richard effect dominates the Olson effect if a) the drop in x_r corresponding to a given increase in x_m is sufficiently small, b) population is sufficiently large and c) the base level wealth of the richest individual, $\bar{x}_r$, is sufficiently high. The intuition behind the effect of population is, again, that higher population decreases the per capita cost of subsidizing public goods production. As the stake of the median voter in the public good increases, she is willing to decrease the tax rate faster when population is large, because the benefit to herself of doing so is increasing in the number of tax payers. Figure 1 illustrates the relationship between median voter wealth and public goods production under anarchy as well as under democracy and redistributive taxation. The latter case is shown for both high and low values of k.

[Insert Figure 1]

One simple but interesting special case is when all agents have the same asset holding, x_m, except agent r who is wealthier. In terms of equation (13), the parameter values characterizing this distribution are $\bar{x}_r = 1$ and $k = N-1$. It is easy to verify that in this situation, the expression in (15) equals zero. Therefore, this is a society where the Olson- and Meltzer Richard effects exactly cancel out, leaving the level of public goods production entirely unaffected by the distribution of assets, aptly exemplifying the general result summarized in Proposition 1.

To summarize, the main contributions of this section are, first, to demonstrate by example that the effect of inequality on production in the public goods dependant economy with democracy and redistributive taxation might be either positive or negative, depending on the parameters of the asset distribution. Second, the section also shows that the compensatory function of the tax system more easily comes to dominate the redistributive function when the public goods production technology is effective and when population is large.

6 Limits to the supply of effort

We have assumed that agents are never constrained in their ability to supply effort to production of the public good. Under some circumstances, this assumption may not be realistic. If effort comes in the form of labour, agents may be constrained if labour markets are imperfect. Likewise, if effort takes the form of monetary payments, imperfect credit markets may impose constraints. In line with Baland and Platteau, 1997, we therefore now assume that each agent faces a fixed upper limit on effort, denoted $\bar{e}_i$. The following first order conditions with respect to the choice of effort now apply:

$$\left((1-\tau)\,x_i + \frac{\tau}{N}\right) G'\left(\sum_{j=1}^{N} e_j\right) - 1 > 0 \quad \text{and } e_i = \bar{e}_i$$

$$\text{or} \quad \left((1-\tau)\,x_i + \frac{\tau}{N}\right) G'\left(\sum_{j=1}^{N} e_j\right) - 1 = 0 \quad \text{and} \quad 0 \leq e_i \leq \bar{e}_i \tag{16}$$

$$\text{or} \quad \left((1-\tau)\,x_i + \frac{\tau}{N}\right) G'\left(\sum_{j=1}^{N} e_j\right) - 1 < 0 \quad \text{and} \quad e_i = 0$$

Agents can be grouped into three groups: *Constrained contributors* supply as much effort they can and would like to supply more. Denote the set of constrained contributors by C. *Unconstrained contributors* supply a positive amount of effort, but are not constrained by the upper limit. *Non-contributors* supply no effort to production of the public good. If agents are strictly ranked in terms of wealth, there will be at most one unconstrained contributor. For simplicity we shall assume that there is indeed one and only one agent of this type, denoted by u. Note that the first-order conditions immediately imply that constrained contributors are strictly wealthier than the unconstrained contributor who is in turn wealthier than non-contributors. The effort of the unconstrained contributor is given by:

$$e_u = \psi\left(\left((1-\tau)\,x_u + \frac{\tau}{N}\right)^{-1}\right) - \sum_{j \in C} \bar{e}_j \tag{17}$$

Total effort is therefore simply equal to $\psi\left(\left((1-\tau)\,x_u + \frac{\tau}{N}\right)^{-1}\right)$. Comparing with (4) and noting that $x_u < x_r$, we see that production is strictly lower with constrained capacities to contribute than without, even though the number of agents supplying effort is higher. Assume that the unconstrained contributor is richer than the mean, i.e. that $x_u > 1/N$. This means that we are still focusing on societies where public goods production is undertaken by the relatively well off. The median voter, who is a non-contributor, chooses the tax rate that maximizes:

$$U_m = \left((1-\tau)\,x_m + \frac{\tau}{N}\right) G\left(\psi\left(\left((1-\tau)\,x_u + \frac{\tau}{N}\right)^{-1}\right)\right) \tag{18}$$

Comparing equations (17) and (18) to equations (4) and (7) in section 2.2 above, we see that the analyses with- and without constrained effort are completely analogous. The role played by the richest agent, r, in the case with no constraints on contributions is simply taken by the unconstrained contributor, u, in the case of constrained ability to contribute. Interpretation of results, on the other hand, is somewhat more complicated in the case of constrained capacity to contribute, especially when it comes to analyzing the effects of inequality. As shown in Baland and Platteau, 1997, inequality is no longer unambiguously good for public goods production, even in anarchy. For example, transfers from the unconstrained- to a constrained contributor increase inequality but decrease production. In societies with democracy and redistributive taxation, transfers from the median voter to constrained contributors have the same effect. In this sense, the introduction of limits to the supply of effort decreases the strength of the Olson effect, in both anarchic and democratic societies. As long as the unconstrained contributor is relatively rich, however, the tension between the Olson- and Meltzer-Richard effects remains in place. Changes in distribution that benefit the unconstrained contributor at the expense of the median asset holder continue to be dis-equalizing, all else equal. Such changes unambiguously increase production under anarchy but have ambiguous effects under democracy and redistributive taxation. For infinitesimal changes, this trade-off is in general described by equation (10), with e_u inserted instead of e_r, and by (15) if technology is given by a concave power function.

Now briefly focus on the situation where the unconstrained contributor is poorer than the mean, i.e. $x_u < 1/N$. This assumption changes the analysis radically, because, from equation (17), the unconstrained agents' effort is now *increasing* in the tax rate. This means that the Meltzer-Richard effect is completely annulled, since a median voter who is poorer than the mean now always chooses the highest possible tax rate. The analysis of this type of society is not pursued further.

In sum, introduction of limits to the supply of effort in general reduces the positive effects of inequality on public goods production, under democracy as well an under anarchy. As long as the unconstrained, or marginal, contributor to the public good is richer than the mean asset holder, the tensions between the Olson- and Meltzer-Richard effects described above continue to exist. Increases in the wealth of the median asset holder at the expense of the marginal contributor decreases production under anarchy, but may either increase or decrease it under democracy and redistributive taxation. The introduction of democracy and taxation benefits both the median asset holder and the effort-supplying elite if and only if the median voter is rich enough to choose a regressive tax system.

7 Example: Finance of higher education

The suggestion in section 2 to think of the model in terms of farmers with different holdings of agricultural land suggests that it might be relevant in the context of local communities in developing countries. This might indeed be the case. Public goods and common property resources are often important in such settings (Jodha 1986), and in many developing countries, power is increasingly devolved to democratically elected local governments, as discussed in Bardhan and Mookherjee (2006). The model shows that the introduction of local, democratic governments may qualitatively alter the relationship between economic distribution and public goods production in such settings.

A different field where the model is relevant is that of higher education. The model predicts that governments may some times tax the poor and subsidize the rich, in order to stimulate the production of public goods. One field where this relationship is regularly observed is public finance of higher education. Government spending on tertiary education is typically regressive, since it transfers resources from all taxpayers to those who would have the highest lifetime-income, even in the absence of the transfer (Barr 2004). Such policies are usually justified with reference to positive externalities related to higher education. Highly educated individuals contribute more than proportionally to the production of certain public goods, in particular the generation and dissemination of knowledge (cf. Birdsall 1996).

Now, assume that knowledge and innovation are complementary to other economic resources in the agents' indirect utility function (like x and G are complementary in the utility function in the model). For example, technological innovations are often embodied in products, such as televisions and computers and the utility derived from these innovations therefore depends on the ability to purchase those products. Also, the benefit obtained from innovative methods of production typically depends on a person's ability to adapt to new circumstances. This ability in turn depends on her level of general education, and on her financial resources (financially well-endowed individuals will find it easier to invest in re-schooling or relocate to another town for a new job). If this assumption holds, the model presented in the previous sections predicts that countries with an equal distribution of economic resources will be more likely to engage in public funding of tertiary education than countries with an unequal distribution of resources.

UNESCO provides data for a number of countries on public finance of higher education for the period 1999 to 2006 (UNESCO 2010). Table 1 investigates in panel regressions how per capita government spending on tertiary education is related to economic inequality among the subset of countries for which data on inequality is available.

[Insert Table 1]

Inequality is measured by the gini coefficient of income.[6] The first regression shows the bivariate relationship, while the next three include controls for population, GDP, total government expenditure, region of the world and year (estimates for year dummies not shown). Table A1 in the appendix presents the countries included, the mean of the two main variables of interest (per capita spending on tertiary education and inequality), and the number of observations available for each country. To reduce the potential impact of endogeneity, the gini variable is lagged two years. Note, however, that since government spending on tertiary education is arguably regressive, we should expect reverse causality to lead to a positive bias in the estimated coefficient, whereas the model predicts a negative effect. GDP is also lagged two years due to concerns about endogeneity. Column 2 shows the results of estimating a pooled OLS regression; column 3 presents the estimates from a random effects model, while column 4 introduces country fixed effects. The last exercise is particularly interesting since the inclusion of fixed effects allows us to rule out that a correlation between inequality and spending on tertiary education is caused by cultural, institutional or other stable country characteristics that may potentially affect both economic distribution and government spending patterns.

Results are consistent with the hypothesis of a negative effect of inequality on public finance of tertiary education. The gini variable is always negative and significant at the five percent level or better. Since total government spending is controlled, this is not a result of tertiary education spending proxy'ing for a large public sector in general. Results are very similar if we use the first, third or fourth lags of inequality and GDP, rather than the second. On the other hand, there is no significant effect of inequality when the current or first leaded variables are used. This supports the view that causality runs from inequality to spending and not the other way around. The interpretation of these results offered by our theoretical model is that in equal countries, the "common man" derives higher benefits from the positive externalities of higher education than in unequal countries. He is therefore also more willing to subsidize it.[7]

[6] Income inequality is an imperfect proxy for the theoretical variable of interest, which is inequality in assets complementary to innovation and knowledge. Some data on inequality of physical and financial assets (wealth) exists, but I refrain from using it for two reasons: First, data is available only for a small subset of the countries in the sample. Second, the theoretically relevant assets include not only physical and financial assets, but also human assets, such as the quality of primary and secondary education. Therefore, income inequality might well be a better proxy for the underlying variable of interest than wealth inequality.

[7] The results contrast with those in Zhang (2008) who finds a *positive* correlation between inequality and spending on higher education *as a share of total spending on education.* The difference is partly driven by the fact that Zhang focuses on the effect of education spending on inequality, while this paper focuses on the effect in the other direction. Also, Zhang looks primarily at spending on higher education relative to spending on other types of education, while this paper investigates absolute, per capita levels of

8 Conclusion

Even in the presence of a well-functioning state, the provision of some public goods, such as innovation, is still fully or partly left to private agents. The paper points out that voters in a democracy may use the fiscal system to stimulate the production of such goods. Government resources may for example be used to subsidize higher education, which stimulates the production of innovation and knowledge. However, such subsidization is typically distributionally regressive, and is only a political equilibrium if the distribution of resources complementary to the public good is sufficiently equal. For example, voters in a democracy may only support spending on higher education if they have the human and financial resources necessary to take advantage of the positive spillovers from advanced education and research. I have presented a simple, Downsian model of political competition to illustrate these points. The model shows that the relationship between inequality and public goods production is qualitatively altered when it is embedded in a context of democracy and redistributive taxation. From another perspective, it also shows that the presence of public goods in a democratically governed economy changes the politics of redistributive taxation. When public goods are important, the median voter may choose a negative tax rate, even if he is poorer than the mean, provided that the distribution of economic resources is sufficiently equal. Therefore, the democratic, political equilibrium might increase welfare for the wealthy elite as well as for the "middle class", as represented by the median voter. It might even be a Pareto improvement over the situation with no political intervention.

Under reasonable assumptions, the model predicts that equal countries engage more heavily in public funding of higher education than unequal ones. This hypothesis is supported in a panel analysis of government spending on higher education in a broad sample of countries. The result is robust to the introduction of year- and country fixed effects in the regressions.

expenditure. Glomm and Ravikumar (2003), Levy (2005) and Di Gioacchino and Sabani (2009) investigate the relationship between inequality and public finance of education in theoretical models. However, these papers do not consider positive externalities from education.

References

[1] Acemoglu, D. and Robinson, J., 2006. Economic origins of dictatorship and democracy. New York: Cambridge University Press.

[2] Baland, J.M. and Platteau, J.P., 1997. Wealth inequality and efficiency in the commons, I: the unregulated case. Oxford Economic Papers 49, 451–82.

[3] Baland, J.M. and Platteau, J.P., 1998. Wealth inequality and efficiency in the commons, II: the regulated case. Oxford Economic Papers 50, 1–22.

[4] Bardhan, P., Mookherjee, D., 2006. Decentralization to local governments in developing countries: A comparative perspective. Cambridge, MA: MIT Press.

[5] Barr, N., 2004. Higher education funding. Oxford Review of Economic Policy 20, 264-283.

[6] Bergstrom, T., Blume, L., Varian, H., 1986. On the private provision of public goods. Journal of Public Economics 29, 25-49.

[7] Birdsall, N. (1996): Public spending on higher education in developing countries: Too much or too little? Economics of Education Review 15, 407-419

[8] Di Gioacchino, D., Sabani, L., 2009. Education policy and inequality: A political economy approach. European Journal of Political Economy 25, 463-478.

[9] Harms, P., Zink, S.; 2003. Limits to redistribution in a democracy: a survey. European Journal of Political Economy 19, 651-668.

[10] Glomm, G., Ravikumar, B., 2003. Public education and income inequality. European Journal of Political Economy 19, 289-300.

[11] Foster, A.D., Rosenzweig, M.R., 2001. Democratization, decentralization and the distribution of local public goods in a poor rural economy. PIER Working Paper 01-056.

[12] Jodha, N.S., 1986. Common property resources and the rural poor in dry regions of India. Economic and Political Weekly 22, 1169-1182.

[13] Levy, G., 2005. The politics of public provision of education. Quarterly Journal of Economics 120, 1507-1534.

[14] Lindert, P.H., 1996. What limits social spending? Explorations in Economic History 33, 1-34.

[15] Meltzer, A., Richard, S., 1981. A rational theory of the size of government. Journal of Political Economy 89, 914-927.

[16] Milanovic, B., 2000. The median-voter hypothesis, income inequality and income redistribution: an empirical test with the required data. European Journal of Political Economy 16, 367-410.

[17] Milanovic, B., 2010. Four critiques of the redistribution hypothesis: An assessment. European Journal of Political Economy 26, 147-154.

[18] Moene, K.O., Wallerstein, M., 2001. Inequality, social insurance, and redistribution. American Political Science Review 95, 859-874.

[19] Olson, M., 1965. The logic of collective action. Public goods and the theory of groups. Cambridge MA: Harvard University Press.

[20] Perotti, R., 1996. Growth, income distribution, and democracy. What the data say. Journal of Economic Growth 1, 149-187.

[21] Przeworski, A., Alvarez, M., Cheibub, J.A., Limongi, F., 2000. Democracy and development: Political institutions and material well-being in the World: 1950-1990. New York: Cambridge University Press.

[22] Romer, T., 1975. Individual welfare, majority voting and the properties of a linear income tax. Journal of Public Economics 7, 163-168.

[23] UNESCO, 2010. UNESCO Instute for Statistics, www.uis.unesco.org (accessed 25.02.2010).

[24] Wang, X., Piesse, J., 2009. Welfare effects of regressive taxation and subsidies in China. Brooks World Poverty Institute Working Paper 108, The University of Manchester.

[25] World Bank, 2008. World development indicators 2008. Washington D.C.: The World Bank.

[26] Zhang, L., 2008. Political economy and income distribution dynamics. Journal of Development Economics 87, 119-139.

Appendix

Second derivative of U_i with respect to τ

Differentiating (8) with respect to τ and collecting terms, we obtain:

$$\frac{\partial^2 U_i}{\partial \tau^2} = \left(x_r - \frac{1}{N}\right)\psi'\left(\Delta^{-1}\right)\Delta^{-3}\left(\begin{array}{c} 2\left(\frac{1}{N} - x_i\right) + \\ \left(x_r - \frac{1}{N}\right)\left(x_i + (\frac{1}{N} - x_i)\tau\right)\Delta^{-2}\left(\frac{\psi''(\Delta^{-1})}{\psi'(\Delta^{-1})} + 3\Delta\right) \end{array}\right)$$

A sufficient but not necessary condition for this expression to be negative is that $\psi''\left(\Delta^{-1}\right) < 0$. Since $\psi'\left(\Delta^{-1}\right) = 1/G''(\psi(\Delta^{-1}))$, it holds that

$$\psi''\left(\Delta^{-1}\right) = \frac{-G'''(\psi(\Delta^{-1}))\psi'(\Delta^{-1})}{\left(G''(\psi(\Delta^{-1}))\right)^2}$$

This is negative if G''' is negative. Therefore, a negative third derivative of G is a sufficient but not necessary condition for U_i to be universally concave in τ, as claimed in footnote 4.

Optimal tax rate with production given by a power function:

Given equation (11), which provides an expression for the effort of agent r, voters maximize:

$$U_i = \left(x_i + (\frac{1}{N} - x_i)\tau\right)\left(\alpha\left(x_r + \left(\frac{1}{N} - x_r\right)\tau\right)\right)^{\frac{\alpha}{1-\alpha}}$$

for $i \neq r$. The first order conditions with respect to τ are:

$$\begin{aligned} &\left(\frac{1}{N} - x_i\right)\left(\alpha\left(x_r + (\frac{1}{N} - x_r)\tau\right)\right)^{\frac{\alpha}{1-\alpha}} \\ &+ \frac{\alpha^2(\frac{1}{N} - x_r)}{1-\alpha}\left(x_i + (\frac{1}{N} - x_i)\tau\right)\left(\alpha\left(x_r + (\frac{1}{N} - x_r)\tau\right)\right)^{\frac{2\alpha-1}{1-\alpha}} = 0 \quad (19) \end{aligned}$$

Assuming that $x_i < \frac{1}{N}$, we solve for τ and obtain equation (12). Now, τ_i^* is a maximum if $\frac{\partial^2 U_i}{\partial \tau^2}(\tau_i^*) < 0$. We prove that this is the case. First, differentiate the left-hand side of (19) with respect to τ and collect terms::

$$\begin{aligned} \frac{\partial^2 U_i}{\partial \tau^2}(\tau_i^*) \quad = \quad & \frac{2\alpha^2}{1-\alpha}\left(\frac{1}{N} - x_i\right)\left(\frac{1}{N} - x_r\right)\left(\alpha\left(x_r + \left(\frac{1}{N} - x_r\right)\tau_i^*\right)\right)^{\frac{2\alpha-1}{1-\alpha}} \\ & + \frac{\alpha^3(\frac{1}{N} - x_r)^2}{1-\alpha}\left(x_i + (\frac{1}{N} - x_i)\tau_i^*\right)\left(\alpha\left(x_r + \left(\frac{1}{N} - x_r\right)\tau_i^*\right)\right)^{\frac{3\alpha-2}{1-\alpha}} < 0 \Leftrightarrow \end{aligned}$$

$$3\left(\frac{1}{N}-x_i\right)\left(\frac{1}{N}-x_r\right)\tau_i^* > \left(\frac{1}{N}-x_r\right)x_i - 2\left(\frac{1}{N}-x_i\right)x_r$$

Now, insert the expression for τ_i^* given in (12) and collect terms again:

$$\begin{aligned} 3\left(\frac{1}{N}-x_i\right)\left(\frac{1}{N}-x_r\right)\left(\frac{(1-\alpha)x_r}{x_r-\frac{1}{N}}+\frac{\alpha x_i}{x_i-\frac{1}{N}}\right) &> \left(\frac{1}{N}-x_r\right)x_i - 2\left(\frac{1}{N}-x_i\right)x_r \Leftrightarrow \\ x_r &> x_i \end{aligned}$$

This condition is always true and τ_i^* is therefore a maximum.

[Insert Table A1]

Figure 1 Public goods production under anarchy and democracy

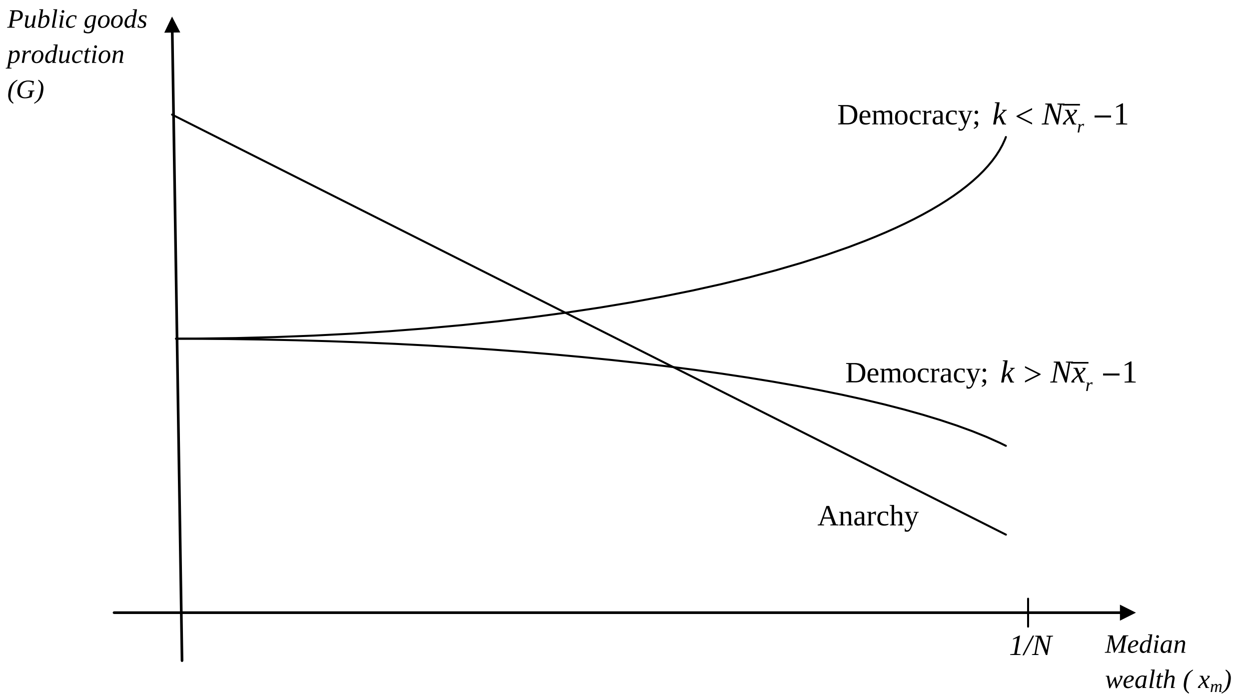

Table 1 Inequality and government expenditure on tertiary education

	Dependent variable: Per capita govt. expenditure on tertiary education (log)			
	OLS	OLS	Random effects	Fixed effects
Gini, 2nd lag	-0.032	-0.016	-0.021	-0.024
	(2.80)***	(1.98)**	(3.41)***	(2.55)**
Population (log)		-1.114	-1.219	-4.428
		(15.57)***	(14.07)***	(3.77)***
GDP, 2nd lag (log)		0.587	0.807	0.165
		(3.91)***	(4.53)***	(0.32)
Total govt. expenditure (log)		0.516	0.397	0.457
		(4.26)***	(2.70)***	(0.92)
Central Asia		-0.602	-0.877	
		(2.09)**	(2.74)***	
East Asia		-0.067	-0.137	
		(0.23)	(0.42)	
South Asia		-0.411	-0.399	
		(1.27)	(1.17)	
Latin America		-0.23	-0.357	
		(0.83)	(1.32)	
Central and Eastern Europe		-0.189	-0.331	
		(0.78)	(1.57)	
W. Europe and N. America		-0.222	-0.526	
		(0.7)	(1.73)*	
Sub-saharan Africa		-0.118	0.031	
		(0.41)	(0.13)	
Constant	4.38	-3.419	-4.275	62.951
	(8.06)***	(3.86)***	(3.74)***	(2.56)**
Year effects	No	Yes	Yes	Yes
Observations	149	142	142	142
R-squared	0.04	0.94		

Robust t statistics in parentheses. Standard errors adjusted for within-country clustering. * significant at 10%; ** significant at 5%; *** significant at 1%. The dependent variable is observed in the years 1999 to 2006, with gaps for some countries. The reference category for region of the world is Middle East and North Africa. Data sources: Tertiary education spending calculated from UNESCO (2010) and World Bank (2008). Gini, population, GDP, government expenditure from World Bank 2008.

Table A1 Country data (means)

Country	Annual per capita govt. expenditure on tertiary education (2000 prices)	Gini	Obs.	Country	Annual per capita govt. expenditure on tertiary education (2000 prices)	Gini	Obs.
Jordan	16.0	36.4	1	Austria	312.1	29.1	1
Morocco	13.9	39.5	1	Belgium	305.0	33.0	1
Tunisia	30.7	39.8	1	Canada	430.2	32.6	1
Belarus	24.0	29.7	1	Denmark	683.8	24.7	1
Bulgaria	15.7	31.8	2	Finland	492.6	26.9	1
Croatia	34.6	31.2	2	Germany	269.7	28.3	1
Estonia	52.7	36.6	4	Greece	164.0	34.3	1
Hungary	56.9	27.3	6	Ireland	325.8	34.3	1
Latvia	35.2	34.2	4	Israel	228.3	39.2	1
Lithuania	48.9	33.7	5	Italy	167.6	36.0	1
Poland	45.1	33.2	5	Netherlands	331.9	30.9	1
Romania	15.0	30.8	4	Norway	800.0	25.8	1
Russia	12.6	41.7	4	Portugal	105.1	38.5	1
Slovenia	148.1	30.9	1	Spain	145.2	34.7	1
Macedonia	9.0	34.4	1	Sweden	588.4	25.0	1
Turkey	27.7	41.7	2	Switzerland	476.8	33.7	1
Ukraine	14.4	28.4	3	UK	201.3	36.0	1
Azerbaijan	1.6	36.5	1	United States	498.0	40.8	1
Kazakhstan	5.2	34.4	2	Bangladesh	0.9	33.4	1
Kyrgyzstan	2.3	33.2	7	India	4.1	36.8	1
Tajikistan	0.6	33.1	2	Burkina Faso	1.1	39.5	1
New Zealand	236.4	36.2	1	Cape Verde	13.2	50.5	1
Philippines	4.1	45.3	2	Côte d'Ivoire	7.1	43.8	1
Thailand	21.4	42.3	3	Guinea	2.1	38.6	1
Argentina	55.8	51.5	4	Kenya	2.5	42.5	1
Bolivia	14.8	58.1	2	Madagascar	0.8	40.5	2
Brazil	31.7	58.0	6	Mozambique	1.9	47.3	1
Chile	28.4	55.3	3	South Africa	23.8	57.8	1
Colombia	13.6	57.7	5	Swaziland	15.9	50.4	1
Costa Rica	35.9	46.9	3	Uganda	1.5	45.7	1
Ecuador	0.9	53.6	1	Zambia	1.2	53.4	1
El Salvador	4.0	52.0	2				
Guatemala	6.2	49.4	1				
Mexico	55.1	49.2	3				
Panama	47.8	53.9	3				
Paraguay	10.7	57.1	3				
Peru	8.3	52.4	4				
Uruguay	33.9	45.1	5				