E C O N O M I C S B U L L E T I N

On inequality and the allocation of public spending

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Abstract

Empirical evidence on the link between inequality and redistribution mechanisms is inconclusive, and depends on the nature of the mechanism in question. We present a series of political economy models, and the associated results may be interpreted as being consistent with these facts. Specifically, we demonstrate that the link between inequality and redistribution depends on the nature of the mechanism relative to the alternatives that are available. Our analysis suggests that, in the presence of higher inequality, a median voter faced with the choice of the proportion of expenditure between two mechanisms is likely to choose in favour of public goods that are more efficient mechanisms of redistribution. In some cases, inequality does not matter and the proportion of spending on any particular public good is related only to the preference and technology related parameters of the model.

We thank Greg Huffman, Debajyoti Chakraborty, seminar participants at the University of Bologna, conference participants at the 35th Annual Conference of Economists, Perth, Australia, and conference participants at the 7th International Public economic Theory Meeting, Hanoi, Vietnam for useful suggestions and comments.
Citation: Lahiri, Radhika and Elisabetta Magnani, (2008) "On inequality and the allocation of public spending." *Economics Bulletin*, Vol. 5, No. 8 pp. 1-8
Submitted: February 17, 2008. **Accepted:** March 9, 2008.
URL: http://economicsbulletin.vanderbilt.edu/2008/volume5/EB-08E60013A.pdf

1. Introduction

Models with agent heterogeneity in some form yield interesting political economy perspectives on the determination of public policy. For example, political economy models incorporating income inequality offer an explanation for the link between inflation and inequality in terms of a desire for voters to redistribute income via an inflation-tax. (See Dolmas et al., 2000). Heterogeneity in the form of demographic structure has had implications for fiscal policy and the policy on immigration. (Storeslotten, 2000, and Dolmas and Huffman, 2004). There is also a large body of literature on that explores the link between inequality and the provision of various types of public goods, or more generally between inequality and different mechanisms of redistribution. (For a survey see Zweimuller 2000 and references therein).

Standard political-economy models with a median voter representation suggest that inequality has a positive impact on redistribution. (Gioacchino et al. 2005). In recent years, however, motivated by the lack of empirical evidence in favour of a positive link, strands of literature have emerged that seek to justify a *negative* link between inequality and the expenditure on mechanisms of redistribution such as education, health, transfers etc. The work of Benabou (2000), Zhang(2002), Gradstein(2003), for example, departs from the standard majority rule framework in order to explain a negative link between inequality and education.

This paper considers two fairly standard political economy models in order to rationalize why the empirical evidence on the link between inequality and redistribution is somewhat inconclusive. An aspect of the choice of the redistribution mechanism that has often been neglected in the literature is the fact that public revenues have alternative uses, and voters may prefer some mechanisms of redistribution over others. Of course, this neglect is partly due to the fact that median voter characterization of the political process does not accommodate choice over several alternatives. However, one can always accommodate choice between two alternatives by a vote on the proportion of revenues that is used for alternative schemes of redistribution.

To that end, the first model we present considers the proportion of tax revenue that is spent on a public good, which we refer to as “environment”, but may be interpreted as any other public good with a non-excludable nature. The remainder of tax revenues is redistributed as a lump sum transfer payment to agents in the economy. We find that the proportion of revenues allocated to environmental maintenance or improvement is *inversely* related to inequality. That is, a direct transfer payment is likely to be the preferred mode of redistribution in this economy. This is because a direct transfer implies larger utility gains as it can be spent on other goods in the economy and allows the agents to smooth consumption over time. Put differently, the public good in the utility function is non-excludable and non-rival in the sense that if benefits all agents in the economy in a uniform manner. Consequently, the lump sum transfer is preferable in an economy with inequality since its benefits are felt to a greater degree by the poorer agents.

The second model looks at the preference over two different types of public goods, referred to as “environment” and “publicly provided education”. The former is modeled in a manner identical to the first model, i.e., it appears in the utility function. Education, on the other hand, enhances production and output as it is complementary input in the human capital formation of agents in the economy. Again, the second public good is labeled as “education”, but any other interpretation which is appropriate to the features modeled would suffice. In this model, however, the

proportion spent on "environment" is *unrelated* to inequality. Specifically, this proportion is related only to the preference and technology related parameters of the model, an in particular negatively related to a parameter representing the returns to human capital.

An interesting implication of the above feature is that the parameter representing the returns to human capital impacts on the inequality in incomes, even though our model does not find a direct mathematical relationship between inequality and the proportion spent on the environment. This suggests that one may empirically find a negative correlation between inequality and the proportion spent on environment even if a relationship of this type did not, in actual fact, exist.

The analysis suggests that the existence of a positive or a negative correlation between individual mechanisms of redistribution is contingent on the menu of choices that are available, and to what extent each alternative is effective as a means of redistribution. Indirectly, this also implies that "pure" public goods may not be the preferred mechanism of distribution due to the "uniformity" of benefits associated with them. One may also speculate that public goods with some degree of exclusion and rivalry in consumption would be preferred if the groups "excluded" constitute richer segments of society. The opposite would be true if the public good benefited the rich to a greater extent than the poor. Furthermore institutional features of economies are likely to determine the excludability of various types of public goods, and consequently their efficiency as mechanisms of redistribution. Any empirical research that finds a negative or positive correlation between inequality and redistribution must therefore be interpreted with caution.

Sections 2 and 3 present the two models and discuss the analytical and numerical results. Section 4 concludes.

2. Model 1

Consider a small open economy in which time is discrete, and in each period t=0,1,2,…, a generation of two period lived individuals is born. There is heterogeneity in the income endowment of individuals, which is in turn based on the heterogeneity in the endowment of abilities, and determined by the distribution *F(.)*. Ability of individuals, within a generation, denoted by e, is indexed between 0 and 1, and the density function of each generation is denoted by $f(e)$, with $\int_0^1 f(e)de = 1$. The supply of labor by the young is inelastic and normalized to 1 unit. However, the income earned as a result is related to the productivity $h(e_t^i)$, where e_t^i denotes the ability endowment of agent *i* born in *t*. For convenience, we drop the superscript *i* from subsequent notation. Labor income is then denoted $w_t h_t(e_t)$, where w_t is the wage rate at time t, and productivity is determined by the human capital production function $h(e) = \lambda_h e^{\psi}$. The wage and interest rates are taken as given by the individual agents, and are equal to the marginal product of labor and capital respectively. Firms use a production function of the Cobb-Douglas form, so that:

$$Y_t = \lambda_{yt} K_t^{\alpha} H_t^{1-\alpha}$$

where K and H represent aggregate physical and human capital respectively, and λ represents the productivity parameter. The wage and interest rate are given by

$$w_t = \lambda_y (1-\alpha)\left[\frac{k_t}{h_t}\right]^{\alpha}$$

$$r_t = \lambda_y \alpha \left[\frac{k_t}{h_t} \right]^{\alpha-1}$$

The small open economy assumption essentially implies that the capital to human capital ratio is pinned down by the world interest rate, so that the wage and rental rates above are given and assumed constant over time. Furthermore, they are essentially taken as given from the point of view of the agent's optimization problem which we describe below. For notational convenience, we let $y_t = w_t \lambda_h e_t^{\psi}$ in the analysis that follows.

Agents born in period *t* have preferences described by the following lifetime utility function:

$$u(c_t, c_{t+1}, b_{t+1}, a_{t+1}) = \log(c_t) + \beta\{\log(c_{t+1}) + \log(a_{t+1})\} \qquad (1)$$

where c_t and c_{t+1} denote the agents consumption in the first and second period of life. The variable a_{t+1} represents a public good, which we identify with something created as a result of the expenditure on "environmental quality", which is financed by taxing the young in any given period. However, only a proportion ϕ of the tax revenue is used for expenditure on environmental quality. Tax revenue in period *t* is given by:

$$T_t = \int_{y_{\min}}^{y_{\max}} \tau y_t F(dy_t) = \tau \bar{y}_t .$$

Here, τ represents the tax rate and $\bar{y}_t$ is the mean income of the cohort born in period t. Then, $a_{t+1} = \phi \tau \bar{y}_t$, and the remainder of tax revenue is given to the young in period *t* as a lump-sum transfer $TR_t = (1-\phi)\tau \bar{y}_t$. We assume that the young agents in period *t* vote on the proportion ϕ at the beginning of the period.[1] Individual budget constraints in periods *t* and *t+1* may then be written as

$$c_t = y_t(1-\tau) - s_t + TR_t \qquad (2)$$

$$c_{t+1} = (1 + r_{t+1}) s_t . \qquad (3)$$

In equations (2) and (3), $y_t = w_t \lambda_h e_t^{\psi}$ represents the income endowment of the young in *t*, $s_t = k_{t+1}$ represents their savings, and r is the world interest rate, taken as given and constant by this small open economy.

$$c_t = \frac{1}{(1+\beta)} \left[y_t(1-\tau) + (1-\phi)\tau \bar{y}_t \right] \qquad (6)$$

$$c_{t+1} = \frac{\beta(1+r)}{(1+\beta)} \left[y_t(1-\tau) + (1-\phi)\tau \bar{y}_t \right] \qquad (7)$$

$$s_t = \frac{\beta}{(1+\beta)} \left[y_t(1-\tau) + (1-\phi)\tau \bar{y}_t \right]. \qquad (8)$$

[1] Since environmental quality in t+1 does not affect the old in t, and lump sum transfers are made to the young in t, we do not believe this assumption is too restrictive. With transfers given in the second period of life, we will get a somewhat sterile result: the old will not want any expenditure on environmental protection, and the young will all want the same, as their preference are represented by the median voter. In that case, the young will always determine the political outcome when there is positive population growth. Furthermore, for the time being, we wish to abstract from issues relating to the intergenerational transfer of wealth, and focus on the effects of transfers *within* the generation. We also choose to include altruism via a bequest motive to minimize the aspect of intergenerational conflict.

Substitution of these expressions and $a_{t+1} = \phi\tau\bar{y}_t$ into the utility function, yields an indirect utility function as a function of ϕ, the agents income y_t, and the average income and wealth of the individual's cohort $\bar{y}_t$. This function is described below:

$$V(\phi, y_t, \bar{y}_t) = (1+\beta)\log\left[y_t(1-\tau) + (1-\phi)\tau\bar{y}_t\right] + \beta\log(\phi\tau\bar{y}_t) + C. \qquad (9)$$

In the above equation C is a constant term that is unrelated to ϕ. Inspection of the above suggests that utility is non-monotonic in ϕ. Now individuals will essentially vote for ϕ that maximizes the above function. Taking the partial derivative of the above and setting equal to zero, we can solve for the agents preferred equilibrium proportion of expenditure on the environment:

$$\phi^* = \eta\left(\frac{1-\tau}{\tau\frac{\bar{y}_t}{y_t}} + 1\right) = \eta\left(\frac{1-\tau}{\tau\nu} + 1\right) \qquad (10)$$

where $\eta = \frac{\beta}{2+\beta}$ and $\nu = \frac{\bar{y}_t}{y_t}$.[2]

Note that the preferred proportion of spending is *inversely* related to the parameter ν which can be used to characterize inequality in this economy. Put differently, the lower the individual's income and wealth relative to the average of his cohort, he or she will prefer a lower expenditure on environment. Since preferences over ϕ are single peaked, the median voter would vote for low ϕ when inequality is high – which is the case when mean income is greater than median income. The intuition underlying this result is as follows: In this model lump sum transfers directly given to agents are perfect substitutes for current consumption, and consequently more effective as a mechanism of redistribution. From the point of view of the poorer agents, the public good created by the lump sum transfer has a lower degree of excludability than the one appearing in the utility function. In a relative sense, the benefits from the lump-sum transfer are greater for the poorer agents, while the impact of the environmental good is uniform across agents.

Note also that ϕ is also inversely related to the tax rate. This is probably the implication of the fact that we have abstracted from the work effort decision and tax revenues are an increasing function of tax rates as there are no incentive effects on income. Consequently, if the tax rate is high a lower proportion of the revenue may be devoted to the environment. On the other hand, models that produce a *Laffer curve* may have different implications.

3. Model 2

Now consider the same economy, but one in which the government is faced with a different choice in relation to the allocation of its revenues. The model has features in common with Holtz-Eakin et al(2000), especially with respect to the modeling of human capital.

We define human capital production by:

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[2] Note that for an interior solution we require $0 < \eta < \frac{\tau\nu}{1-\tau+\tau\nu}$.

$$h(e_t) = \lambda_{ht}\left[e_t(1-\phi)g_t\right]^{\psi}. \quad (11)$$

Here $h(e_t)$ is the human capital acquired by the agent with ability endowment e_t, $g_t = \tau\int_0^1 w_t h(e_t)de_t$ is tax revenue, so that $(1-\phi)g_t$ can be regarded as the amount of government expenditure allocated to education. The parameter ϕ has the same interpretation as before – i.e it the proportion of government revenue allocated to the environment.

Using the same methods as in the previous model, we can derive equilibrium expressions for consumption, saving, and bequests and consequently obtain the corresponding indirect utility function, which is given by:

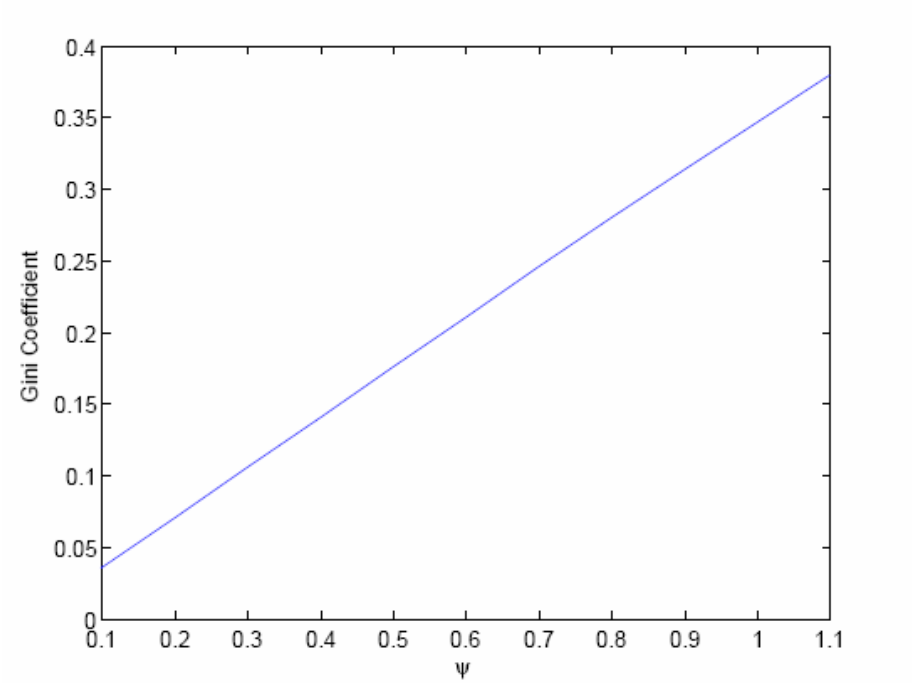
$$V(\phi, e_t) = (1+\beta)\log\left((1-\tau)w_t\lambda_h\left[e_t(1-\phi)g_t + 1\right]^{\psi}\right) + \beta\log(\phi g_t) \quad (12)$$

Maximizing with respect to ϕ and manipulating the first order condition we get:

$$\phi^* = \frac{\beta}{\psi(1+\beta)+\beta} \quad (13)$$

In this case, the proportion spent on environment is unrelated to inequality as characterized by the parameter ν in Model 1, or, for that matter any other characterization of inequality. However, this proportion will be correlated negatively with inequality, since larger values of the parameter ψ cause greater inequality in the income distribution of agents in this economy. This is intuitively obvious, since ψ represents the returns to human capital or ability, so it magnifies the existing inequality in the ability-endowment. We illustrate this correlation using numerical experiments, which are summarized in Figure 1, which plots the Gini coefficient of the resulting income distribution for different values of ψ.[3]

[3] The underlying distribution of ability is held constant for all values of ψ. In order to construct the ability distribution we draw a random sample of 501 values from a lognormal distribution with mean 3.7 and standard deviation 0.6. we then normalize by dividing all values by the largest value in the sample. For a given value of ϕ, the amount of revenue devoted to education is determined as a fixed point. That is, for given initial guess for the amount spent on the public good, incomes are affected which in turn impacts on the tax revenue raised, which impacts on the amount spent on the public good. We repeat this process for each ϕ until there is convergence in the tax revenue raised.



The discussion above has interesting implications for empirical research: one could find a negative correlation between inequality and the proportion spent on environment in the data, even if a relationship of this type did not, in actual fact, exist. Researchers finding such a correlation would then have to interpret their results with caution.

The intuition underlying the negative relationship between the parameter ψ and the proportion spent on the environment is as follows. For a given value of ϕ, the amount of revenue spent on either public good is a constant, and essentially causes a parallel shift in the human capital production function, and the utility function of all agents. For large values of ψ the shift in the production function may amount to a greater benefit in terms of utility than the direct shift of the utility function caused by increasing ϕ. While the increase in ψ does increase inequality, agents may be better off in an absolute sense due to the increase in incomes at all levels. Also, unlike the previous model, changes in ϕ (while holding ψ constant) do not have any impact on inequality.

4. Concluding Remarks

In this paper we explored the issue of public spending on alternative mechanisms of redistribution. The political economy models analyzed here suggest that the link between inequality and redistribution depends on the nature of the mechanism relative to the alternatives that are available. We find that, in the presence of higher inequality, a median voter faced with the choice of the proportion of expenditure between two mechanisms is likely to choose in favour of public goods that are more efficient mechanisms of redistribution.

The analysis suggests that the existence of a positive or a negative correlation between individual mechanisms of redistribution is contingent on the menu of choices that are available. Indirectly, this also implies that "pure" public goods may not be the preferred mechanism of distribution due to the "uniformity" of benefits associated with them. One may also speculate that public goods with some degree of exclusion and rivalry in consumption would be preferred if the groups "excluded" constitute richer segments of society. The opposite would be true if the public good benefited

the rich to a greater extent than the poor. Furthermore institutional features of economies are likely to determine the excludability of various types of public goods, and consequently their efficiency as mechanisms of redistribution. Any empirical research that finds a negative or positive correlation between inequality and redistribution must therefore be interpreted with caution.

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