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Altruistic Redistribution and Strategic Deficit

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Abstract:

Most strategic deficit models neglect the role of redistribution. Few models regard redistribution, but only in a purely egoistic way. In the two period model here, both egoistic and altruistic motifs for redistribution are considered. Voters differ with regard to their pre-tax earnings. Each voter's earnings are a mixture of fair (or deserved) and unfair (or undeserved) components. Each voter likes to have high earnings for himself, but dislikes an unfair income distribution among society as a whole. In both periods they vote on the tax and redistribution policy and additionally on the budget balance in the first period. The first period voting outcome is analyzed under different scenarios, i. e. intertemporal changes of median voter income as well as of the variance of unfair earnings are regarded. Numerical examples show that the sign of the budget balance depends both on strategic / egoistic and altruistic motifs.

Keywords: budget deficit, public debt, median voter, redistribution

JEL: H23, H62, H63

1. Introduction

Strategic debt models like those of Alesina and Tabellini (1989), Persson and Svensson (1989) and Tabellini und Alesina (1990) try to explain budget deficits as a result of a Stackelberg game between succeeding governments. A common feature of those two period models is that different parties have different preferences for the size or the composition of public consumption. The government in office during the first period foresees that it may be out of office in the second period. Then it can have an incentive to use debt as a strategic tool in order to influence its successor's spending decisions or in order to transfer resources to the first period.

However those models neglect the important role of redistribution in the budgetary process. Martimort (2001) develops a model in which parties have different exogenous preferences for redistribution. In Siebel (2007) those preferences are endogenized by using a median voter model. Those papers regard the budget balance as a channel to influence redistributive policies in the second period.

In the approach here redistribution also plays a central role. Voters differ with regard to their pre-tax earnings. Each voter's earnings comprise a 'fair' or 'deserved' part, equalizing the voter's marginal productivity and an 'unfair' or 'undeserved' part, owed to luck/bad luck or crime, corruption etc.. The distributions of 'fair' and 'unfair' earnings among the population are uncorrelated. Each voter has a positive marginal utility from his own earnings, regardless of the mixture of 'fair' or 'unfair' components. However, each voter also dislikes an 'unfair' distribution of earnings among society as a whole.

In both periods voters decide on the linear tax rate and the size of redistribution via social transfers. In contrast to purely 'egoistic' redistribution in the well-known median voter models of Romer (1975), Roberts (1977) and Cukierman and Meltzer (1989) voters regard redistribution also as a means to dampen the harmful effects of an unfair pre-tax income distribution. Hence redistribution here is also altruistically motivated in the sense of Alesina and Angeletos (2005).

In the first period voters also decide on the budget deficit or surplus to be left to the second period. They know that the budget has to be rebalanced at the end of the second period.

Similar anti-deficit rules nowadays exist in many western democracies, especially on federal level.

It turns out that the deficit chosen in the first period depends on intertemporal changes in the income distribution. The intertemporal change of the median voter income makes the budget deficit c. p. decline whereas an increasing variance in the distribution of unfair earnings causes the budget deficit to increase.

A crucial feature of all strategic debt models is the assumption, that the budget has to be rebalanced at the end of the second period. In recent days, such restrictions on budget deficits can be observed in several western democracies. Currently all U. S. states except Vermont face some kind of balanced budget requirement (Rose, 2006). Empirical research by Bohn and Inman (1996) shows that stringent balanced budget rules have a significant influence on public spending in certain U. S. states. See also Poterba (1996). In Canada, 6 of 10 provinces have anti-deficit laws. Even in provinces with less stringent laws, expenditures must not exceed revenues over a period of several years (Millar, 1997 or Tellier and Imbeau, 2004). Another kind of budget restriction is the Maastricht treaty, which gives a strict ceiling for public debt (60 per cent of GDP) within EU countries. Hence this paper shows that such restrictions do not prevent governments from running a deficit as long as the succeeding government will be held responsible for rebalancing the budget.

This paper is organized as follows: In chapter 2.1 the basic assumptions are outlined, describing both individual behavior and the given constraints. Chapters 2.2 and 2.3 show voting behavior for both periods. In chapter 3 possible budgetary outcomes are analyzed for certain numerical examples. Chapter 4 concludes.

2. The model

2.1 Basic assumptions

Private utility of agent j in period $i = 1, 2$ is given by the quadratic function $V^i\left(x_i^j\right) = -\left(x_i^j\right)^2 + 2 \cdot \beta \cdot x_i^j$, with $x_i^j \geq 0$ being individual private consumption and β being a parameter measuring the relative preference for individual consumption. In order to ensure that all values of x_i^j, solving the model are on the increasing side of the parabola, $x_i^j < \beta$ has to be imposed as a necessary condition.

Each agent faces a budget constraint. According to his budget constraint, consumption cannot exceed the agent's income, composed of after tax earnings and grants from redistribution.

Agent *j*'s earnings are denoted y_i^j and comprise two different sources: The first one is labor income e^j, depending on agent j's individual qualification and the hours worked[1]. e^j can be interpreted as the 'deserved' part of income. Additionally, a second part of the income is supposed to be 'undeserved', depending on factor like luck / bad luck or social harmful activities like corruption etc.. The undeserved part of income ('luck') shall be denoted by η_i^j .

(1a) $y_i^j := e_i^j + \eta_i^j$

If $\eta_i^j > 0\,(<0)$, the agent earns more (less) than deserved. In order to avoid the extreme case of negative pre-tax earnings, we assume that $\eta_i^j \geq -e^j$ for all *j*. Furthermore it shall be assumed that

(1b) $Cov\left(e^j, \eta_i^j\right) = 0$

As $t_i \in [0,1]$ is the linear tax rate and $f_i \geq 0$ redistributive grants in period *i*, the individual budget constraint reads

(2) $x_i^j = (1-t_i)\cdot y_i^j + f_i$,.

Additionally to his private consumption, each agent cares about a 'fair' distribution of income in society. More precisely, agent *j* has an aversion against an unfair distribution. His disutility from unfair distribution reads[2]

(3a) $S^i\left(e^j, \eta_i^j, t_i,\ f_i\right) = -\int\limits_0^\infty \left[(1-t_i)\cdot\left(e^j + \eta_i^j\right) + f_i - (1-t_i)\cdot e^j\right]^2 h(j)\,dj$,

[1] In this early version of the paper we have no consumption-leisure trade off.
[2] To simplify things it shall be assumed that the number of agents is normalized to 1.

which is the aggregate quadratic difference between private consumption based on fair earnings and private consumption based on unfair earnings, corrected by redistribution. The use of a quadratic loss function ensures, that agents both dislike earnings which are considered too high or too low [schrecklich]. It immediately applies, that (3a) can be simplified to

(3b) $\bar{S}^i\left(\eta_i^j, t_i,\ f_i\right) = -\int_0^{\infty}\left[\left(1-t_i\right)\cdot\eta_i^j + f_i\right]^2 dH^i\left(\eta_i^j\right)$

In order to further analyze (3b), we have to regard the government's budget constraint. In each period redistribution has to equal tax revenues corrected by the budget balance, denoted b. The first period government can borrow $\left(b>0\right)$ or lend $\left(b<0\right)$ on a foreign capital market with the qualification that the funds borrowed by the government of period 1 have to be paid back or that the public savings from running a budget surplus in the first period need to be spent in the second period. Hence the government's budget constraint in period $i=1,2$ is $f_i = \int_0^{\infty} t_i\cdot y_i^j dH\left(y_i^j\right) - \left(-1\right)^i\cdot b$. After some transformations it turns into $f_i = t_i\cdot\bar{y}_i - \left(-1\right)^i\cdot b$. $\bar{y}_i = \bar{e}_i + \bar{\eta}_i$ is mean pre-tax earnings, $\bar{e}_i$ is mean labor income and $\bar{\eta}_i$ is mean luck. In order to simplify algebra, it shall be assumed, that $\bar{\eta}_1 = \bar{\eta}_2 = 0$, so that the government budget constraint in period *i* finally reads

(4) $f_i = t_i\cdot\bar{e}_i - \left(-1\right)^i\cdot b$

Therefore agent j's disutility from unfair income distribution can be rewritten as $\hat{S}^i\left(\eta_i^j, t_i, \bar{e}_i, b_i\right) = -\int_0^{\infty}\left[\left(1-t_i\right)\cdot\eta_i^j + t_i\cdot\bar{e}_i - \left(-1\right)^i\cdot b\right]^2 dH^i\left(\eta_i^j\right)$ and further as

(5) $\hat{S}^i\left(\sigma_{\eta_i}^2, t_i, \bar{e}_i, b\right) = -\left[\left(1-t_i\right)^2\cdot\sigma_{\eta_i}^2 + t_i^2\cdot\bar{e}_i^2 - \left(-1\right)^i\cdot 2\cdot t_i\cdot\bar{e}_i^2\cdot b + b^2\right]$,

where $\sigma_{\eta_i}^2$ is the variance of luck in period *i* (See appendix).

Combining (2) and (4) and defining $x_i^j := X^{ij}\left(t_i, y_i^j, \overline{e}_i, b\right) = \left(1-t_i\right)\cdot y_i^j + t_i \cdot \overline{e}_i - \left(-1\right)^i \cdot b$, we get agent *j*'s indirect utility[3] from private consumption in period i:

(6) $\hat{V}^i\left(t_i, y_i^j, \overline{e}_i, b\right) = -\left[X^{ij}\left(t_i, y_i^j, \overline{e}_i, b\right)\right]^2 + 2\cdot\beta\cdot\left[X^{ij}\left(t_i, y_i^j, \overline{e}_i, b\right)\right]$

At the beginning of each period an election is held. Each agent has the opportunity to vote on a tax and redistribution policy that is in his best interest. However, some agent's may abstain from voting, and $\Phi^i\left(y^j\right) \leq H^i\left(y^j\right) \quad \forall y^j$ should be supposed to be the distribution of voters in period i. We assume that both the distribution of income as well of voters can intertemporal change, i. e. $H^1\left(y^j\right) \neq H^2\left(y^j\right)$ and $\Phi^1\left(y^j\right) \neq \Phi^2\left(y^j\right)$ are feasible.

2.2 The second period

In this paper we deal with a Stackelberg game: First period policy may try to influence second period policy's decisions on redistribution. Hence the behavior of second period agents has to be analyzed first.

At the beginning of the second period a government is voted via majority voting. At least some of the agents engage in voting. As mentioned above, $H^2\left(y^j\right)$ is the income distribution of all agents and $\Phi^2\left(y^j\right)$ is the distribution of voters.

We examine the behavior of a voter with income e^j who votes on the tax rate by combining (5) and (6) for $i=2$:

$$(7)\ \max_{t_2} W^2\left(t_2, y_2^j, \overline{e}_2, \sigma_{\eta_2}^2, b\right) = \hat{V}^2\left(t_2, y_2^j, \overline{e}_2, b\right) + \hat{S}^2\left(\sigma_{\eta_2}^2, t_2, \overline{e}_2, b\right)$$
$$= -\left[\left(1-t_2\right)\cdot y_2^j + t_2\cdot\overline{e}_2 - b\right]^2 + 2\cdot\beta\cdot\left[\left(1-t_2\right)\cdot y_2^j + t_2\cdot\overline{e}_2 - b\right]$$
$$+\left(1-t_2\right)^2\cdot\sigma_{\eta_2}^2 + t_2^2\cdot\overline{e}_2^2 - 2\cdot t_2\cdot\overline{e}_2^2\cdot b + b^2.$$

From the first order condition we get the optimal tax rate $t_2 =: T^2\left(y_2^j, b, \beta, \overline{e}_2, \sigma_{\eta_2}^2\right) = \dfrac{\left(y_2^j\right)^2 + \left(2\cdot b+\beta\right)\cdot\overline{e}_2 - y_2^j\cdot\left(b+\beta+\overline{e}_2\right) + \sigma_{\eta_2}^2}{\left(y_2^j\right)^2 - 2\cdot y_2^j\cdot\overline{e}_2 + 2\cdot\overline{e}_2^2 + \sigma_{\eta_2}^2}$. This optimal tax rate

[3] Note that $\left(1-t_i\right)\cdot y_i^j + t_i\cdot\overline{e}_i - \left(-1\right)^i\cdot b < \beta$ must be fulfilled.

is strictly increasing in the inherited deficit b, as long as $y_2^j > 2 \cdot \overline{e}_2$ is fulfilled i. e. as long as the voter earns less than twice the mean of fair income.

As $W^2_{t_2 t_2}\left(t_2, y_2^j, \overline{e}_2, \sigma^2_{\eta_2}, b\right) = -2 \cdot \left[\left(y_2^j - \overline{e}_2\right)^2 + \overline{e}_2 + \sigma^2_{\eta_2}\right] < 0$ the second order condition is fulfilled. Assume that a voter with income y_2^m is the decisive voter, whose desired tax and redistribution policy is fulfilled[4] and is given by

$$(8)\ t_2 =: T^2\left(y_2^m, b, \beta, \overline{e}_2, \sigma^2_{\eta_2}\right) = \frac{\left(y_2^m\right)^2 + \left(2 \cdot b + \beta\right) \cdot \overline{e}_2 - y_2^m \cdot \left(b + \beta + \overline{e}_2\right) + \sigma^2_{\eta_2}}{\left(y_2^m\right)^2 - 2 \cdot y_2^m \cdot \overline{e}_2 + 2 \cdot \overline{e}_2^2 + \sigma^2_{\eta_2}}.$$

The functional relationships between private and public variables ((2), (4) and (8)) as well as between public variables and the decisive voter preferences and inherited debt ensure that agent j's private consumption can be expressed as a function

$$\begin{aligned} x_2^j := \overline{X}^{2j}\left(y_2^j, y_2^m, \overline{e}_2, b, \beta, \sigma^2_{\eta_2}\right) &= \left[1 - T^2\left(y_2^m, b, \beta, \overline{e}_2, \sigma^2_{\eta_2}\right)\right] \cdot y_2^j + T^2\left(y_2^m, b, \beta, \overline{e}_2, \sigma^2_{\eta_2}\right) \cdot \overline{e}_2 - b \\ &= \left(1 - \frac{\left(y_2^m\right)^2 + \left(2 \cdot b + \beta\right) \cdot \overline{e}_2 - y_2^m \cdot \left(b + \beta + \overline{e}_2\right) + \sigma^2_{\eta_2}}{\left(y_2^m\right)^2 - 2 \cdot y_2^m \cdot \overline{e}_2 + 2 \cdot \overline{e}_2^2 + \sigma^2_{\eta_2}}\right) \cdot y_2^j \\ &\quad + \frac{\left(y_2^m\right)^2 + \left(2 \cdot b + \beta\right) \cdot \overline{e}_2 - y_2^m \cdot \left(b + \beta + \overline{e}_2\right) + \sigma^2_{\eta_2}}{\left(y_2^m\right)^2 - 2 \cdot y_2^m \cdot \overline{e}_2 + 2 \cdot \overline{e}_2^2 + \sigma^2_{\eta_2}} \cdot \overline{e}_2 - b, \end{aligned}$$

while the disutility from an unfair income distribution is

$$\begin{aligned} \overline{S}^2\left(\sigma^2_{\eta_2}, y_2^m, \overline{e}_2, b, \beta\right) = -\Big\{ &\left[1 - T^2\left(y_2^m, b, \beta, \overline{e}_2, \sigma^2_{\eta_2}\right)\right]^2 \cdot \sigma^2_{\eta_2} + \left[T^2\left(y_2^m, b, \beta, \overline{e}_2, \sigma^2_{\eta_2}\right)\right]^2 \cdot \overline{e}_2^2 \\ &- 2 \cdot T^2\left(y_2^m, b, \beta, \overline{e}_2, \sigma^2_{\eta_2}\right) \cdot \overline{e}_2^2 \cdot b + b^2 \Big\}. \end{aligned}$$

[4] In this early version of the paper, I declare one voter to be the 'decisive' voter in an ad hoc way. In order to derive a median voter result, I have to check whether there is a strictly monotone correlation between each voter's income and his desired tax rate. The median voter with income y_2^m would then be defined by $\Phi\left(y_2^m\right) = \int_0^{y_2^m} y^j d\Phi\left(y^j\right) = \frac{1}{2} \cdot \int_0^{\infty} y^j d\Phi\left(y^j\right) \le \frac{1}{2}$.

2.3 The first period

At the beginning of the first period a majority vote takes place and each voter decides on the tax rate which serves his interests best. We already know that private consumption in the first period is given by (2) for *i*=1. Invoking (3a) and (6) voter j 's calculus is

$$(9)\ \max_{t_1} W^1\left(t_1, y_1^j, \overline{e}_1, \sigma_{\eta_1}^2, b\right)=\hat{V}^1\left(t_1, y_1^j, \overline{e}_1, b\right)+\hat{S}^1\left(\sigma_{\eta_1}^2, t_1, \overline{e}_1, b\right)=$$

$$-\left[\left(1-t_1\right)\cdot y_1^j+t_1\cdot\overline{e}_1+b\right]^2+2\cdot\beta\cdot\left[\left(1-t_1\right)\cdot y_1^j+t_1\cdot\overline{e}_1+b\right]$$
$$+\left(1-t_1\right)^2\cdot\sigma_{\eta_1}^2+t_1^2\cdot\overline{e}_1^2+2\cdot t_1\cdot\overline{e}_1^2\cdot b+b^2.$$

The first order condition delivers the optimal tax rate:

$$t_1=:T^1\left(y_1^j, b, \beta, \overline{e}_1, \sigma_{\eta_1}^2\right)=\frac{\left(y_1^j\right)^2-\left(2\cdot b-\beta\right)\cdot\overline{e}_1+y_1^j\cdot\left(b-\beta-\overline{e}_1\right)+\sigma_{\eta_1}^2}{\left(y_1^j\right)^2-2\cdot y_1^j\cdot\overline{e}_1+2\cdot\overline{e}_1^2+\sigma_{\eta_1}^2}.$$

This optimal tax rate is strictly decreasing in the deficit, as long as $y_1^j<2\cdot\overline{e}_1$ is fulfilled i. e. as long as the voting agent earns less than twice the mean of fair income.

As $W_{t_1t_1}^1\left(t_1, y_1^j, \overline{e}_1, \sigma_{\eta_1}^2, b\right)=-2\cdot\left[\left(y_1^j-\overline{e}_1\right)^2+\overline{e}_1+\sigma_{\eta_1}^2\right]<0$ the second order condition is fulfilled. A voter with income y_1^m is the decisive voter, whose desired tax and redistribution policy is fulfilled (See footnote 4):

$$(10)\ t_1=:T^1\left(y_1^m, b, \beta, \overline{e}_1, \sigma_{\eta_1}^2\right)=\frac{\left(y_1^m\right)^2-\left(2\cdot b-\beta\right)\cdot\overline{e}_1+y_1^m\cdot\left(b-\beta-\overline{e}_1\right)+\sigma_{\eta_1}^2}{\left(y_1^m\right)^2-2\cdot y_1^m\cdot\overline{e}_1+2\cdot\overline{e}_1^2+\sigma_{\eta_1}^2},$$

Hence private consumption of agent *j* in the first period is

$$x_1^j:=\overline{X}^{1j}\left(y_1^j, y_1^m, \overline{e}_1, b, \beta, \sigma_{\eta_1}^2\right)=\left[1-T^1\left(y_1^m, b, \beta, \overline{e}_1, \sigma_{\eta_1}^2\right)\right]\cdot y_1^j+T^1\left(y_1^m, b, \beta, \overline{e}_1, \sigma_{\eta_1}^2\right)\cdot\overline{e}_1+b$$
$$=\left(1-\frac{\left(y_1^m\right)^2-\left(2\cdot b-\beta\right)\cdot\overline{e}_1+y_1^m\cdot\left(b-\beta-\overline{e}_1\right)+\sigma_{\eta_1}^2}{\left(y_1^m\right)^2-2\cdot y_1^m\cdot\overline{e}_1+2\cdot\overline{e}_1^2+\sigma_{\eta_1}^2}\right)\cdot y_1^j$$
$$+\frac{\left(y_1^m\right)^2-\left(2\cdot b-\beta\right)\cdot\overline{e}_1+y_1^m\cdot\left(b-\beta-\overline{e}_1\right)+\sigma_{\eta_1}^2}{\left(y_1^m\right)^2-2\cdot y_1^m\cdot\overline{e}_1+2\cdot\overline{e}_1^2+\sigma_{\eta_1}^2}\cdot\overline{e}_1+b$$

and

$$\overline{S}^1\left(\sigma_{\eta_1}^2, y_1^m, \overline{e}_1, b, \beta\right) = -\Big\{\left[1 - T^1\left(y_1^m, b, \beta, \overline{e}_1, \sigma_{\eta_1}^2\right)\right]^2 \cdot \sigma_{\eta_1}^2 + \left[T^1\left(y_1^m, b, \beta, \overline{e}_1, \sigma_{\eta_1}^2\right)\right]^2 \cdot \overline{e}_1^2$$
$$+ 2 \cdot T^1\left(y_1^m, b, \beta, \overline{e}_1, \sigma_{\eta_1}^2\right) \cdot \overline{e}_1^2 \cdot b + b^2\Big\}$$

is disutility from an unfair income distribution, which is the same among all agents.

It shows that utility from both periods is a strictly monotone transformation of the value of the budget balance. In deciding on the tax and redistribution policy, the first period decisive voter also decides on the budget balance, whereas the second period decisive voter can just decide on his best reaction. Assume that the first period decisive voter perfectly foresees both the income of his successor and the properties of second period's (fair and unfair) income distribution. In order to choose the optimal value of the budget balance b he maximizes his indirect intertemporal utility function:

(11) $$\max_b W\left(y_1^m, y_2^m, \overline{e}_1, \overline{e}_2, b, \beta, \sigma_{\eta_1}^2, \sigma_{\eta_2}^2\right) :=$$
$$-\left[\overline{X}^{1m}\left(y_1^m, \overline{e}_1, b, \beta, \sigma_{\eta_1}^2\right)\right]^2 + 2 \cdot \beta \cdot \overline{X}^{1m}\left(y_1^m, \overline{e}_1, b, \beta, \sigma_{\eta_1}^2\right) + \overline{S}^1\left(\sigma_{\eta_1}^2, y_1^m, \overline{e}_1, b, \beta\right)$$
$$-\left[\overline{X}^{2m}\left(y_1^m, y_2^m, \overline{e}_2, b, \beta, \sigma_{\eta_2}^2\right)\right]^2 - 2 \cdot \beta \cdot \overline{X}^{2m}\left(y_1^m, y_2^m, \overline{e}_2, b, \beta, \sigma_{\eta_2}^2\right) + \overline{S}^2\left(\sigma_{\eta_2}^2, y_2^m, \overline{e}_2, b, \beta\right).$$

The first order condition

$$W_b\left(y_1^m, y_2^m, \overline{e}_1, \overline{e}_2, b, \beta, \sigma_{\eta_1}^2, \sigma_{\eta_2}^2\right) =$$
$$-2 \cdot \overline{X}^{1m}\left(y_1^m, \overline{e}_1, b, \beta, \sigma_{\eta_1}^2\right) \cdot \overline{X}_b^{1m}\left(y_1^m, \overline{e}_1, b, \beta, \sigma_{\eta_1}^2\right) + 2 \cdot \beta \cdot \overline{X}_b^{1m}\left(y_1^m, \overline{e}_1, b, \beta, \sigma_{\eta_1}^2\right)$$
$$+ \overline{S}_b^1\left(\sigma_{\eta_1}^2, y_1^m, \overline{e}_1, b, \beta\right) - 2 \cdot \overline{X}^{2m}\left(y_1^m, y_2^m, \overline{e}_2, b, \beta, \sigma_{\eta_2}^2\right) \cdot \overline{X}_b^{2m}\left(y_1^m, y_2^m, \overline{e}_2, b, \beta, \sigma_{\eta_2}^2\right)$$
$$+ 2 \cdot \beta \cdot \overline{X}_b^{2m}\left(y_1^m, y_2^m, \overline{e}_2, b, \beta, \sigma_{\eta_2}^2\right) + \overline{S}_b^2\left(\sigma_{\eta_2}^2, y_2^m, \overline{e}_2, b, \beta\right) = 0$$

delivers the optimal budget balance

(12) $$b^m =: B\left(y_1^m, y_2^m, \overline{e}_1, \overline{e}_2, \beta, \sigma_{\eta_1}^2, \sigma_{\eta_2}^2\right) =$$
$$\frac{A\left(y_1^m, \overline{e}_1, \overline{e}_2, \beta, \sigma_{\eta_1}^2\right) - C\left(y_1^m, y_2^m, \overline{e}_2, \beta, \sigma_{\eta_2}^2\right) + D\left(y_1^m, y_2^m, \overline{e}_2, \beta, \sigma_{\eta_2}^2\right)}{E\left(y_1^m, y_2^m, \overline{e}_1, \overline{e}_2, \sigma_{\eta_1}^2, \sigma_{\eta_2}^2\right)}$$

with

$$A\left(y_1^m, \overline{e}_1, \overline{e}_2, \beta, \sigma_{\eta_1}^2\right) := \frac{2\cdot\left[2\cdot\overline{e}_1^2\cdot\left(\beta-2\cdot\overline{e}_2\right)+\left(y_1^m\right)^2\cdot\left(\beta+\overline{e}_1-2\cdot\overline{e}_2\right)+y_1^m\cdot\overline{e}_1\cdot\left(4\cdot\overline{e}_2-3\cdot\beta\right)+2\cdot\left(\overline{e}_1-\overline{e}_2\right)\cdot\sigma_{\eta_1}^2\right]}{\left(y_1^m\right)^2-2\cdot y_1^m\cdot\overline{e}_1+2\cdot\overline{e}_1^2+\sigma_{\eta_1}^2},$$

$$C\left(y_1^m, y_2^m, \overline{e}_2, \beta, \sigma_{\eta_2}^2\right) := \frac{2\cdot\left(y_1^m-y_2^m\right)\cdot\left(y_2^m-2\cdot\overline{e}_2\right)\cdot\left(y_1^m+y_2^m-2\cdot\overline{e}_2\right)\cdot\left[\left(\beta-2\cdot\overline{e}_2\right)\cdot\overline{e}_2+y_2^m\cdot\left(\overline{e}_2-\beta\right)\right]}{\left[\left(y_2^m\right)^2-2\cdot y_2^m\cdot\overline{e}_2+2\cdot\overline{e}_2^2+\sigma_{\eta_2}^2\right]^2},$$

$$D\left(y_1^m, y_2^m, \overline{e}_2, \beta, \sigma_{\eta_2}^2\right) := \frac{2\cdot\left[\left(y_2^m\right)^2\cdot\left(\beta-\overline{e}_2\right)-2\cdot\left(\beta-2\cdot\overline{e}_2\right)\cdot\overline{e}_2^2+y_1^m\cdot\left(2\cdot y_2^m\cdot\left(\overline{e}_2-\beta\right)+\left(3\cdot\beta-4\cdot\overline{e}_2\right)\cdot\overline{e}_2\right)\right]}{\left(y_2^m\right)^2-2\cdot y_2^m\cdot\overline{e}_2+2\cdot\overline{e}_2^2+\sigma_{\eta_2}^2}$$

and

$$E\left(y_1^m, y_2^m, \overline{e}_1, \overline{e}_2, \sigma_{\eta_1}^2, \sigma_{\eta_2}^2\right) := 2\cdot\left[\frac{\left(y_1^m-2\cdot\overline{e}_1\right)^2}{\left(y_1^m\right)^2-2\cdot y_1^m\cdot\overline{e}_1+2\cdot\overline{e}_1^2+\sigma_{\eta_1}^2}-\frac{\left(y_1^m-y_2^m\right)\cdot\left(y_2^m-2\cdot\overline{e}_2\right)^2\cdot\left(y_1^m+y_2^m-2\cdot\overline{e}_2\right)}{\left[\left(y_2^m\right)^2-2\cdot y_2^m\cdot\overline{e}_2+2\cdot\overline{e}_2^2+\sigma_{\eta_2}^2\right]^2}\right.$$
$$\left.+\frac{\left(2\cdot y_1^m-y_2^m-2\cdot\overline{e}_2\right)\cdot\left(y_2^m-2\cdot\overline{e}_2\right)}{\left(y_2^m\right)^2-2\cdot y_2^m\cdot\overline{e}_2+2\cdot\overline{e}_2^2+\sigma_{\eta_2}^2}-4\right].$$

3. Numerical examples

In order to derive further results about the budgetary outcome some numerical examples will be computed.

First we analyze, what happens when all parameters with exception of the median voter income change, i. e. $\overline{e}_1 = \overline{e}_2$ and $\sigma_{\eta_1}^2 = \sigma_{\eta_2}^2$. In this case (12) turns into

$$b^m =: B\left(y_1^m, y_2^m, \overline{e}_1, \beta, \sigma_{\eta_1}^2\right) =$$
$$=$$

Setting $\overline{e}_1 = 1$, $\sigma_{\eta_1}^2 = 1$ and $\beta = 2$, we can derive the result, that $b^m = 0$, if $y_1^m = y_2^m$ and $b^m < 0$, if $y_1^m \neq y_2^m$.

[to be continued]

Next regard the case, when all parameters expect the variance of unfair earnings change between the two periods. We set $\overline{e}_1 = \overline{e}_2$ and $y_1^m = y_2^m$ and from (12) we get

$$b^m =: B\left(y_1^m, \overline{e}_1, \beta, \sigma_{\eta_1}^2, \sigma_{\eta_2}^2\right) =$$
$$=$$

Setting $\overline{e}_1 = 1$, $y_1^m = 1$ and $\beta = 2$ delivers

$$b^m =: B\left(1, 1, 2, \sigma_{\eta_1}^2, \sigma_{\eta_2}^2\right) = \frac{\sigma_{\eta_2}^2 - \sigma_{\eta_1}^2}{2 + 3 \cdot \sigma_{\eta_2}^2 + \sigma_{\eta_1}^2 \cdot \left(3 + 4 \cdot \sigma_{\eta_2}^2\right)}.$$

Clearly, we have $sign\left\{B\left(1, 1, 2, \sigma_{\eta_1}^2, \sigma_{\eta_2}^2\right)\right\} = sign\left\{\sigma_{\eta_2}^2 - \sigma_{\eta_1}^2\right\}$.

There is a budget deficit (surplus) if the variance of unfair earnings in the second period is larger (smaller) than in the first period. Consider the case of a deficit first. The first period decisive voter knows that the income distribution will be more unfair in the next period. Leaving a deficit forces his successor to demand higher taxes. Then agents with higher unfair earnings will have to share a higher extra burden of taxation.

[to be continued]

4. Conclusions

This paper analyzes the role of income distribution in a two period Stackelberg game with budget deficit as political control variable.

[to be continued]

Appendix

[Still to come]

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