Distributional Conflict in Small Open Economies

Andreas Schäfer (University of Leipzig)

Thomas Steger (University of Leipzig and CESifo Munich)[‡]

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We aim at a better understanding of the inefficiencies resulting from distributional conflict in small open economies. To this end, a general equilibrium model with the following characteristics is set up: two groups of agents (capitalists and workers), an endogenous income tax, productive government expenditures, social transfers, and an outside option for capital. The overall distributional-conflict inefficiency is decomposed into three components: (i) a fundamental time inconsistency problem; (ii) strategic interaction in the political process; (iii) heterogeneity among individuals and the resulting unavoidable conflict of interest. A numerical exercise (based on OECD data) indicates that the distributional-conflict inefficiency may cause a substantial output loss.

Keywords: Distributional Conflict; Time Inconsistency; Strategic Interaction; Heterogeneity.

JEL: E6; H2; O4.

[‡]University of Leipzig; CESifo, Munich. Corresponding author: University of Leipzig, Institute for Theoretical Economics, Grimmaische Strasse 12, D-04109 Leipzig, Tel: +49 (0)341-9733541, Fax: +49 (0)341-9733549, Email: steger@wifa.uni-leipzig.de.

1 Introduction

Conflict over the distribution of resources (i.e. "distributional conflict") is an unavoidable characteristic of every market economy. We believe that the way this conflict is carried out has first-order implications for economic efficiency and social welfare. Much research has recently been devoted to less developed economies which are characterized by imperfect property rights (e.g. Benhabib and Rustichini, 1996; Strulik, 2005; Gonzalez and Neary, 2005). But even in developed economies with perfect property rights fundamental distributional conflicts prevail. These conflicts are typically carried out via the political process. The probably most important channel consists in the manipulation of the tax and expenditure system by major interest groups in their favor.[1]

We aim at a better understanding of the sources and consequences of distributional conflict in small open economies. To this end, a simple general equilibrium model is set up that captures the major characteristics of modern economies, relevant for the analysis of distributional conflicts, i.e. two groups of agents (capitalists and workers), an endogenous income tax, productive government expenditures, social transfers, and an outside option for capital. We use this model to investigate the macroeconomic consequences of distributional conflicts.

The paper at hand contributes to the literature on the macroeconomic consequences

[1] There are, of course, other channels like the implementation of regulations to the advantage of specific groups. More generally, a number of real-world institutions are designed and implemented to favor specific groups in society.

of distributional conflicts along three dimensions:

First, the political mechanism employed in this paper deviates from the most commonly used political mechanism, i.e. the median voter principle. This is not to say that the median voter principle is an invalid description of political processes. However, real-world political processes are also characterized by a country's specific political institutions, its political culture, and especially by the degree of organization of major interest groups.[2] The political mechanism employed in this paper is consistent with the strong positive correlation between unionization rates and average tax rates across OECD economies, as displayed by Figure 1 below. In addition, it gives rise to a richer set of implications, i.e. the political equilibrium belongs to one of three regimes ("dominance of capitalists", "dominance of workers", "no group dominates"). A further advantage is that we can easily distinguish between the presence and the absence of strategic interaction in the political sphere.

Second, the analysis shows that the decentralized equilibrium is generally inefficient; the decentralized tax rate can be either too high or too low. This implies that it is not in general one group which can be held responsible for an inefficient tax rate. The distributional conflict gives rise to either "weak inefficiency" (i.e. the tax rate deviates from the first-best solution but a change in the tax rate would at least hurt one group) or "strong inefficiency" (i.e. the tax rate deviates from the first-best solution and can

[2] In the median voter model all that matters is the preference of the median voter. Moreover, when it comes to the analysis of distributional conflicts among two major groups in society, the median voter principle is less instructive since it implies that it is always the larger group that can implement its preferred policy, irrespective of the political influence of the other group.

be changed such that both groups would be better off).

Third, the main contribution of the paper lies, however, in the decomposition of the overall distributional-conflict inefficiency into three components. The first component reflects a fundamental time inconsistency problem, which is due to the fact that dominant groups are in general unable to commit to a specific policy (Acemoglu, 2003). The second component is associated with the presence of strategic interaction in the political process. The third component results from heterogeneity among individuals and the resulting unavoidable conflict of interest. A calibrated version of the model (using OECD data) is employed to demonstrate the numerical importance of distributional-conflict inefficiency. The model implies a proportional output loss of about 7 percent, which indicates that the distributional-conflict inefficiency may be quite substantial.

There is, of course, a substantial number of papers which deal with different aspects of distributional conflicts from a macroeconomic perspective. For instance, Hassler et al. (2003) employ a dynamic OLG model with endogenous redistribution, based on the median voter principle, to investigate the conditions for the "survival of the welfare state". Acemoglu (2003) argues that inefficient institutions, resulting from fundamental distributional conflicts in society, are likely to persist due to insurmountable commitment problems in the political sphere. In addition, there are three strands of well established contributions, which should be mentioned here: Romer (1975), Roberts (1977), Meltzer and Richard (1981) investigate the sources and consequences of redistribution with distortionary taxation. Kydland and Prescott (1977) and Fischer (1980) consider the time inconsistency problem in the context of capital taxation. Finally, Persson and Tabellini (1994), Alesina and Rodrick (1994), Bertola (1993) focus on the implications of distributional conflicts in a dynamic perspective. All of these papers do not, however, dig deeper into the different components of the distributional-conflict inefficiency, as they arise in every market economy.

The paper is structured as follows: Section 2 introduces the basic model, which is employed in Section 3 to develop the decentralized equilibrium. Section 4 describes the first-best solution. The different forms of distributional-conflict inefficiencies are described in Section 5. The subsequent Section 6 decomposes the overall inefficiency into three fundamental components. The model is used in Section 7 to evaluate the quantitative importance of the inefficiency. Finally, Section 8 provides a short summary and some conclusions.

2 The structure of the model

Output and factor markets are perfectly competitive. There are two types of agents, capitalists (of mass one) and workers (of mass L), who are asymmetrically affected by changes in the tax rate. Government revenues are used to finance productive government expenditures and lump-sum transfers in favor of workers. Tax revenues are collected by levying a uniform income tax on capital and labor income. The model captures a fundamental distributional conflict, namely the struggle over market income net of taxes and transfers between capitalists and workers in modern societies.

2.1 Production technology and factor prices

The output technology for the final output good Y_M exhibits constant returns to scale in private inputs:

$$Y_M = G^{\beta} K_M^{\alpha} (uL)^{1-\alpha}, \tag{1}$$

where $0 < \alpha, \beta < 1$, G denotes productive government expenditures, K_M is capital employed in the domestic market sector, $0 \leq u \leq 1$ is working time per worker, and L is "the number" of workers. Let $0 \leq \tau \leq 1$ denote the uniform tax rate levied on capital and labor income and $\alpha \leq q \leq 1$ the share of tax revenues devoted to productive government expenditures.[3] Productive government expenditures may then be expressed as $G = q\tau Y_M$. Hence, the reduced form technology, after having eliminated G, reads as follows:

$$Y_M = (q\tau)^{\frac{\beta}{1-\beta}} K_M^{\frac{\alpha}{1-\beta}} (uL)^{\frac{1-\alpha}{1-\beta}}. \tag{2}$$

Competitive factor prices can be expressed as:

$$r = \alpha (q\tau)^{\frac{\beta}{1-\beta}} K_M^{\frac{\alpha-1+\beta}{1-\beta}} (uL)^{\frac{1-\alpha}{1-\beta}} \tag{3}$$

$$w = (1-\alpha)(q\tau)^{\frac{\beta}{1-\beta}} K_M^{\frac{\alpha}{1-\beta}} (uL)^{\frac{\beta-\alpha}{1-\beta}}, \tag{4}$$

where r is the rate of return on capital and w denotes the wage rate.

[3] The restriction $\alpha \leq q$ is important since the workers' preferred tax rate would otherwise turn negative. Moreover, this restriction is likely to be satisfied empirically, see Section 7.

2.2 Capitalists and workers

Both capitalists and workers earn a competitive market income which is subject to a uniform income tax. This simplifying assumption is not at all implausible. For instance, Persson and Tabellini (2000, p. 305) notice that "in a sample of 14 OECD countries, the average effective tax rate on capital and labor were about the same (about 38 percent) over the period 1991-1995."

The typical capitalist can employ his capital stock in the domestic market sector earning a rate of return r. The resulting market income is subject to an income tax τ. Alternatively, he has the option to earn the fixed rate of return $\bar{r} > 0$ by investing abroad. Following Persson and Tabellini (1992) and Lejour and Verbon (1997) we assume that investments abroad are subject to transaction costs, which accrue each period. This might be due to transaction costs associated with foreign investments resulting from, for instance, the foreign contract law, the tax system, and foreign labor market institutions. Total investment costs of investing abroad are convex in foreign investments and given by $\varepsilon \frac{K-K_M}{K}(K-K_M)$, where $K > 0$ is the overall stock of capital owned by the typical domestic capitalist such that $K - K_M$ represents foreign investments, and $\varepsilon \geq 0$. For simplicity, we assume that the returns from foreign investments are not subject to an income tax. Income of the typical capitalist is hence given by:

$$y^K = (1-\tau)rK_M + (\bar{r} - \varepsilon \frac{K-K_M}{K})(K-K_M). \tag{5}$$

The problem of the typical capitalist then reads:[4]

$$\max_{K_M,\tau} \; y^K \quad \text{s.t.} \;\; (5), \;\; (3), \;\; \text{and} \;\; K - K_M \geq 0.$$

Notice that income is maximized by choosing K_M and τ. These decisions are made sequentially, as elaborated in Section 3.

Workers supply $0 \leq u \leq 1$ units of labor services (measured in units of time) inelastically to the market. The wage rate is denoted as w. The resulting market income is subject to an income tax τ. In addition, workers receive social transfers. The transfer per worker equals the total amount of tax revenues spent on social transfers divided by the number of workers, i.e. $(1 - q)\tau Y_M/L$. Total income of the typical worker is hence given by:

$$y^L = (1 - \tau)wu + (1 - q)\tau Y_M/L. \tag{6}$$

The problem of the typical worker is as follows:

$$\max_{\tau} \; y^L \quad \text{s.t.} \;\; (6), \;\; (4), \;\; \text{and} \;\; (2).$$

2.3 The government

The government does two things: First, it collects government revenues according the tax rate resulting from the political process. Second, it splits total tax revenues, according to the share $0 \leq q \leq 1$, into productive government expenditures G and

[4] When maximizing with respect to K_M capitalists take r as given. This changes when deciding on the optimal tax rate, as explained below.

lump-sum transfers in favor of workers Q:

$$G = q\tau Y_M$$

$$Q = (1 - q)\tau Y_M.$$

Notice that the government is assumed to run a balanced budget, i.e. $G + Q = \tau Y_M$.

2.4 The political process

Most theoretical models on distributional conflicts rely on electoral competition and the median voter principle.[5] We do not follow this route for the following reasons: First, the political tax rate determination process is likely to be affected by political culture, political institutions as well as the degree of organization of major interest groups. For instance, empirical data show that there is a strong positive correlation between unionization rates and average tax rates across OECD economies; see Figure 1 below. This simple correlation indicates that the (relative) strength of major interest groups is likely to affect the political outcome. The political mechanism employed in this paper is consistent with this observation. Second, we think that one should not rule out the presence of strategic interaction among major interest groups a priori.[6] The reason is that strategic interaction may act as an amplifier with respect to the equilibrium tax rate and may therefore enlarge the welfare costs of distributional conflicts (see Section 6).

[5] According to Roemer (2001, p. 3) "probably 95% of the formal literature in political economy since Downs has employed this particular specification."

[6] For a critical discussion of the Downsian model of electoral competition and the median voter principle see Roemer (2001, Chapter 1.2).

We employ a tractable shortcut formulation which allows us to take the power of major interest groups as well as the presence of strategic interaction among major interest groups into account. Specifically, it is assumed that the equilibrium tax rate can be represented as a linear combination of the demands from the two groups:

$$\tau = \theta\tau_C + (1-\theta)\tau_L, \tag{7}$$

where $0 \leq \theta \leq 1$ gives the weight of capitalists in the political process, i.e. $1-\theta$ is the weight of laborers, $0 \leq \tau_C \leq 1$ is the tax rate demanded by capitalists, and $0 \leq \tau_L \leq 1$ is the tax rate demanded by laborers. The weight parameter θ can be interpreted as capturing the political or bargaining power of capitalists, i.e. $1-\theta$ captures the power of workers. To put this modeling strategy into perspective, several remarks are at order.

(i) Instead of the linear specification (7), one could also assume that the tax rate aggregation rule is $\tau = \tau_C^{\theta}\ \tau_L^{1-\theta}$. This non-linear specification would make the model more complicated without changing the qualitative results.

(ii) A plausible alternative, consistent with the piece of evidence captured by Figure 1, is a tax bargaining setup; in analogy to wage bargaining models (Oswald, 1985). The equilibrium tax rate then results from $\max\limits_{\tau} \left(y^K\right)^{\theta} \left(y^L\right)^{1-\theta}$ s.t. (2), (3), (4), (5), and (6). The equilibrium tax rate turns out to be a non-linear function of the bargaining parameter θ.[7] The main implications remain valid, i.e. the equilibrium tax rate is bounded between the most preferred tax rates of capitalists ($\tau_{DC}^{*} = \beta$, determined

[7] This statement also holds true if the we assume that the Nash maximand is $\theta y^K + (1-\theta)\, y^L$ instead of $\left(y^K\right)^{\theta} \left(y^L\right)^{1-\theta}$.

in Section 3.1) and most preferred tax rates of workers ($\tau^*_{DL} = \frac{(\alpha-1)\beta}{\alpha-q}$, determined in Section 3.1) and it depends negatively on θ. The advantages of our specification, compared to a tax bargaining setup, is that, first, the equilibrium tax rate turns out to be a linear function of θ, second, we can easily take the presence (or the absence) of strategic interaction into account, and, third, we are able to distinguish between three political regimes (as explained in Section 3.1.3).

The presence of strategic interaction among major interest groups requires that both groups have, at least to some extent, resolved their internal coordination problem. Of course, an influential position is that of Olson (1965) who has argued that collective actions are very unlikely to occur in large groups because of inherent free rider problems. Medina (2006) argues, however, that collective action problems typically exhibit multiple equilibria, including both cooperation and non-cooperation. The solution to the collective action problem, i.e. the selection of the cooperation equilibrium, then crucially depends on common beliefs individuals have about the actions of others. Moreover, Elster (1982, p. 468) stresses repeated interactions and, in the case of workers, class consciousness as mechanisms to overcome the collective action problem.[8]

(iii) Our specification allows for a richer set of implications when compared to the median voter principle. In particular, since capital ownership is typically highly concentrated, the median voter principle would result in a decentralized tax rate equal

[8] Lancaster (1973) investigates the implications of the distributional conflict in a setting of strategic interaction between capitalists and workers. Acemoglu et al. (2006) study the process of coalition formation, employing a dynamic game framework, in political environments.

to the tax rate preferred by the typical laborer. In contrast, the tax rate aggregation rule (7) gives rise to different political regimes, which crucially depend on the parameter θ.

Our modelling of the political process shares some similarities with Becker (1983), who has presented an analysis of competition among pressure groups for political influence, which in turn is instrumental to redistribution. The similarities are as follows: (i) political decisions are the result of a competition among pressure groups, voting does not play an explicit role; (ii) politicians and bureaucrats are assumed to carry out the implications of the political equilibrium; (iii) there is strategic interaction among major interest groups. Since we focus on inefficiencies for any given political power of interest groups and not on its explanation, the key difference concerns the simplifying assumption stating that "political influence" (θ in our notation) is exogenous and not, as in Becker (1983), endogenously determined by political pressure.[9]

[9] In Becker's analysis "political pressure" depends on the amount of resources allocated to produce political pressure and other characteristics, like the size of the pressure group.

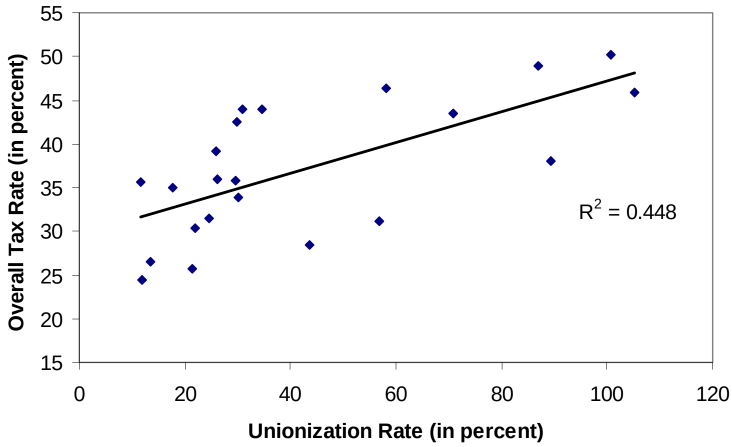

Figure 1: Tax rates and unionization rates in 2000 (OECD, 2006; ILO, 2006).

3 The decentralized equilibrium

The timing of events is as follows: (i) capitalists decide on optimal K_M; (ii) the tax rate is determined from the political process; (iii) production takes place and earnings are realized; and (iv) consumption takes place. In the case of strategic interaction among major groups, every group decides strategically, i.e. taking the aggregation rule $\tau = \theta\tau_C + (1-\theta)\tau_L$ into account. The model is solved by backward induction.

3.1 Second stage: determination of τ^*

3.1.1 Capitalists

The problem of the agent who acts on account of the group of capitalists reads:[10]

$$\max_{\tau_C} \{(1-\tau) r K_M\} \quad s.t. \quad (3) \text{ and } (7), \tag{8}$$

where we assume that $K_M > 0$, which is determined at the first stage. From the first-order condition for an interior solution, one can readily derive the interior segments of capitalists' reaction function:

$$\tau_C = \frac{\beta}{\theta} - \frac{1-\theta}{\theta}\tau_L. \tag{9}$$

Several aspects should be observed: (i) The slope of this reaction curve, which is exclusively determined by the parameter reflecting the relative importance of the two groups θ, is $\frac{\partial \tau_C}{\partial \tau_L} = -\frac{1-\theta}{\theta} < 0$; (ii) If capitalists alone could determine the tax rate, i.e. $\theta = 1$, one gets $\tau = \tau_C = \beta$, which is the Barrovian result (Barro, 1990). (iii) If the capitalist's political influence becomes negligible, i.e. $\theta \to 0$, they opt for lowest feasible tax rate such that the resulting τ still is β. Since we have imposed $\tau_C \in [0,1]$ the complete reaction function is given by:

$$\tau_C = \begin{cases} 1 & \text{for} \quad \frac{\beta}{\theta} - \frac{1-\theta}{\theta}\tau_L > 1 \\ \frac{\beta}{\theta} - \frac{1-\theta}{\theta}\tau_L & \text{for} \quad 0 \le \frac{\beta}{\theta} - \frac{1-\theta}{\theta}\tau_L \le 1 \\ 0 & \text{for} \quad \frac{\beta}{\theta} - \frac{1-\theta}{\theta}\tau_L < 0 \end{cases} . \tag{10}$$

[10] Notice that we can ignore capital income earned in the outside option since this component is independent of τ.

3.1.2 Workers

The problem of the agent acting on account of workers is as follows:

$$\max_{\tau_L} \{(1-\tau)wu + (1-q)\tau Y_M/L\} \quad s.t. \quad (2), (4), \text{ and } (7).$$

From the first-order condition for an interior solution, one can readily derive the interior segments of the workers' reaction function to read:

$$\tau_L = \frac{(\alpha-1)\beta}{(1-\theta)(\alpha-q)} - \frac{\theta}{1-\theta}\tau_C. \tag{11}$$

To enable a direct comparison with (9), we solve the preceding equation for τ_C:

$$\tau_C = \frac{(\alpha-1)\beta}{\theta(\alpha-q)} - \frac{1-\theta}{\theta}\tau_L. \tag{12}$$

Several points are worth being noticed: (i) Remember that we have imposed the restriction $\alpha < q$, which guarantees that the first term on the RHS is indeed positive. Moreover, for $q < 1$ the worker's reaction function always lies above the capitalist's reaction function since $\frac{(\alpha-1)\beta}{\theta(\alpha-q)} > \frac{\beta}{\theta}$. (ii) The reaction curve of the two groups run parallel to each other. This can be seen by inspecting (12), which implies $\frac{\partial\tau_C}{\partial\tau_L} = -\frac{1-\theta}{\theta}$. As a consequence, the political equilibrium (τ_C^*, τ_L^*) will be a corner solution for at least one group provided that $q < 1$. (iii) Assuming that there are no transfers to workers $(q = 1)$ both groups prefer the same tax rate, i.e. $\tau^* = \tau_L^* = \tau_C^* = \beta$. In this case the two reaction curves are identical and given by $\tau_C = \frac{\beta}{\theta} - \frac{1-\theta}{\theta}\tau_L$; see equ. (9) and (12).

If the worker's political impact becomes small, i.e. $\theta \to 1$, they opt for the highest feasible tax rate (see (11)) to prevent a solution $\tau^* = \beta$. Since $\tau_L \in [0, 1]$ the complete reaction function is given by:

$$\tau_L = \begin{cases} 1 & \text{for} \quad \frac{(\alpha-1)\beta}{(1-\theta)(\alpha-q)} - \frac{\theta}{1-\theta}\tau_C > 1 \\ \frac{(\alpha-1)\beta}{(1-\theta)(\alpha-q)} - \frac{\theta}{1-\theta}\tau_C & \text{for} \quad 0 \leq \frac{(\alpha-1)\beta}{(1-\theta)(\alpha-q)} - \frac{\theta}{1-\theta}\tau_C \leq 1 \\ 0 & \text{for} \quad \frac{(\alpha-1)\beta}{(1-\theta)(\alpha-q)} - \frac{\theta}{1-\theta}\tau_C < 0 \end{cases} . \qquad (13)$$

3.1.3 Political equilibria

Depending on the underlying parameter constellation, there are three possible solutions for the equilibrium tax rate $\tau^* = \theta\tau_C^* + (1-\theta)\tau_L^*$. These cases are illustrated by Figure 2 and summarized in Table 1. Notice that the reaction curve of capitalists (solid line) hits the τ_L-axis at $\frac{\beta}{1-\theta}$ and the reaction curve of workers (dashed line) hits the τ_L-axis at $\frac{(\alpha-1)\beta}{(1-\theta)(\alpha-q)}$.

Case (1) is labelled *dominance-of-workers regime* (DL): Provided that $\frac{(\alpha-1)\beta}{(1-\theta)(\alpha-q)} < 1$ (implying $\frac{\beta}{1-\theta} < 1$), one gets $\tau_C^* = 0$ and $\tau_L^* = \frac{(\alpha-1)\beta}{(1-\theta)(\alpha-q)} < 1$. The equilibrium tax rate is then given by $\tau_{DL}^* = \frac{(\alpha-1)\beta}{\alpha-q} < 1$.[11] Case (2) is dubbed *no-group-dominates regime* (ND): For $\frac{\beta}{1-\theta} < 1 \wedge \frac{(\alpha-1)\beta}{(1-\theta)(\alpha-q)} > 1$ we have $\tau_C^* = 0$ and $\tau_L^* = 1$. The equilibrium tax rate therefore is $\tau_{ND}^* = 1-\theta$. Case (3) is denoted as *dominance-of-capitalists regime* (DC): If $\frac{\beta}{1-\theta} > 1$ (implying that $\frac{(\alpha-1)\beta}{(1-\theta)(\alpha-q)} > 1$), then $\tau_C^* = \frac{\beta-(1-\theta)}{\theta}$ and $\tau_L^* = 1$. The tax rate in this case reads $\tau_{DC}^* = \theta\frac{\beta-(1-\theta)}{\theta} + (1-\theta) = \beta$.

[11] Notice that $\tau_{DL}^* < 1$ since we have assumed here that $\frac{(\alpha-1)\beta}{(1-\theta)(\alpha-q)} < 1$ and $\theta \in [0,1]$.

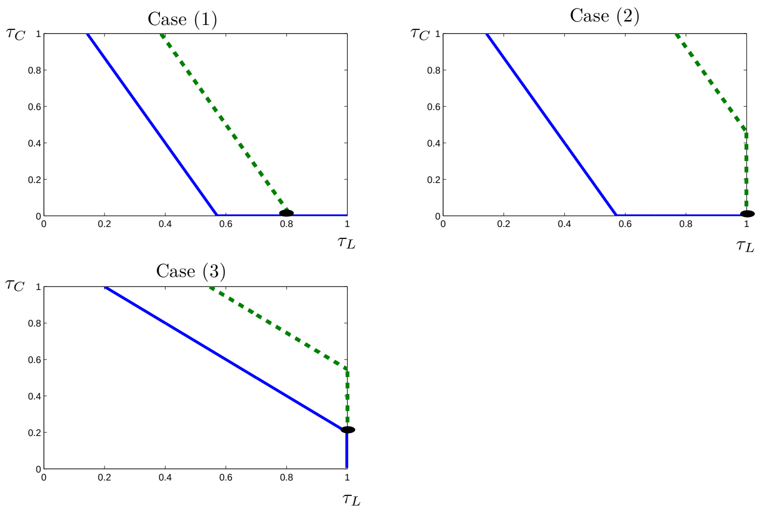

Figure 2: Reaction functions.

Table 1 provides a summary of the results. Consider the dominance-of-workers regime. If the political impact of workers is sufficiently high in the specific sense that the measure of their importance exceeds their desired tax rate, i.e. $1-\theta > \frac{(\alpha-1)\beta}{\alpha-q}$, then workers are able to implement their preferred tax rate $\frac{(\alpha-1)\beta}{\alpha-q}$ by strategically demanding a tax rate of unity (Case (1)).[12] On the other hand, if capitalists are sufficiently powerful in the specific sense that $\theta > 1-\beta$, then capitalists manage to implement their desired tax rate β by strategically demanding a tax rate of zero (Case (3)).[13] Finally, if both conditions for political dominance are violated the equilibrium

[12]This should be interpreted in a metaphorical sense: Under strategic interaction workers demand the "highest admissible tax rate". In the real world there might be bounds on the "highest admissible tax rate". For instance, it is quite plausible to argue that a tax rate demand which is "too high" reduces the public support in the political process.

[13]The fact that capitalists are more likely to implement their desired tax rate as β increases is due to the fact that workers always desire a higher tax rate than β and hence it becomes in fact easier for

tax rate is $1-\theta$ (Case (2)).

Table 1: Different political regimes and the equilibrium tax rate.

Regime	Condition	Equilibrium tax rate
Case (1): Dominance of workers	$1-\theta \geq \frac{(\alpha-1)\beta}{\alpha-q}$	$\tau^*_{DL} = \frac{(\alpha-1)\beta}{\alpha-q}$
Case (2): No group dominates	$1-\theta < \frac{(\alpha-1)\beta}{\alpha-q} \wedge 1-\theta > \beta$	$\tau^*_{ND} = 1-\theta$
Case (3): Dominance of capitalists	$1-\theta \leq \beta$	$\tau^*_{DC} = \beta$

Next we assume that the two groups cannot solve their internal coordination problem such that there is *no strategic interaction* in the political process. The equilibrium tax rate, denoted as $\tilde{\tau}^*$, is then given by:

$$\tilde{\tau}^* = \theta\beta + (1-\theta)\frac{(\alpha-1)\beta}{\alpha-q}. \tag{14}$$

The equilibrium tax rate is simply a linear combination of the tax rates which maximizes income of the respective groups.

We now have four different solutions for the equilibrium tax rate, i.e. τ^*_{DL}, τ^*_{ND}, τ^*_{DC}, and $\tilde{\tau}^*$. How do these compare to each other? To illustrate this point, assume that the underlying set of parameters satisfies the restriction $\alpha < q < 1$, such that $\frac{(\alpha-1)\beta}{\alpha-q} > \beta$ holds. Figure 3 shows the resulting tax rates as a function of θ. The equilibrium tax rate, assuming strategic interaction among major interest groups, is represented by the bold solid line, which comprises three segments: (i) $\frac{(\alpha-1)\beta}{\alpha-q}$ for $1-\theta \geq \frac{(\alpha-1)\beta}{\alpha-q}$; (ii) $1-\theta$ for $\beta < 1-\theta < \frac{(\alpha-1)\beta}{\alpha-q}$; and (iii) β for $1-\theta \leq \beta$. The equilibrium tax rate in the absence of strategic interaction as a function of θ is shown by the dashed curve.

capitalists to implement their preferred tax rate as β increases.

Figure 3 suggests that strategic interaction among major interest groups induces a higher tax rate compared to the case of no strategic interaction provided that laborers are strong in the specific sense $\theta < \theta^* = \frac{\alpha - q + \beta(1-\alpha)}{\alpha + \beta - q(1+\beta)}$.[14] Conversely, strategic interaction induces a lower tax rate provided that capitalists are strong in the sense $\theta > \theta^*$. Hence, strategic interaction may act as an amplifier with regard to the equilibrium tax rate. Moreover, it is interesting to see that a tax rate determination according to the median voter principle would yield the other extreme, i.e. $\tau^* = \frac{(\alpha-1)\beta}{\alpha - q}$ for $\theta < 0.5$ and $\tau^* = \beta$ for $\theta \geq 0.5$, provided that one interprets θ as population share.

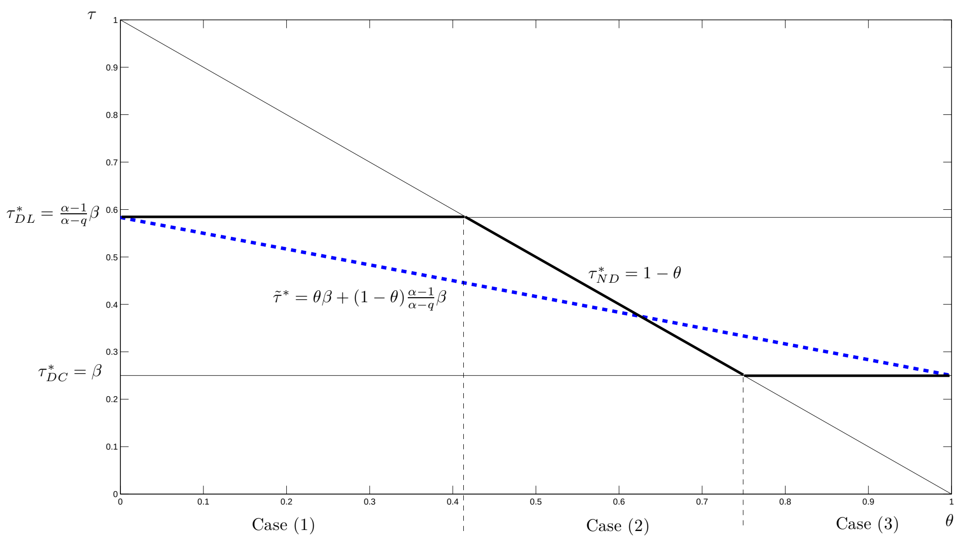

Figure 3: Equilibrium tax rates in response to θ.

The ranking of the four solutions can be summarized as follows:

$$0 < \tau^*_{DC} \leq \tau^*_{ND}, \tilde{\tau}^* \leq \tau^*_{DL} < 1.$$

[14]The critical value θ^* results from $1 - \theta = \theta\beta + (1-\theta)\frac{(\alpha-1)\beta}{\alpha-q}$.

Table 2: Notation - equilibrium tax rates.

τ^*_{DC}	equilibrium tax rate in dominance-of-capitalist regime
τ^*_{ND}	equilibrium tax rate in no-group-dominates regime
$\tilde{\tau}^*$	equilibrium tax rate without strategic interaction
τ^*_{DL}	equilibrium tax rate in dominance-of-workers regime

3.2 First stage: determination of K_M

At the first stage, capitalists decide on optimal K_M. By doing so, they take the equilibrium tax rate τ^* as given. Optimal K_M is determined by the first-order condition $(1-\tau^*)r = \bar{r} - \varepsilon\frac{K-K_M}{K}$, which can be stated more explicitly as follows:

$$(1-\tau)\alpha(q\tau)^{\frac{\beta}{1-\beta}} K_M^{\frac{\alpha-1+\beta}{1-\beta}} (uL)^{\frac{1-\alpha}{1-\beta}} = \bar{r} - \varepsilon\frac{K-K_M}{K}. \tag{15}$$

This equation implicitly determines the equilibrium allocation K^*_M as a function of model parameters and τ, i.e. $K^*_M = K_M(\bar{r}, q, \alpha, \beta, u, L, \varepsilon; \tau)$. Unfortunately, this equation cannot be solved analytically for K_M. However, for the special case $\varepsilon = 0$ (i.e. no investment costs) an explicit solution is readily found:

$$K^*_M = \left(\frac{\bar{r}}{(1-\tau)\alpha}\right)^{\frac{1-\beta}{\alpha-1+\beta}} (q\tau)^{\frac{\beta}{1-\alpha-\beta}} (uL)^{\frac{1-\alpha}{1-\alpha-\beta}}. \tag{16}$$

This solution shows that domestic capital supply is determined by the profitability of the outside option $\bar{r}$, the tax rate τ (which unfolds two opposing effects), and the amount of labor supplied to the domestic market sector.

3.3 The decentralized equilibrium

We now know the equilibrium tax rate τ^* and the equilibrium capital allocation K_M^*. Moreover, since K_M^* can be expressed as a function of the tax rate τ, we can express income of capitalists and workers (equ. (5) and (6)) as a function of the tax rate only. Hence, $K_M = K_M(\tau)$ together with (5) and (6) gives:

$$y^K(\tau) = (1-\tau)r(\tau)K_M(\tau) + (\bar{r} - \varepsilon\frac{K - K_M(\tau)}{K})(K - K_M(\tau)) \tag{17}$$

$$y^L(\tau) = (1-\tau)w(\tau)u + (1-q)\tau Y_M(\tau)/L. \tag{18}$$

Figure 4 illustrates income of capitalists $y^K(\tau)$, income of workers $y^L(\tau)$, and aggregate income $y^K(\tau) + Ly^L(\tau)$ as a function of the tax rate.[15] It can be recognized that $y^K(\tau)$ and $y^L(\tau)$ follow an inverted U-shape pattern. Both $y^K(\tau)$ and $y^L(\tau)$ increase initially with the tax rate because an increase in τ leads to larger tax revenues, more productive government spending, a rise in the marginal product of capital and labor, and hence an increase in competitive factor prices. On the other hand, income net of taxes decreases with the tax rate simply because the tax burden rises. Furthermore, in the case of workers, there is an additional effect since social transfers increase, given q, with tax revenues. This describes the mechanics of the base model with $\bar{r} = 0$.[16]

The existence of a capital outside option, i.e. $\bar{r} > 0$, together with foreign invest-

[15] The underlying set of parameters is described in Table 2 below.

[16] It should be noticed that the income tax does not, in this case, bias any private allocation decisions. Nonetheless, there is a unique first-best tax rate, i.e. a unique tax rate which balances marginal benefits and costs of a change in the tax rate from the social perspective.

ment costs, i.e. $\varepsilon > 0$, adds the following mechanisms of tax rate changes. In this case, domestic capital supply becomes endogenous and hence the income tax becomes distortionary. As τ increases, capitalists tend to shift capital abroad. This reallocation causes the marginal (and average) foreign investment costs to increase. Hence, $y^K(\tau)$

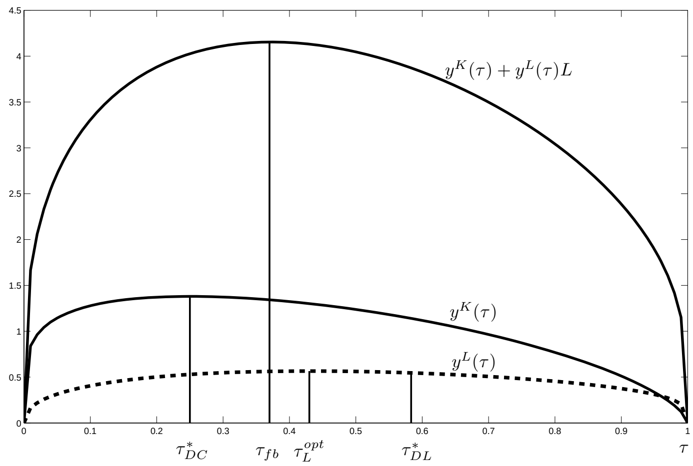

Figure 4: Income in response to the tax rate.

4 The first-best solution

The first-best tax rate is the solution to the following social planner's problem:[17]

$$\max_{\tau} \{y^K(\tau) + Ly^L(\tau)\} \quad s.t. \quad (2), (4), (7), \ (17), \ \text{and} \ (18), \tag{19}$$

[17] Here the first-best tax rate is determined by income maximization. Alternatively, the first-best tax rate could be determined by maximizing a utilitarian welfare function. Both procedures yield the same solution provided that a lump-sum transfer scheme is available.

where the equilibrium amount of capital K_M is determined by (15). Once more, an analytical solution is not available for the general case. Therefore, we will revert to numerical procedures in the subsequent analysis.

There is, however, an interesting benchmark case, which enables an explicit solution. For the special case $\bar{r} = 0$ the unique first-best tax rate is given by:

$$\tau_{fb} = \frac{\beta}{q}, \tag{20}$$

which is increasing in the productivity of governmental expenditures β and declining in the share of the budget allocated to productive government expenditures q.

5 Distributional-conflict inefficiencies

We are now ready to investigate the distributional-conflict inefficiency. Consider the situation displayed in Figure 4. The decentralized tax rate lies somewhere between τ^*_{DC} and τ^*_{DL} (both are indicated by vertical lines). Given the parameters of the model, the decentralized tax rate is crucially determined by the relative political power of capitalists and workers, as captured by θ. The unique first-best tax rate, on the other hand, is indicated by the vertical line at τ_{fb}. There are at least two important observations which are worth being discussed.

First, the decentralized tax rate can be either too high or too low. In a dominance of capitalist regime, the decentralized tax rate is too low. In contrast, in a dominance of workers regime, the decentralized tax rate is too high. The fact that the decentralized tax rate may deviate from the first-best tax rate indicates that there is at least weak inefficiency.[18] This implies that, at a theoretical level, the social planner could implement the first-best tax rate, thereby increasing aggregate income, and subsequently use a lump-sum transfer scheme to realize any desired income distribution.

Second, provided that the tax rate is to the right of τ_L^{opt} (the tax rate which maximizes the workers' income), the decentralized equilibrium exhibits strong inefficiency.[19] This means that a reduction in the tax rate would not only increase aggregate income but would clearly make both groups better off. The finding of strong inefficiency points to substantial imperfections in the politico-economic equilibrium. The reasons behind this failure will be discussed in the next section.

6 A decomposition of the overall inefficiency

The extent of the distributional-conflict inefficiency can be measured either by the gap between the first-best tax rate and the decentralized tax rate, i.e. $\Delta\tau = \tau_{fb} - \tau^* \gtreqless 0$, or by the gap between aggregate income evaluated at the first-best tax rate and aggregate income evaluated at the decentralized tax rate, i.e. $\Delta y = y(\tau_{fb}) - y(\tau^*) \geq 0$.

6.1 Time inconsistency due to lack of commitment

The finding of strong inefficiency is due to a time inconsistency problem inherent in the market economy. There are two critical assumptions which give rise to this time

[18]To be precise, weak inefficiency labels a situation where $y^K(\tau^*) + y^L(\tau^*) < y^K(\tau_{fb}) + y^L(\tau_{fb})$ holds.

[19]Strong inefficiency is characterized by $y^K(\tau^*) < y^K(\tau_{fb})$ and $y^L(\tau^*) < y^L(\tau_{fb})$.

inconsistency problem: First, the existence of a sufficiently profitable outside option for capitalists. Second, the underlying timing of events. More specifically, the assumption that capitalists first decide on their investments and then the political process determines the equilibrium tax rate is crucial. The assumption on the underlying timing of events is motivated by the observation that the relevant time horizon for foreign (direct) investments typically exceeds the time horizon underlying political tax change decisions.

The basic logic behind the time inconsistency result runs as follows. When workers decide on their preferred tax rate, they take the amount of capital invested in the domestic market sector as given. Capitalists, on the other hand, anticipate the equilibrium tax rate resulting from the political process at the second stage. Provided that workers are sufficiently powerful, i.e. θ is sufficiently low, the anticipated tax rate can be so high that capitalists invest a significant amount of capital abroad. As a result, the workers' income is depressed through two channels: First, a lower amount of capital invested in the domestic market sector reduces the wage rate because capital is complementary to labor. Second, a higher tax rate implies a lower amount of capital invested in the domestic market sector, which leads to a lower domestic capital income; notice that, within the relevant range, capital income in fact decreases with the tax rate. Hence, tax revenues from capital income, total tax revenues and, given q, the amount of social transfers in favor of workers fall.

We can use Figure 4 to illustrate the inefficiency as measured by $\Delta\tau = \tau^* - \tau_{fb}$. The time inconsistency problem can be easily eliminated from the model by reversing the timing of events. If workers decide on their preferred tax rate before capitalists invest, the time inconsistency problem vanishes. The reason is that, by construction, workers now take the negative consequences of a higher tax rate due to the two channels described above into account. The preferred tax rate in this case is τ_L^{opt}, i.e. the tax rate which maximizes the income of workers. Hence, the inefficiency due to the time inconsistency problem is given by $\Delta\tau = \tau_{DL}^* - \tau_L^{opt}$.

The time inconsistency problem is basically due to the lack of a commitment technology. Workers are in fact better off if they could commit to demand a tax rate according to $\tau_L^{opt} = \theta\tau_C + (1-\theta)\tau_L$ instead of $\tau_{DL}^* = \theta\tau_C + (1-\theta)\tau_L$. This would indeed be optimal in the pre-investment situation. In the post-investment situation, however, this solution is not incentive compatible anymore. Therefore, any attempt to commit to a strategy according to $\tau_L^{opt} = \theta\tau_C + (1-\theta)\tau_L$ is not credible. Capitalists understand this commitment problem and hence correctly anticipate the strategy $\tau_{DL}^* = \theta\tau_C + (1-\theta)\tau_L$.

It is instructive to view this problem from a slightly different perspective. Acemoglu (2003) argues that a Political Coase Theorem is generally impossible. His main argument stresses the fact that every contract needs a third party which enforces the contract. Once dominant groups are involved, this enforcement is not guaranteed anymore. This is due to the fact that dominant groups can, by definition, control the government and hence there is in fact no independent superordinate third party.

A final clarification is warranted. The emergence of time inconsistency is crucially driven by the timing assumption. In reality, there are, however, both short term as well as long term investment projects. In case of the former, the time span until a return can be realized is shorter than the time lag associated with changes in the tax rate in real world political systems. For long term investment projects, however, the opposite is likely to apply. In their seminal paper "Time to build and aggregate fluctuations" Kydland and Prescott (1982, p. 1345) state "That wine is not made in a day has long been recognized by economists (e.g., Böhm-Barwerk [6]). But, neither are ships nor factories built in a day." In case of long term investment projects the time span until a return can be realized may very well be longer than the time lag associated with political decisions to change income taxes. This then implies that the assumption according to which capitalists decide on investment projects and then the political process determines the tax rate appears justified. If the structure of the capital stock is such that it comprises both short term and long term projects, the time inconsistency problem does only apply to the long term investment projects. Hence, when applying the current model in order to decompose the sources of distributional conflict inefficiencies quantitatively, one would overestimate the time inconsistency component.

6.2 Strategic interaction in the political process

Does the existence of strategic interaction among major interest groups intensify or moderate the distributional-conflict inefficiency? At a general level, the answer to this question is ambiguous. Three points are, nonetheless, worth being emphasized in this context.

First, strategic interaction gives rise to the same tax rate, compared to the case of no strategic interaction, provided that $\theta = \theta^* = \frac{\alpha - q + \beta(1-\alpha)}{\alpha + \beta - q(1+\beta)}$ (see footnote 13). In this case, strategic interaction cannot exert an impact on $\Delta\tau$. Moreover, strategic interaction leads to a higher (lower) decentralized tax rate whenever $\theta < \theta^*$ ($\theta > \theta^*$).

Second, consider the case $\bar{r} = 0$ such that $\tau_{fb} = \beta/q$.[20] Assuming that $\theta \neq \theta^*$, strategic interaction always magnifies the inefficiency provided that $q = \alpha + \beta$. This condition implies that the first-best tax rate $\tau_{fb} = \beta/q$ equals the decentralized tax rate for $\theta = \theta^*$; remember that for $\theta = \theta^*$ the decentralized tax rate with and without strategic interaction coincide. This constellation represents an important benchmark case. Since strategic interaction always leads to a higher (lower) decentralized tax rate whenever $\theta < \theta^*$ ($\theta > \theta^*$), it follows that the gap $\Delta\tau$ is always larger, in absolute terms, under strategic interaction.

Third, the reverse result, strategic interaction moderates the inefficiency, is more likely to occur when either (i) the first-best tax rate is close to the tax rate preferred by laborers and when laborers are strong in the sense $\theta < \theta^*$ or (ii) the first-best tax rate is close to the tax rate preferred by capitalists and when capitalists are strong in the sense $\theta > \theta^*$. In this respect, it is interesting to notice that the first-best tax rate, assuming that $\bar{r} = 0$, can be represented as an average of the tax rates preferred by the two groups according to:

$$\tau_{fb} = a\tau^*_{DL} + (1-a)\tau^*_{DC},$$

where $a = \frac{q-\alpha}{q} > 0$. Hence, if (i) α is either close to q and $\theta > \theta^*$ or (ii) α is close to zero and $\theta < \theta^*$, then strategic interaction is more likely to moderate the

[20] The basic argument also holds true in the more general case $\bar{r} > 0$.

inefficiency. The fact that strategic interaction can indeed moderate the inefficiency is, of course, a second best implication. Given an inefficiency $\tau_{fb} \neq \tau^*$, the presence of an additional imperfection in the political sphere can moderate the inefficiency provided that τ_{fb} is "close" to either τ^*_{DL} or τ^*_{DC} simply because strategic interaction pushes the decentralized tax rate more towards τ^*_{DL} or τ^*_{DC} if one group is strong or even dominates the tax rate determination process.

Taken together, strategic interaction is likely to magnify the inefficiency provided that the parameter restriction $q = \alpha + \beta$ approximately holds true. Considering empirically plausible values of the relevant parameters, $q \approx 0.6$, $\alpha \in [0.3, 0, 4]$ and $\beta \in [0.2, 0.3]$, this restriction is not unlikely to be roughly satisfied in reality. Moreover, the extent to which strategic interaction magnifies the inefficiency depends on the fact whether one group is strong in the sense $\theta \neq \theta^*$.

6.3 Heterogeneity

Even if we remove time inconsistency and strategic interaction from the model the decentralized tax rates are likely to deviate from the first-best tax rate. What is the reason for this remaining inefficiency?[21] This residual inefficiency must be due to a fundamental conflict of interest. Since both groups are asymmetrically affected by changes in the tax rate, every group prefers a different tax rate. However, heterogeneity is not sufficient for inefficiency to occur. From the median voter model we know that

[21] Notice that productive government expenditures G do not cause an ineffiency in this model. It is true that G represents an external effect from the perspective of the representative firm. However, when deciding on the preferred tax rate individuals internalize the associated change in G.

political competition, based on the median voter principle, delivers an efficient solution provided that the income distribution is symmetric. In this case, the first-best tax rate coincides with the preferred tax rate of the median voter (decisive voter).

Our model departs along two dimensions from this benchmark case. First, we do not apply the median voter principle and, second, the income distribution is discrete with two realizations ("income of workers" and "income of capitalists"). In this case, there is simply no voter who prefers the first-best tax rate. Consequently, there is no decentralized decision mechanism, relying on the principle of one voter being decisive, that can deliver the first-best solution.

The remaining inefficiency can be labelled "natural inefficiency" since it could only be avoided by an omnipotent social planner who sets the tax rate to its first-best level. Put differently, the decentralized economy is intrinsically characterized by a conflict of interest between the two classes. Since both groups are asymmetrically affected by changes in the tax rate, the political process is likely to give rise to a tax rate that is different from the first-best tax rate.

7 A simple numerical exercise

The simple model laid out above has only a small number of parameters and hence suggests a numerical illustration. To this end, the model parameters are specified numerically to calculate the implied welfare loss. To enable a sensible numerical specification of the parameters we disentangle the share of productive government expenditures (labeled q above) and the share of social transfers (labeled $1-q$ above). That is, we set $q = q_1$ and $1 - q = q_2$ and assume $q_1 + q_2 \leq 1$ such that we allow for a third category of expenditures (neither productive government expenditures nor social transfers). Expenditures on social security transfers as a percentage of total tax receipts, q_2, averaged to 35 percent in 2000 (OECD, 2006). The definition of "social security transfers" is, however, somewhat narrow in the context of the model. Public social expenditure as a percentage of total tax receipts among OECD countries averaged to 60 percent in 2000 (OECD, 2006). This definition would, however, be too broad. Hence, we let $q_2 \in \{0.4, 0.5, 0.6\}$. There is also substantial uncertainty on the the share of productive government expenditures and hence we choose q_1 from the set $q_1 \in \{0.2, 0.3, 0.4\}$. Moreover, the empirical literature indicates that the elasticity of productive government expenditures in the production of final output should lie in the interval $\beta \in [0.03, 0.2]$ (Glomm and Ravikumar, 1997, Section 4). For our quantitative illustration we chose $\beta \in \{0.05, 0.1\}$. The capital share of $\alpha = 0.3$ is standard. The assumption $u = 0.6$ means that individuals supply 60 percent of their time endowment (net of recreation) to the labor market. The outside option for capital $\bar{r} = 0.1$ might appear somewhat high at first glance. However, the implied rate of return on capital earned in the outside option net of investment costs (associated with foreign investments) amounts to 0.066 (more precisely, $\bar{r} - \varepsilon \frac{K - K_M(\tau=0.4)}{K} \cong 0.066$). Table 3 shows the underlying set of parameters.

Table 3: Set of parameters.

Technology and endowment	$\alpha = 0.3, \beta \in \{0.05, 0.1\}, L = 5, u = 0.6, K = 20$
Policy and capital outside option	$q_1 \in \{0.2, 0.3, 0.4\}, q_2 \in \{0.4, 0.5, 0.6\}, \bar{r} = 0.1, \varepsilon = 0.1$

The overall distributional-conflict inefficiency is measured by $\frac{y(\tau_{fb})-y(\tau^*)}{y(\tau^*)}$. The decentralized tax rate τ^* depends on the presence or absence of strategic interaction and, additionally, on the value of the political impact parameter θ. Assuming, first, strategic interaction among capitalists and workers in the political process, and, second, that the economy is in a dominance of workers regime we receive welfare losses in the range between 0.5 percent and 25 percent, as described by Table 4.

Table 4: Proportional welfare loss.

	q_2= 0.4		q_2= 0.5		q_2= 0.6	
q_1= 0.2	$\beta = 0.05$	$\beta = 0.1$	$\beta = 0.05$	$\beta = 0.1$	$\beta = 0.05$	$\beta = 0.1$
	0.00458	0.01203	0.01416	0.03985	0.06558	0.25132
q_1= 0.3	$\beta = 0.05$	$\beta = 0.1$	$\beta = 0.05$	$\beta = 0.1$	$\beta = 0.05$	$\beta = 0.1$
	0.00454	0.01186	0.01406	0.03932	0.06520	0.24858
q_1= 0.4	$\beta = 0.05$	$\beta = 0.1$	$\beta = 0.05$	$\beta = 0.1$	$\beta = 0.05$	$\beta = 0.1$
	0.00452	0.01174	0.01399	0.03894	0.06493	0.24665

One recognizes that the proportional welfare loss increase with q_2 and β and decreases with q_1. The mechanics behind this observation can be understood by noting that welfare loss depends on the gap between the first best tax rate, τ_{fb}, and the decentralized tax rate, τ^*, which is by assumption equal to the most preferred tax rate of workers. This tax rate increases both with q_2 and β such that the gap $\tau^* - \tau_{fb}$ becomes larger. On the other hand, the gap $\tau^* - \tau_{fb}$ becomes smaller as q_1 increases.

8 Summary and conclusion

Employing a simple general equilibrium model we have investigated the sources and consequences of distributional-conflict inefficiencies in small open economies. The overall distributional-conflict inefficiency is decomposed into three components: (i) the time-inconsistency component; (ii) strategic interaction in the political sphere; and (ii) an unavoidable residual which results from heterogeneity. Furthermore, using data for OECD economies we have used a calibrated version of the model to assess the magnitude of the distributional-conflict inefficiency. This exercise indicates that the inefficiency may be quite substantial. For our baseline set of parameters we find an output loss of about 7 percent (recall that severe recessions are associated with an output gap of around 3 percent).

These results leave us with a natural follow-up question: What are the mechanisms that have the potential to reduce the distributional-conflict inefficiency. Since a discussion of this topic would clearly constitute a separate paper, we restrict ourselves to the following enumeration. There appear to be three such "mechanisms": (i) One obvious possibility lies in the reduction of income heterogeneity, which could be induced by appropriate government policies. (ii) At a theoretical level, one could think of a wage contract implying that workers exchange a share of their wage income against a claim on the capital income *net of taxes*. As a result, it becomes incentive-compatible for workers to opt for a comparably low tax rate at the ex post investment stage. (iii) A mechanism which is at work in reality lies in repeated interaction in the political process. We did not model this aspect to keep the analysis as simple as possible. The political-institutional system then determines the relevant time horizon.

It appears interesting to consider the consequences of inequality aversion as a fundamental cultural factor (Fehr and Schmidt, 1999). Tyran and Sausgruber (2006) have shown that "a small degree of inequality aversion" can lead to large equilibrium redistribution. In an open economy, then, it seems that inequality aversion indeed magnifies the output loss due to distributional conflicts.

The paper at hand contributes to the theoretical literature, which tries to understand the differences in per capita income across countries. Recent macroeconomic studies have decomposed the international variation of per capita income into three basic components (Caselli, 2005): (i) physical inputs; (ii) technology; (iii) institutions and policy. Olson (1996) has argued that the third component is substantial. We have shown that policy choices are shaped by distributional conflicts and the way these conflicts are carried out. Our quantitative finding suggests that the distributional-conflict inefficiency can indeed be substantial.

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9 Appendix (not for publication)

9.1 Reduced-form technology

Using $G = q\tau Y_M$ together with $Y_M = G^{\beta} K_M^{\alpha} (uL)^{1-\alpha}$ gives $G = (q\tau K_M^{\alpha}(uL)^{1-\alpha})^{\frac{1}{1-\beta}}$. Plugging this expression for G back into $Y_M = G^{\beta} K_M^{\alpha} (uL)^{1-\alpha}$ yields:

$$Y_M = q^{\frac{\beta}{1-\beta}} \tau^{\frac{\beta}{1-\beta}} K_M^{\frac{\alpha}{1-\beta}} (uL)^{\frac{1-\alpha}{1-\beta}}.$$

This is equation (1) in the main text.

9.2 Factor prices

The competitive interest rate is given by:[22]

$$r = \frac{\partial Y_M}{\partial K_M} = \alpha G^\beta K_M^{\alpha-1}(uL)^{1-\alpha}$$

$$r = \alpha(q\tau K_M^\alpha (uL)^{1-\alpha})^{\frac{\beta}{1-\beta}} K_M^{\alpha-1}(uL)^{1-\alpha}$$

$$r = \alpha(q\tau)^{\frac{\beta}{1-\beta}} K_M^{\frac{\alpha-1+\beta}{1-\beta}} (uL)^{\frac{1-\alpha}{1-\beta}}$$

This is equation (3) in the main text.

The competitive wage rate reads:

$$w = \frac{\partial Y_M}{\partial L} = (1-\alpha) G^\beta K_M^\alpha (uL)^{-\alpha}$$

$$w = (1-\alpha)(q\tau K_M^\alpha (uL)^{1-\alpha})^{\frac{\beta}{1-\beta}} K_M^\alpha (uL)^{-\alpha}$$

$$w = (1-\alpha)(q\tau)^{\frac{\beta}{1-\beta}} K_M^{\frac{\alpha}{1-\beta}} (uL)^{\frac{\beta-\alpha}{1-\beta}}$$

This is equation (4) in the main text.

9.3 Reaction function of capitalists

The maximization problem of capitalists can be expressed as follows:

$$\max_{\tau_C} \left\{ y^K(\tau) = (1-\tau)\alpha(q\tau)^{\frac{\beta}{1-\beta}} K_M^{\frac{\alpha-1+\beta}{1-\beta}} (uL)^{\frac{1-\alpha}{1-\beta}} K_M \right\}$$

$$s.t. \;\; \tau = \theta\tau_C + (1-\theta)\tau_L$$

$$\text{and } 0 \leq \tau_C \leq 1,$$

[22] Notice that it is necessary to first take the partial derivative w.r.t. K or L and then insert $G = (q\tau K_M^\alpha L^{1-\alpha})^{\frac{1}{1-\beta}}$.

given the worker's vote and $0 \leq \tau_L \leq 1$ satisfying $0 \leq \tau \leq 1$. Formulating the Lagrangian yields

$$L = y^K(\tau) + \lambda_0(-\tau_C) + \lambda_1(1 - \tau_C).$$

The Kuhn-Tucker conditions can be stated as follows (Sydsaeter et al., 2000, pp. 97)

$$\begin{aligned}
(A)\ \tau_C \frac{\partial L}{\partial \tau_C} &= \tau_C \left(\frac{\partial y^K}{\partial \tau_C} - \lambda_0 - \lambda_1 \right) = 0. \\
(B)\ \lambda_0 \frac{\partial L}{\partial \lambda_0} &= \lambda_0 \tau_C = 0 \\
(C)\ \lambda_1 \frac{\partial L}{\partial \lambda_1} &= \lambda_1 (1 - \tau_C) = 0.
\end{aligned}$$

1. $\lambda_1 = \lambda_0 = 0$ - no restriction is binding and there is an interior solution with $\frac{\partial y^K}{\partial \tau_C} = 0$:

$$\begin{aligned}
& -\theta\alpha(q\tau)^{\frac{\beta}{1-\beta}} K_M^{\frac{\alpha-1+\beta}{1-\beta}} (uL)^{\frac{1-\alpha}{1-\beta}} K_M \\
& +(1-\tau)\theta\alpha \frac{\beta}{1-\beta} (q)^{\frac{\beta}{1-\beta}} \tau^{\frac{2\beta-1}{1-\beta}} K_M^{\frac{\alpha-1+\beta}{1-\beta}} (uL)^{\frac{1-\alpha}{1-\beta}} K_M = 0 \\
\Rightarrow\ & \tau = \beta
\end{aligned}$$

   such that

$$\theta \tau_C + (1 - \tau)\tau_L = \beta$$

   and hence

$$\tau_C = \frac{\beta}{\theta} - \frac{1-\theta}{\theta} \tau_L.$$

2. $\lambda_1 = 0$ and $\lambda_0 \neq 0$ - negative tax rates are excluded, such that in light of condition $(B):\ \tau_C = 0$. If this is the case, we yield from $(A):\ \frac{\partial y^K}{\partial \tau_C} = \lambda_0$. Since, we have for interior solutions $\frac{\partial y^K}{\partial \tau_C} = 0$, we yield $\frac{\partial y^K}{\partial \tau_C} < 0$ and therefore $\frac{\beta}{\theta} - \frac{1-\theta}{\theta}\tau_L < 0$.

3. $\lambda_1 \neq 0$ and $\lambda_0 = 0$ - tax rates greater then one are excluded. Hence, we get from $(C):\ \tau_C = 1$ and from $(A):\ \frac{\partial y^K}{\partial \tau_C} = \lambda_0$, where $\frac{\partial y^K}{\partial \tau_C} > 0$ implying that $\frac{\beta}{\theta} - \frac{1-\theta}{\theta}\tau_L > 1$.

Collecting all the feasible outcomes for τ_C together, yields

$$\tau_C = \begin{cases} 1 & \text{for} \quad \frac{\beta}{\theta} - \frac{1-\theta}{\theta}\tau_L > 1 \\ \frac{\beta}{\theta} - \frac{1-\theta}{\theta}\tau_L & \text{for} \quad 0 \leq \frac{\beta}{\theta} - \frac{1-\theta}{\theta}\tau_L \leq 1 \\ 0 & \text{for} \quad \frac{\beta}{\theta} - \frac{1-\theta}{\theta}\tau_L < 0 \end{cases}$$

9.4 Reaction function of workers

The workers' maximization problem of is:

$$\max_{\tau_L} \left\{ y^L(\tau) = (1-\tau)(1-\alpha)(q\tau)^{\frac{\beta}{1-\beta}} K_M^{\frac{\alpha}{1-\beta}} (uL)^{\frac{\beta-\alpha}{1-\beta}} L + (1-q)\tau q^{\frac{\beta}{1-\beta}} \tau^{\frac{\beta}{1-\beta}} K_M^{\frac{\alpha}{1-\beta}} (uL)^{\frac{1-\alpha}{1-\beta}} \right\}$$

$$s.t. \quad \tau = \theta\tau_C + (1-\theta)\tau_L$$

$$\text{and } 0 \leq \tau_L \leq 1,$$

given the capitalists' vote and $0 \leq \tau_C \leq 1$ satisfying $0 \leq \tau \leq 1$. Formulating the Lagrangian yields

$$L = y^L(\tau) + \lambda_0(-\tau_L) + \lambda_1(1-\tau_L).$$

The Kuhn-Tucker conditions can be stated as follows (Sydsaeter et al., 2000, pp. 97)

$$
\begin{aligned}
(A')\ \tau_L \frac{\partial L}{\partial \tau_L} &= \tau_L \left(\frac{\partial y^L}{\partial \tau_L} - \lambda_0 - \lambda_1 \right) = 0. \\
(B')\ \lambda_0 \frac{\partial L}{\partial \lambda_0} &= \lambda_0 \tau_L = 0 \\
(C')\ \lambda_1 \frac{\partial L}{\partial \lambda_1} &= \lambda_1 (1 - \tau_L) = 0.
\end{aligned}
$$

1. $\lambda_1 = \lambda_0 = 0$ - no restriction is binding and there is an interior solution with $\frac{\partial y^L}{\partial \tau_L} = 0$:

$$
\begin{aligned}
&(1-\theta)(1-\alpha)(q\tau)^{\frac{\beta}{1-\beta}} K_M^{\frac{\alpha}{1-\beta}} (uL)^{\frac{\beta-\alpha}{1-\beta}} L \\
&+(1-\tau)\frac{\beta}{1-\beta}(1-\alpha)(1-\theta)(q)^{\frac{\beta}{1-\beta}} \tau^{\frac{2\beta-1}{1-\beta}} K_M^{\frac{\alpha}{1-\beta}} (uL)^{\frac{\beta-\alpha}{1-\beta}} uL \\
&+(1-q)\frac{1}{1-\beta}(1-\theta)(q)^{\frac{\beta}{1-\beta}} \tau^{\frac{\beta}{1-\beta}} K_M^{\frac{\alpha}{1-\beta}} (uL)^{\frac{1-\alpha}{1-\beta}} (uL) = 0
\end{aligned}
$$

implying that

$$
\tau = \frac{\alpha - 1}{\alpha - q}\beta
$$

and hence

$$
\begin{aligned}
\frac{\alpha - 1}{\alpha - q}\beta &= \theta\tau_C + (1-\theta)\tau_L \\
\tau_L &= \frac{(\alpha-1)\beta}{(1-\theta)(\alpha-q)} - \frac{\theta}{1-\theta}\tau_C
\end{aligned}
$$

2. $\lambda_1 = 0$ and $\lambda_0 \neq 0$ - negative tax rates are excluded, such that in light of condition (B') : $\tau_L = 0$. If this is the case, we yield from (A') : $\frac{\partial y^L}{\partial \tau_L} = \lambda_0$. Since, we have for interior solutions $\frac{\partial y^L}{\partial \tau_L} = 0$, we yield $\frac{\partial y^K}{\partial \tau_L} < 0$ and therefore $\frac{(\alpha-1)\beta}{(1-\theta)(\alpha-q)} - \frac{\theta}{1-\theta}\tau_C < 0$.

3. $\lambda_1 \neq 0$ and $\lambda_0 = 0$ - tax rates greater then one are excluded. Hence, we get from (C') : $\tau_L = 1$ and from (A') : $\frac{\partial y^L}{\partial \tau_L} = \lambda_0$, where $\frac{\partial y^L}{\partial \tau_L} > 0$ implying that $\frac{(\alpha-1)\beta}{(1-\theta)(\alpha-q)} - \frac{\theta}{1-\theta}\tau_C > 1$.

Collecting all the feasible outcomes for τ_L together, yields

$$\tau_L = \begin{cases} 1 & \text{for} \quad \frac{(\alpha-1)\beta}{(1-\theta)(\alpha-q)} - \frac{\theta}{1-\theta}\tau_C > 1 \\ \\ \frac{(\alpha-1)\beta}{(1-\theta)(\alpha-q)} - \frac{\theta}{1-\theta}\tau_C & \text{for} \quad 0 \leq \frac{(\alpha-1)\beta}{(1-\theta)(\alpha-q)} - \frac{\theta}{1-\theta}\tau_C \leq 1 \\ \\ 0 & \text{for} \quad \frac{(\alpha-1)\beta}{(1-\theta)(\alpha-q)} - \frac{\theta}{1-\theta}\tau_C < 0 \end{cases}$$

9.5 First-best tax rate - no outside option

Maximization of aggregate income

Forming the first-order condition w.r.t τ in problem (19) yields after some manipulations

$$-\alpha\tau^{\frac{\beta}{1-\beta}} + \frac{(1-\tau)\alpha\beta}{1-\beta}\tau^{\frac{2\beta-1}{1-\beta}} + (1-q)\tau^{\frac{\beta}{1-\beta}} + (1-q)\tau^{\frac{\beta}{1-\beta}} = 0.$$

Hence,

$$-\alpha(1-\beta) - (1-\alpha)(1-\beta) + \beta(\frac{1}{\tau} - 1) + (1-q) = 0$$

which implies immediately that

$$\tau_{fb} = \frac{\beta}{q}.$$

This is equation (20) in the main text.