CONSUMPTION VERSUS INCOME TAXATION: THREE MOMENTS IN THE POLITICAL ECONOMY OF FISCAL CHOICE

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ABSTRACT

Most modern economies tax both consumption and labour income. While there is an extensive normative literature on the optimal mix of the two taxes, there is little examination of what determines the actual mix in a well specified political economy context. We use a multi-dimensional spatial voting framework to simulate endogenous political tax equilibria. The model accommodates complex interactions between many of the first three moments (mean, variance and skewness) of three distributions identified in the literature as crucial: the distribution of income, of preferences for public goods and the distribution of political influence. To simplify, we focus on a balanced and an asymmetric society and analyze how different combinations of distributional moments interact in the determination of tax equilibria. Interesting links emerge between the nature of the distribution of preferences for public expenditure, income inequality and the relative importance of consumption taxation. The analysis suggests that studies of single taxes have limited relevance for the explanation of the observed tax mix.

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1. INTRODUCTION

The choice between consumption and income as sources of public finance is a major issue facing all modern economies. Statistics reveal a large degree of variation in the relative reliance on the two tax sources. In 2003, for example, the European Union raised close to 20 per cent of its revenues from taxes on general consumption, while the United States and Japan only derived 8 to 9 per cent from this source, with much variation occurring among countries falling in between the low and the high end (see OECD 2006). Reliance on personal income taxation is similarly varied, but generally moves in the opposite direction: Excluding social security contributions, the U.S. raised approximately 35 per cent of total revenues in this manner, a figure falling substantially above the average for OECD members as a whole, which was close to 25 per cent.

There is a long tradition of fiscal analysis relating to the choice between consumption and income taxation. Reviews of the extensive literature are provided by Bradford (1996), and Zodrow and McClure (forthcoming). This literature is mostly normative in nature. Work on the choice between the two revenue sources, when both are determined endogenously as part of a political process is less extensive, although relevant examples can be found in Renstrom (1996), Hettich and Winer (1999), and Kenny and Winer (2006). While there may be good normative arguments to prefer consumption over income taxation, or vice versa, it is important to understand the actual influences and circumstances that lead to more or less reliance on particular tax sources in the real world. This requires a framework in which policy choices are endogenously determined as part of a political process set against the background of a private economy.

To study the actual tax mix, one needs a conceptual framework able to cope with the existence of multiple policy instruments and in which the size of government is determined simultaneously with tax structure. This precludes use of the median voter model which provides no stable equilibrium in such a complex environment. In this paper, we use a probabilistic spatial voting framework to explore the determinants of the tax mix and the size of government in a static political equilibrium.

Several key elements of both the private and public sectors must be present in such a model. Some of these factors may act directly on tax structure, while others may only exert an indirect influence. Existing empirical work has shown the importance of the relative size of consumption and income tax bases in determining tax mix (Kenny and Winer 2006). In addition, research has demonstrated that the variance of incomes plays a significant role in determining income tax structure (Cukierman and Meltzer 1991) and that the size of government is also involved, since tax structure may change with the overall role of government in the economy (Kenny and Winer 2006). Since work on the size of government has identified average income as a significant determinant (see the literature on Wagner's Law, reviewed by Mueller 2003), this factor must be added to the list. In addition, the skewness of the income distribution has been pinpointed as crucial in research based on the median voter framework (Meltzer and Richard 1981, 1983). In a different context, Usher (1977) has drawn attention to the variance in the distribution of tastes for public goods as a determining factor of whether a commodity is brought into the public sector. Finally, we must add the distribution of political influence in a representative democracy to the list of key factors, even though its influence has not as yet been studied in much detail.

In this paper, we focus on whether the three first moments of the relevant distributions pointed to above -

their mean, variance and skewness - have a significant in fluence on the choice of the tax mix and the size of government. We proceed by simulating fiscal equilibria in a competitive political system in order to explore the role and interaction of the three moments in determining the consumption-income tax mix. The analysis considers the role of the first two moments of the distribution of tastes for public goods and of the first three moments of the distribution of skills (or pre-tax income) in determining the relative reliance on consumption and income as a tax bases and in fixing the size of government. To this we add important elements stemming from the endogenous or political nature of policy choices, namely the second and third moments of the distribution of political influence.[1] To limit the complexity of possible interactions, the model does not include an analysis of the consumption-savings choice of individuals.

The model we employ is stylized, but is still sufficiently complex so that simulation analysis is required in order to explore the determinants of the consumption-income tax mix.[2] We follow the work of Rutherford and Winer (1990) and Holtz-Eakin (1992), who simulate equilibrium fiscal systems that results from the electoral competition between two vote maximizing parties. The object of the simulation experiments is to acquire intuition about the role of the moments of the three key distributions identified above, or at least of as many of them as is feasible, given the technical difficulties of constructing and using such a simulation model.

To reduce the number of possible simulations to manageable size, we define types of societies characte-

[1] Since political influence is a relative concept, the mean of its distribution has no meaning in the model.

[2] In an even more simplified framework that deals only with the size of government, Usher (1977) also relies on simulation.

rized by different configurations of the moments of tastes, skills and influence, and use these societies as a basis for comparative analyses. We consider two types of societies (i) a *balanced* one marked by symmetrical distributions; and (ii) an *asymmetric* society where the distributions of skills and political influence can be skewed in various ways.

The paper proceeds as follows: We begin in section two by outlining the structure of the simulation model in general terms. Readers who are not interested in the technical details that follow this overview may skip the ensuing discussion and proceed to the start of the simulation experiments in section four. Individual behavior is specified in the remainder of section two, and the general equilibrium structure of the model is presented in section three. Section four sets up the simulations with a discussion of the treatment of the distributions of skills, tastes and political influence. The simulations of a balanced and asymmetric society follow in sections five and six respectively. Conclusions are summarized in a final section.

2. THE MODEL

We employ a spatial, probabilistic voting model of a perfectly competitive electoral system of a type that is now common in the literature. Textbook introductions to such models are provided by Mueller (2003, chapter 12) and Persson and Tabellini (2000, chapters 2 and 3). Further references are provided below. The innovation of the model constructed here is to use the spatial voting framework in a manner that allows us to explore how changes in the moments of the distributions of skills, tastes for the public good and of political influence affect the equilibrium consumption - income tax mix.

There are three policy instruments in the mode, a proportional tax an labor income, a proportional consumption tax, and one pure public good. Since the fiscal system is multi-dimensional, a median voter model cannot be used to replicate this equilibrium except by severely restricting the nature of voters' preferences or by assuming that each policy instrument is, somehow, determined in a separate policy process. This is still a simple fiscal system – because both taxes are assumed to be proportional in nature – but it is sophisticated enough to provide some interesting results.

Fiscal policy choices in this framework reflect the balancing of the heterogeneous and sometimes opposing interests of the voters. Voters (indexed by *h*) are defined by their skill level or gross income (s), rentier income (ω), tastes for a single pure public good (α_1), private consumption (α_2) and leisure (α_3), and their political influence $\chi(s,\omega)$. The latter is assumed to be associated with income. Preferences are Cobb-Douglas, and the presence of an exogenous amount of rentier income from a fixed capital stock insures that labor supply is elastic with respect to taxation, falling when the tax rate on labor income rises.

The aggregate supply of labor determines the size of economic activity. Proportional taxes on labor (t_l) and on consumption (t_c) in part determine the demand for leisure (x_l) and private consumption (x_c), and the supply of labor to the public (H_g) and private (H_c) sectors. Production in the public sector (x_g) uses only labor and is subject to diminishing productivity, while production of private goods uses both labor and the exogenous stock of capita or endowments.

Using equilibrium conditions for labor and goods markets, the zero profit condition for firms and the government budget restraint, and given tax rates and the size of public output, we can solve (after some work) for the indirect utility function of any voter *h*. This is then 'fed into' the political sector of the model that determines equilibrium tax rates, with the level of public output then following from application of the government budget restraint.

The political system is assumed to be fully competitive. There are two parties facing voters whose decisions at the ballot box depend on which party's fiscal platform promises the greater level of individual (indirect) utility, as well as on a valance term that depends on the party's credibility, the 'look' of the candidate, or other matters that are unaffected by policy choices. Parties are uncertain about the nature of these valences for any voter, but they do have common knowledge of how proposed policies affect voter utility. All citizens vote sincerely.

This probabilistic spatial voting setup allows us to formulate the expected vote function (defined over all voters) for each party, which each party is assumed to want to maximize by choice of its proposed fiscal platform. These expected vote functions are assumed to be symmetric, one being the number of voters less the other. Since the expected vote functions are symmetric, party platforms converge in the Nash equilibrium of the electoral contest.

The trick is to actually simulate this equilibrium. This we can do by making use of the Representation Theorem (see Hettich and Winer 1999, chapter 4 or Coughlin 1992 for discussion of this theorem and proofs). The theorem tells us that the equilibrium will be one which maximizes a synthetic political support function, which is a particular weighted sum of the indirect utilities of the voters. The intuition behind the theorem is that expected vote maximizing parties will want to propose a policy platform such that the opposition cannot counter with a proposal that makes at least some voters better off without making some other voter worse off. Otherwise, the opposition will be able to increase its expected vote and thus its chances of winning the election. Competition insures that in an equilibrium, no such platforms remain to be found.

This doesn't mean that all votes have equal political weight. The parties may favor some voters over others in moving towards the Pareto frontier. In the simulation model, the effective influence weights assigned to each voter are exogenous to the political process, and we simulate the effects of changes in the distribution of them in a manner to be discussed below.

In the next section, we take the reader through the mathematical details of the model, ending with the specific form of the political support function that we actually maximize in order to solve for equilibrium tax rates and output of the public good.

2.1 The individual voter-taxpayer

Each individual $h \in R_+$ has two attributes, skill *s*, and endowment or capital income ω, over which voters $h = h(s, \omega)$ are distributed according to the function F.[3] We denote by $m_s = \int s dF^s(s)$ the mean of skills, and by $m_\omega = \int \omega dF^\omega(\omega)$, the mean of endowments.

Governing instruments include a uniform tax at rate t_l on labor income and a tax at rate t_c leveled on consumption of the private good x_c. The resulting tax revenue is used to provide a pure public good x_g.[4] The wage rate for a taxpayer with attribute *s* is denoted by *w(s)* and $x_l^h \equiv x_l^h(s, \omega)$ is the leisure he or she takes out

[3] In the simulations the endowment ω will be correlated to s, for example as $\omega = \omega_o \sqrt{s}$.

[4] $t_c < 0$ represents a subsidy.

of available time T. (We let w be the basic hourly wage and think of s as effective hours so that $w(s) = w \cdot s$). After tax income for a person of type h then is $Y(t;h) \equiv (1-t_l)(T - x_l(h))w \cdot s + \omega$,
and average total income for the population is

$$\overline{y} = \int_R \int_R y(s,\omega) dF^s(s) dF^\omega(\omega) = m_s w T(1-t_l) + m_\omega$$ [5]

Utility is Cobb-Douglas. For type h this is $u^h = x_g{}^{\alpha_1}(x_c^h)^{\alpha_2}(x_l^h)^{\alpha_3}$ where $\alpha = (\alpha_1, \alpha_2, \alpha_3)$ is the taste vector, and $\sum_{i=1}^{3} \alpha_i = 1$, x_g is the public good, x_c^h is the private good, and x_l^h is leisure. Each individual taxpayer-citizen maximizes this utility subject to their own budget

$$y(t,h) \equiv (1-t_l)Tsw + \omega = (1+t_c)p_c x_c^h + x_l^h(1-t_l)sw \quad (2.1)$$

with market prices $p = (p_c, w)$ and tax rates given. This leads to the usual demand equations[6]:

$$x_c^h(s,\omega) = \frac{\alpha_2}{1-\alpha_1}\frac{y(t,h)}{p_c(1+t_c)} \quad (2.2a)$$

and

$$x_l^h(s,\omega) = \frac{\alpha_3}{1-\alpha_1}\frac{y(t,h)}{sw(1-t_l)} = \frac{\alpha_3}{1-\alpha_1}\left(T + \frac{\omega}{sw(1-t_l)}\right) \quad (2.2b)$$

where hours of work are given by

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[5] We will work extensively with **total** after tax income, $y(t;s,\omega) = Tw(s)(1-t_l) + \omega$.

[6] Note that $(\alpha_2/1-\alpha_1) + (\alpha_3/1-\alpha_1) = 1$.

$$l^h = T - x_l^h = \frac{1}{1-\alpha_1}\left(\alpha_2 T - \alpha_3 \frac{\omega^h}{sw(1-t_l)}\right). \qquad (2.3)$$

Note that the presence of endowment income ω in the budget restraint (2.1) insures that labor supply is elastic, so that $dx_l(s,\omega)/dt_l > 0,\ dx_l(s,\omega)/dw < 0$, and $dx_l(s,\omega)/ds < 0$ and hours of work T - l^h rises with wages and skill, and falls with the tax on labor income.[7]

Using these demands, we see that indirect utility for voter h is:

$$v^h(t, p_c) = \left(\frac{\alpha_3}{1-\alpha_1}\right)^{\alpha_3} x_g^{\alpha_1} \left(\frac{\alpha_2}{1-\alpha_1}\frac{y(t,h)}{p_c(1+t_c)}\right)^{\alpha_2} \left(\frac{y(t,h)}{ws(1-t_l)}\right)^{\alpha_3}$$

$$= \left(\frac{\alpha_3}{1-\alpha_1}\right)^{\alpha_3} x_g^{\alpha_1} \left(\frac{\alpha_2}{1-\alpha_1}\frac{1}{p_c(1+t_c)}\right)^{\alpha_2} \frac{y(t,h)^{1-\alpha_1}}{(ws(1-t_l))^{\alpha_3}} \qquad (2.4)$$

2.2 General equilibrium structure

In the above presentation of individual demand, our major concern was to achieve simplicity without losing sight of the essentials. This principle also colors our presentation of the supply side of the economy. We begin by stating key market equilibrium clearing equations:

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[7] In the model, $l^h \geq 0$ implies $\sqrt{s}(1-t_l) \geq (a_3/a_2)(w_0/T)$. This imposes a minimum on s given t_l. Also note that under the condition $\alpha_i = 1/3,\ i = 1,2,3,$ at least one half of time available for work is reserved for leisure.

Equilibrium Condition	***Quantities***	***Price***
Labor	$H^d = H^s$	w
Private Good	$X_c^d = X_c^s$	p_c
Zero Profit	$p_c X_c = wH_c + rK$	r

In the following discussion, we determine the supply of labor (given tax rates), total economic activity, the supply of the consumption good, and the equilibrium price level. With this and other required information, the rental rate *r* is solved for on entering the fixed value of capital (which can be identified with total endowment) in the zero profit condition.

The aggregate level of economic activity is determined by total effective hours of work. In the case where tastes are the same[8], we obtain total mean (effective) hours supplied by totaling over the population where l^h is replaced by $l(s) = l^h$ for voters with skill s,

$$H^s = \int sl(s)dF(h(s,\omega)), \qquad (2.5)$$

giving

$$H^s = \frac{1}{1-\alpha_1}\left(\alpha_2 m_s T - \frac{\alpha_3 m_\omega}{w(1-t_l)}\right) \quad or \quad H^s = \frac{\frac{\alpha_2}{1-\alpha_1}\bar{y} - m_\omega}{w(1-t_l)}. \qquad (2.6)$$

We see that the offer of labor depends on the value of the vectors α and t. The requirement for it to be positive imposes an upper limit on the tax rate $t_l < 1 - \frac{\alpha_3}{\alpha_2}\frac{m_\omega}{m_s T}$.

From (2.4) and (3.2) we can also see that $dl^h / d\omega < 0$ and $dH / dm_\omega < 0$.

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[8] When tastes are subdivided into J groups, (2.5) will be the sum of J parts each defined by the corresponding values of α_1 and α_2.

2.2.1 The allocation of labor to public and private sectors

As shown above, total labor supply H^s depends on the tax system and individual preferences. Once this is determined, the government budget restraint, (2.7) below, then allows us to obtain the labor demanded by the public sector, H_g, which, we shall assume, alone determines output of the public good. (We note that H_g is sensitive to the wage rate through the effect of the wage on tax bases.). The labor left over is made available to the private sector, H_c^s.

We write the government budget restraint as

$$wH_g = t_c pX_c^d + t_l wH \,, \tag{2.7}$$

where X_c^d is the total mean demand for the private good.

To develop this last equation further in order to determine the supply of labor to the private sector, we need to obtain the mean demand for the consumption good. This is achieved by integrating over (2.3) so that

$$X_c^d = \frac{\alpha_2}{1-\alpha_1}\frac{\bar{y}(t)}{p_c\left(1+t_c\right)}. \tag{2.8}$$

Using (2.7), (2.8) becomes

$$wH_g^s = \frac{\alpha_2}{1-\alpha_1}\frac{t_c}{1+t_c}\bar{y}(t) + t_l wH, \tag{2.9}$$

and the supply of work in the private sector can be calculated as

$$H_c^s = H^s - H_g^s = (1-t_l)H - \frac{\alpha_2}{1-\alpha_1}\frac{t_c}{1+t_c}\frac{\overline{y}(t)}{w}$$
$$= \frac{\alpha_2}{1-\alpha_1}\frac{1}{1+t_c}\frac{\overline{y}(t)}{w} - m_\omega. \tag{2.10}$$

The impact on the supply of labor in the private sector with respect to changes in the tax rates can then be shown as $dH_c^s / dt_l < 0$ and $dH_c^s / dt_c < 0$.

2.2.2 Public sector output

As noted earlier, output of the public sector is strictly a function of labor inputs. It is also assumed to be subject to diminishing productivity: $x_g = \left(H_g\right)^i$ where $i \leq 1$. Employing (2.6) and (2.9), we have

$$x_g = \left[\left(\frac{\alpha_2}{1-\alpha_1}\right)\left(\frac{t_c}{1+t_c} + \frac{t_l}{1-t_l}\right)\frac{\overline{y}(t)}{w} - \frac{t_l}{1-t_l}m_\omega\right]^i \tag{2.11}$$

The relative size of government measured in terms of expenditure then can be written as

$$e = \frac{t_c p_c X_c + t_l wH}{p_c X_c + (t_c p_c X_c + t_l wH)} = \frac{t_c p_c X_c + t_l wH}{(1+t_c)p_c X_c + t_l wH},$$

which in turn is the same as

$$(1-t_l)\ \frac{t_c p_c X_c + t_l wH}{\left(\dfrac{\alpha_2}{1-\alpha_1}\overline{y} - t_l m_\omega\right)}. \tag{2.12}$$

Here we see that relative government size increases with mean income as in Wagner's law.

2.2.3 Private sector output

The private good is produced through a CES production function, the output of which represents production for the entire sector. Production requires a fixed level of capital *K*, and labor. We write

$$X_c^s = \left[\beta K^{-b} + (1-\beta)\left(\frac{\alpha_2}{1-\alpha_1} \frac{\overline{y}(t)}{(1+t_c)} - m_\omega \right)^{-b} \right]^{-\frac{1}{b}} \quad (2.13)$$

with $0 < \beta < 1$. Note that $dX^s / dm_s > 0$ and $dX^s / dm_\omega < 0$. The price level for the private good is obtained from the equilibrium condition $X_c^s = X_c^d$, so that

$$p_c = \frac{\frac{\alpha_2}{(1-\alpha_1)} \int y(t,h) dF(h)}{(1+t_c) X_c^s} \quad (2.14)$$

where X^s is defined above in (4.8). Thus consumption of any voter *h* is given as a share of total private consumption,

$$x_c(h) = \frac{y(t,h)}{\overline{y}(t)} \left[\beta \overline{K}^{-b} + (1-\beta)\left(\frac{\alpha_2}{1-\alpha_1} \frac{\overline{y}(t)}{(1+t_c)} - m_\omega \right)^{-b} \right]^{-\frac{1}{b}}$$

. (2.15)

Note that consumption rises with increases in wages and with individual endowments.

We are now able to write utility in its reduced or indirect form as a function of the tax vector alone, with the public good left as a residual that can be determined from the government budget restraint:

$$v^h(t) = \left(\frac{\alpha_3}{1-\alpha_1}\right)^{\alpha_3} \frac{x_g(t)^{\alpha_1}}{\bar{y}(t)^{\alpha_2}} \left[\beta \bar{K}^{-b} + (1-\beta)\left(\frac{\alpha_2}{1-\alpha_1}\frac{\bar{y}(t)}{(1+t_c)} - m_\omega\right)^{-b}\right]^{-\frac{\alpha_2}{b}}$$

$$\times \frac{y(t;h)^{1-\alpha_1}}{\left[s(h)(1-t_l)\right]^{\alpha_3}}. \qquad (2.16)$$

This indirect utility function is used in specifying the political equilibrium, a task to which we turn in the next section.

3. COMPETITIVE POLITICAL EQUILIBRIUM: USING THE REPRESENTATION THEOREM

There are two vote maximizing political parties, denoted by 1 and 2. By assumption, there always is a positive probability of voting by person *h* for the platform of either party 1, where $t^1 = (t_l^1, t_c^1)$ is the vector of tax rates for party 1. (Similarly for party 2.) As is common in the literature, this probability is assumed to be a function of the difference in utilities received from the promised platform of the two parties: $f(v^h(t_1) - v^h(t_2))$.

The expected number of votes for party 1 then is given by the expectation

$$EV_1 = \int [f(v^h(t_1) - v^h(t_2))] dF^h .$$

In the absence of abstention, the expected vote for party 2 is $EV_2 = N - EV_1$.

The parties choose platforms to maximize expected votes, given the platform of the opposition, in a non-cooperative Nash electoral equilibrium. Party 1's platform in this equilibrium must satisfy the first order condition:

$$\frac{\partial EV_1}{\partial t} = \int \left(\frac{\partial f}{\partial v^h}\right)\frac{\partial v^h}{\partial t}\, dF^h = 0 \,. \qquad (3.1)$$

Since the same conditions apply to party 2 (because $EV_2 = N - EV_1$), the platforms of the parties will converge in the equilibrium.

To actually simulate the nature of policy instruments in the equilibrium under various parameter values, we make use of the Representation Theorem for such political economies, as noted earlier. In the present context, on considering the political support function

$$S = Max\left[\int c_h v^h(t)\, dF^h\right],$$

where $c_h = \partial f / \partial v^h$ is the sensitivity of the probability of voting to a change in individual welfare taken from the Nash equilibrium, it can be seen that that the first order condition for maximizing this support function

$$\frac{\partial S}{\partial t} = \int c_h \frac{\partial v^h}{\partial t} dF^h \qquad (3.2)$$

is identical to condition (3.1). Hence choosing policy instruments to maximize S will generate the equilibrium policy platform.

Concerning second order conditions, the Representation Theorem requires concavity of the support function S with respect to policy instruments, and is equivalent to assuming that the parties can each choose expected vote maximizing platforms. This property is considered further in the next section.

Given our assumptions about the political weights, the following proposition gives the form of the support function that we actually maximize after the appropriate parameter values have been specified.

Proposition 1:

$$S(t) = \iint \chi(s,\omega) \frac{\alpha_3^{\alpha_3}}{(1-\alpha_1)^{1-\alpha_1}} x_g^{\alpha_1} X_c^{\alpha_2} \frac{\left[\left(Ts(1-t_l)+\omega\right)\right]^{1-\alpha_1}}{\overline{y}(t)^{-\alpha_2}\left[s(1-t_l)\right]^{\alpha_3}} dF^s dF^\omega$$

$$= k \iint \chi(s,\omega) \frac{\left[\left(Ts(1-t_l)+\omega\right)\right]^{1-\alpha_1}}{\left[s(1-t_l)\right]^{\alpha_3}} dF^s dF^\omega \qquad (3.3a)$$

where

$$k = \frac{\alpha_3^{\alpha_3}}{(1-\alpha_1)^{1-\alpha_1}} \left\{ \left(\frac{\alpha_2}{1-\alpha_1}\right)\left(\frac{t_c}{1+t_c}+\frac{t_l}{1-t_l}\right)\overline{y}(t) - \frac{t_l}{1-t_l} m_\omega \right\}^{i\alpha_1}$$

$$\times \left[\beta K^{-b} + (1-\beta)\left(\frac{\alpha_2}{1-\alpha_1} \frac{\overline{y}(t)}{(1+t_c)} - m_\omega \right)^{-b} \right]^{-\frac{\alpha_2}{b}} \overline{y}(t)^{-\alpha_2}$$

(3.3b)

is independent of skills s (but dependent on t), and
$\overline{y}(t) = \int_R \int_R y(t,s,\omega)\, dF^s(s) dF^\omega(\omega) = m_s w T(1-t_l) + m_\omega$.

Proof: By straightforward if somewhat tedious substitution from the conditions stated in section two and three above. Note that the public good does not appear here. Given the tax rates, public output can be derived using the production for public services and the government budget restraint.

The general equilibrium of the competitive political economy we are modeling is found by actually maximizing the reduced form (3.3) for assumed parameter values[9]. Expression (3.3) contains all the market adjustments that individuals and the economy will make in response to changes in policy instruments (the vector *t*) as well as to changes in the key parameters including the vector α among others. The first term in the rather complicated expression (3.3b) following the constant shows this transfer from the private sector to the public sector. The second term represents aggregate private consumption, and being an aggregate it is independent of skills *s.* The fact that labor income tax leads to an increase in leisure is shown in the denominator of the integral in expression (3.3a).

4. EXPLORING THE TAX MIX AND THE SIZE OF GOVERNMENT IN BALANCED AND ASYMMETRIC SOCIETIES

The key elements that are varied in the simulation experiments are the moments of the distributions of *skills* (pre-fisc incomes), of *tastes for public goods* and of *political influence* (the weights in the political sup-

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[9] Allowing tastes to be variable from one person to the next will complicate our notation. Once the population of voters are partitioned into J taste groups, in a way to be described below. Proposition 1 will become a weighted sum $S(t) = \alpha_{3,j}^{\alpha_{3,j}} \sum_{j=1}^{J} c_j \cdot (x_g^j)^{\alpha_{1,j}} q^{\alpha_{2,j}} \overline{y}^{\alpha_{2,j}} I_j \cdot$ Here:

$$c_j = \frac{1}{(1-\alpha_{1,j})^{1-\alpha_{1,j}}},$$

$$x_g^j = \left\{ \left(\frac{t_c}{1+t_c} + \frac{t_l}{1-t_l} \right) \sum_{r=1}^{3} \left(\frac{\alpha_{2,r}}{1-\alpha_{1,r}} \right) \overline{y}_r(t) - \frac{t_l}{1-t_l} m_\omega \right\}^i ,$$

$$q = \left[\beta K^{-b} + (1-\beta) \left(\frac{1}{(1+t_c)} \sum_{r=1}^{3} \frac{\alpha_{2,r}}{1-\alpha_{1,r}} \overline{y}_r(t) - m_\omega \right)^{-b} \right]^{-\frac{1}{b}},$$

$$I_j = \iint \chi(s,\omega) \frac{\left[\left(Ts(1-t_l) + \omega \right) \right]^{1-\alpha_{1,j}}}{\left[s(1-t_l) \right]^{\alpha_3}} dF_j^s dF_j^\omega \cdot$$

port function. To select meaningful combinations of these elements from the large set of possibilities, we define two basic types of societies. In the ***balanced*** society, the distributions are (with the partial exception of tastes) symmetrical around the mean, and experiments isolate the effects of changes in selected means and variances. A balanced ***homogeneous*** society which we also explore here is a limiting case of this type, where everyone is identical with respect to tastes but not income. It makes little sense to us to consider a society in which everyone is *completely* identical, as there then is no interesting collective choice problem to investigate.

In these two types of societies, as we have been able to actually implement them, we do not fully explore all three moments of the distributions of tastes for the public good. We consider variation in mean tastes, and compare societies with homogeneous and heterogeneous tastes. A full accounting for skewness in the distribution of tastes will have to await further research.

In the ***asymmetric*** society, we introduce skewness in the distributions of skill and influence and compare results to those of the balanced case. Here, among other experiments, we replicate in the present context the central experiment of median voter models in which the skewness of skills (represented usually by the ratio of median to mean income) increases. It is important to note that while in a median voter model it is only possible to consider how such a shock affects the size of government (or one overall tax rate), the spatial voting framework developed here allows investigation of the consequences of increasing income inequality for the income/consumption tax mix as well.

The economy, as embodied in Proposition 1, is defined by the parameters that fix the Cobb-Douglas preferences (the a 's), the production functions, and a coefficient of endowment with respect to skills c in ω =

$c\sqrt{s}$, a simplifying relation used in the simulation model to specify the distribution of endowments and its relation to individual skill levels.[10] The parameters for the production functions were fixed and that for the coefficient of endowment left free, in order to find a set of values of the taste parameters that yield concavity for the political support function (3.3) with positive tax rates.

The simulations were conducted using the nonlinear optimization package and the three-dimensional plotting package of Maple 10. With the help of its plotting package, we were able to verify by a visual examination the existence of concavity of the support function with the vector $(\alpha_1, \alpha_2, \alpha_3) = (0.3,0.3, 0.4)$ and with tax rates in the region $[0,1) \times [0,1)$ of t for a range for the parameter c mentioned above. A final consideration for calibrating the free parameter c is that the model was adjusted by altering it so that the size of government relative to aggregate income in initial solutions for the balanced society is approximately 50% . It turns out that when this is done, there is an interior solution for both tax rates in most, but not all, instances. Some corner solutions do emerge and these also provides useful intuition about the determinants of fiscal structure. Further details concerning the specification of the distribution of skills, tastes and political influence in our experiments are provided in the rest of this section.

4.1 Skills

In the standard balanced society, all distributions are assumed to be normal. Since the normal distribution has the property of tailing off to infinity in both directions, the mean of skills has to be sufficiently above the origin to prevent a tail from attributing negative skills to

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[10] This parameter thus fixes the mean value, m_ω, of the endowments.

a significant part of the population. (We want this part of the tail to be near very small) For the same reason, changes in the variance of skills has to be limited. The reference skill distribution for a standard balanced society is a normal with mean μ_s = 700 and variance $\sigma^2 = 5 \times 10^4$.

In the first experiment we consider changes in mean skills, where an increase leaves everyone better off. This will affect the overall size of the economy and the demand for leisure, the latter reflecting the choice of the Cobb-Douglas form for utility. We then consider changes in the variance of the skills of some voters. This again affects the overall demand for leisure, x_l , *a* factor that has a significant influence on the equilibrium tax mix when we consider variations in the moments of the distribution of income.

For the asymmetric society, the distribution of skills is specified by a Gamma distribution[11], and the same experiments described above are repeated and augmented by changes in skewness in the skill distribution.[12] The Gamma is chosen because it can be used to replicate a situation in which the distribution of skills is skewed to the right, so that there are a relatively larger number of poorer taxpayers.

Political influence is also asymmetric between 'rich' and 'poor' in these experiments in a manner de-

[11]Ideally the distribution of skills should be skewed to the right, so that there is a high population of lower skilled and a smaller population of higher skilled people. This pattern can be obtained by, among others, the gamma function, used in simulating the asymmetric society later on.

[12] For an independent change in skewness we need a 3-parameter distribution. This is not available in the typical 2-parameter empirical distributions, including the Gamma distribution, so changes in skewness will be followed by movements in variance.

scribed below. One should note that for an independent change in skewness, we need a 3-parameter distribution. This is not available in the typical 2-parameter empirical distributions, including the Gamma distribution, employed here. So changes in skewness, when they are introduced in the asymmetric society, will be accompanied by movements in variance that need to be taken into account.

4.2 Tastes

We consider two approaches to the question of the distribution of tastes. The first is that applicable to the balanced society in which symmetry is achieved by assigning the same tastes to everyone, at a point located at the $(\alpha_1, \alpha_2, \alpha_3) = (0.3, 0.3, 0.4)$ noted earlier. This is more than simply balanced or symmetrical, and we refer to it as a situation of *homogeneous* tastes. Second, a symmetric but non-homogeneous distribution is defined over a field of five different taste groups of voters as follows.

Assuming five groups, we fix population weights $\{w_j\} = (0.1, 0.2, 0.4, 0.2, 0.1)$, reading from low to high skills. We may think of these groups as: *1= the poor; 2 = lower income citizens; 3 = middle income citizens; 4 = upper income citizens; and 5 = the rich*. The distribution is constructed to be symmetrical about the largest, middle income group. These skill groups form the taste matrix below.

In Table 1, the first column of the taste matrix applies to the lower 10% of the skill distri-bution, the second to the next 20%, and so on. The rows refer to the value of the preference parameters for the three goods in the Cobb-Douglas utility functions:

TABLE 1
Distribution of Tastes (α_I) For The Public Good

Group	1	2	3	4	5
α_1	.4	.35	.3	.25	.2
α_2	.2	.25	.3	.35	.4
α_3	.4	.4	.4	.4	.4

The groups thus differ only in their relative preference for the public and private goods. A low preference for the public good in row 1 goes along with a high preference for the private good in row 2, and vice versa. By assumption, the poorest have the greatest taste for the public good, while the rich have the weakest.[13] The numerical values for the rows have averages equal to (0.3, 0.3, 0.4), the values for the third group and the ones used in the homogeneous taste case.

One should note that when we change the distribution of skills in the simulations, we shall do this in a manner such that the partition of the population over the five taste groups remains the same. This is done even though it may imply that the lower end of the skill distribution will include (or exclude) progressively poorer voters and the rich end will include (or exclude) richer voters.

4.3 Political influence

In a balanced society, the (normal) distribution of skills also represents the number of individuals in each income group, so that the distributions of individuals and of the effective influence of each group are centered on mean skills and are symmetric. The distribution of political influence $c(s)$ in (3.3) of an individual with

[13] This assumption seems reasonable to us. But we know of no empirical evidence on the matter.

skill s can in principle be different than the distribution of skills or the number of voters. One should note however, that everyone, regardless of income level must have some degree of (positive) influence, even if it is small. Otherwise, in theory, a vote-cycle rather than an equilibrium may emerge.[14]

It proves convenient to discuss the details of how the distribution of influence is specified in an asymmetric society in a later section.

5. SIMULATING A BALANCED SOCIETY

In the following experiments as far as possible we use the model as its own control, judging the pattern of out comes in relation to each other. We also venture some comments about levels of policy instruments, though here we are on less firm ground. The experiments we discuss are mainly recorded in charts throughout the rest of the paper where the following variables are shown: t_l = the tax rate on labor income; t_c = the consumption tax rate; and the relative size of government, *gsize* = $wx_g / (pX_c + wx_g)$, the ratio of government expenditures to total expenditures or total income.

We chart tax rates rather than tax revenues for convenience. In the present model, revenues from each source are always monotonically related to tax rates, and we do not want to overload the amount of information presented in each diagram.

[14] On this point, see for example, Hettich and Winer (1999) chapter 2 and the references cited therein.

5.1 A change in the mean of skills with homogeneous and heterogeneous preferences for the public good

Table 2 and 3 record experiments for the balanced society involving a change in mean skills (or in before-fisc incomes) from 700 to a value of 1000 for a normal distribution of skills (*s*) with variance $5x10^4$. The first table shows equilibrium tax rates and government relative size for a homogeneous population with the same set of preferences, whereas Table 2 shows the result for the same experiments involving a heterogeneous population partitioned into the taste groups defined earlier.

The tables illustrate how the equilibrium tax rates on labor (**tl**), on consumption (**tc**), the tax ratio (**tl/tc)** and the relative size of government (**gsize**) change with increasing mean skills. As the tax income base grows with the mean of skills, the relative reliance on income as opposed to consumption taxation increases, and the size of govern-ment grows. Table 3 is also represented as graphical Chart 1 below the tables. The key results regarding the tax ratio are highlighted in red in the tables.

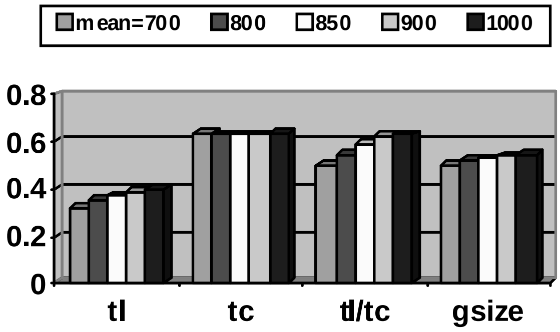
TABLE 2
A balanced society with homogeneous tastes.
Skill variance = 5 x 10^4. Change in mean skills.

mean	***tl***	***tc***	***tl/tc***	***gsize***
700	0.20	0.80	**0.25**	0.51
800	0.25	0.79	**0.32**	0.53
850	0.28	0.78	**0.36**	0.53
900	0.31	0.76	**0.40**	0.54
1000	0.34	0.78	**0.44**	0.56

TABLE 3
A balanced society with heterogeneous tastes.
Skill variance= 5 x 10^4. Change in mean skills.

mean	***tl***	***tc***	***tl/tc***	***gsize***
700	0.32	0.64	**0.50**	0.50
800	0.35	0.63	**0.55**	0.52
850	0.37	0.63	**0.59**	0.53
900	0.39	0.63	**0.62**	0.54
1000	0.40	0.64	**0.63**	0.55

CHART 1 (for Table 3)
A balanced society with heterogenous tastes. Skill variance= 5 x 10^4. Change in mean skills.



In accordance with model structure, the demand for work effort increases with skills.[15] The excess burden of income taxation also falls at any given tax rate as the base expands. Political competition then forces the incumbent government to increase reliance on this tax source. This is the base effect in Hettich and Winer (1999, chapter 3) which has been confirmed for a large

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[15] See equation (2.3), for which: $dl^h / ds > 0,\ d^2 l^h / ds^2 < 0.$

panel of countries by Kenny and Winer (2006). Since the overall cost of raising revenue has declined, the size of government also increases.

Additional insight concerning the tax mix in the balanced society can be obtained from studying the difference between situations with homogeneous and heterogeneous tastes in Tables 2 and 3 respectively. The increased variance in preferences (in Table 3) implies a difference in demand for leisure from the homogenous case, with the higher skilled taxpayer-voters now desiring less leisure compared to the less skilled. As equation (2.2b) shows[16], when the preference for the public good x_g (α_I) decreases, the demand for leisure decreases. Thus the rich work more and the income tax base expands. This decline in leisure demand contributes to the difference in the tax mix in the two situations. In the heterogeneous case in Table 2, we see that the income tax revenue and rate is higher and the consumption tax and rate lower, for the same size of government.

What we learn here is that in a balanced society, diversity of tastes for public and private goods influences not just the level of public services, but also the tax structure. The key is how such diversity affects work effort, hence the relative size of consumption and labor income tax bases. In Usher (1977), diversity of tastes for public services determines whether a private good is brought within the public sector. The observation that heterogeneity in tastes also influences tax structure through its effects on the elasticity of tax bases appears to be new to the taxation literature.

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[16] We see there that $dx_l / da_1 > 0$.

5.2 The role of the variance of skills

The effects of an increase in variance of skills, with mean skill held constant, is shown in Table 4 for homogenous tastes and in Table 5 for heterogeneous tastes. In both tables, as the variance grows, t_l rises and t_c falls, with government relative size remaining more or less the same. There is, thus, a reduction in relative reliance on consumption taxation as the variance in skills increases.

TABLE 4
A homogenous (in tastes) society.
Mean skill = 850. Change in variance of skills.

variance	*tl*	*tc*	*tl/tc*	*gsize*
10000	0.22	0.88	**0.25**	0.54
20000	0.23	0.85	**0.27**	0.54
30000	0.24	0.84	**0.29**	0.54
40000	0.25	0.82	**0.30**	0.54
50000	0.27	0.79	**0.34**	0.54

TABLE 5
A heterogeneous (in tastes) society.
Mean skill = 850. Change in variance of skills.

variance	*tl*	*tc*	*tl/tc*	*gsize*
10000	0.32	0.7	**0.46**	0.53
20000	0.33	0.68	**0.48**	0.53
30000	0.35	0.66	**0.53**	0.53
40000	0.37	0.63	**0.59**	0.53
50000	0.38	0.62	**0.61**	0.53

This last result is foreshadowed by Cukierman and Meltzer (1991) where an increase in income inequality increases the size of government, because total income and income taxation (the only base in their model) rises as a result of the different elasticities of labor supply of the rich and the poor.[17]

Here, however, we see changes in the tax mix even though the size of the income tax base stays more or less constant and the relative size of the public sector does not change. In our model, the size of the total economy and the relative size of the public sector depend on *mean* skills, not its spread (see again equations 2.11 and 2.12). With the increasing spread in skills, those whose skills decline reduce work hours to a greater extent than the gain in hours made by those whose skill increases. (For example, in going from a variance of 5×10^3 to a spread of 25×10^3 (not shown in the tables) we lose about 7% of total labor supply). But in our specification of demand, the amount of efficiency hours remains unchanged as lower skilled people contribute less to output than do higher skilled workers, so
that the size of the economy itself is not affected.

Let us examine the change in tax structure further by imposing a near zero dispersion in skills ($s=1$) and hence in income, so that there are no rich or poor relative to the mean.[18] The results, illustrated only graphically here in Chart 2, shows three cases in which the mean of skills increases from 500 to 1200.

The population with low mean skills equal to 500 has relatively low income, both earned and from their endowments. Then the elasticity of leisure with respect to income is relatively high (see equation 2.2b), and a tax on labor income represents a relatively strong disincentive to work for everyone. It is therefore optim-

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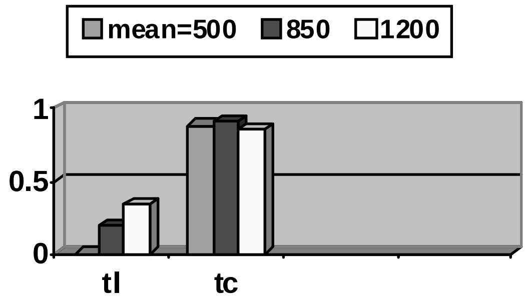
[17] See the paper by Mohl and Pamp (2008) in part 1 of this special issue for a review of the relevant literature.

[18] The presence of some distribution is essential, however small the dispersion, as otherwise there is no equilibrium in the model for a small countable number of voters.

al when maximizing expected votes to have a lower t_l, and in the case of mean skills of 500 this leads to a corner solution where there is no labor income taxation ($t_l = 0$).[19]

CHART 2
A homogeneous society with minimal (= 1) skill variance.



One interpretation of this corner situation is that labor income is taxed as little as possible to make gross incomes as high as possible. Desired public services are then financed by directly diverting private expenditure to the public purse, a use of the consumption tax we shall see again in other experiments.

5.3 Mean tastes for the public good

Now we consider an increase in mean tastes for the public good with a given variance. Starting with the five groups specified in Table 1, we change only the taste for the public good of the middle (40%) of the skill distribution, thus altering the overall mean as indicated in Table 6, with 0.3 representing the initial situation as in Table 1.

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[19] Only the chart that corresponds to the smallest variance (= 1) is shown here.

Table 6 records the results of the experiments, where the tax ratio is divided by 10 for ease of exposition. We see that in a balanced society with heterogeneous tastes, an *increase* in the mean taste for the public good results in a *lower* equilibrium income tax rate and a higher consumption tax rate than otherwise. The share of the public sector in the economy rises only slightly.

TABLE 6
A balanced society with heterogeneous tastes.
Change in mean taste for the public good.

mean	***tl***	***tc***	***(tl/tc)/10***	***gsize***
0.26	0.26	0.56	**0.46**	0.45
0.28	0.21	0.64	**0.33**	0.46
0.3	0.12	0.77	**0.15**	0.47
0.32	0.00	0.94	**-**	0.48

The response in the electoral equilibrium comes about since both private consumption demand and labor supply undergo changes with the change in preference for the public good. The former becomes *less* elastic as the mean taste for x_g increases, so that the consumption tax rate can be higher for the same level of consumption (see equation 2.2). The reduction in the elasticity of the consumption base thus leads to greater reliance on consumption taxation and reduced reliance on labor income taxation. The overall change in the tax mix is accompanied by a slight enlargement of the public sector in relation to the economy. So an increase in the mean preference for public services has an effect similar to that of a decrease in the variance of skills.

This simulation again shows the importance of the interaction of the taste for public goods and tax structure via the tax-elasticity of the different bases. It should be noted that the specific nature of this interaction depends on the model structure that we have adopted. But, in general, it is reasonable to expect some adjustment of this sort.

It is interesting at this point to compare the results here with those in Renstrom (1996) for more or less the same experiment - when the preference for the public good increases. Renstrom uses a quasi-linear specification of preferences which allocates to labor all the income effect from the increase in the tax required when the demand for the public good increases.[20] In this model, the income effect increases labor supply (as well as reducing consumption), which means that it is then more efficient to tax labor income relatively more than consumption. In the present Cobb-Douglas specification, this income effect is distributed across all demands more equally. Consequently labor supply here tends to be lower following the same shock to tastes for the public good than in Renstrom's model, and the incumbent government then taxes consumption relatively more heavily compared to what happens in Renstrom's model.

The comparison with the Renstrom model illustrates how the basic specification adopted colors the results of the experiments. We shall return to the importance of model specification in our concluding remarks.

5.4 Political influence in the balanced society

To complete our study of the balanced society, we consider the effect of increased inequality in political influence. By assumption, the effect of an increase in the spread of the normal distribution of political influence is the same as if skills became less dispersed, as

[20] Renstrom's model is a dynamic one in some respects, and includes a consumption savings margin. But the intuition one gets from it following a shock to tastes for the public good applies to the present static framework in a straightforward manner.

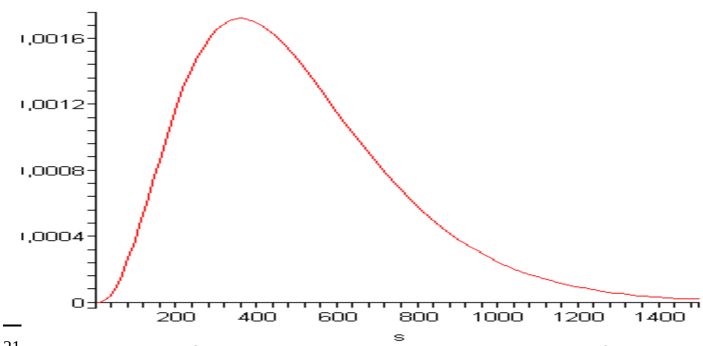
noted earlier. (This is confirmed by experiments with changes in the dispersion of the influence weights which are not reported here.) It follows that when political influence becomes more equal across income groups in a balanced society, that is, when the variance of skills increases, consumption taxation will decline relative to the taxation of labor incomes.

The effects of independent changes in the moments of the distributions of skills and influence will be addressed in the asymmetric society, to which we now turn.

6. AN ASYMMETRIC SOCIETY

The asymmetric society we examine is endowed with a skill distribution specified by a Gamma function. The two parameter Gamma function allows the introduc-tion of skewness and has some resemblance to empirical income distributions. An example with mean and variance $\mu = 500$ and $\sigma^2 = 7 \times 10^4$ is given in Figure 1 below.[21]

FIGURE 1
The Distribution of Skills in the Asymmetric Society



[21] By a change of variables the usual parameters a,b of a standard gamma function $ae^{-as}(as)^{b-1}/\Gamma(b)$ become μ and σ^2. We can also change the mean by simply displacing the entire function to the right.

6.1 Comparing the asymmetric and balanced societies

We want to compare the results of experiments with the asymmetric society with those for the balanced society. So the experiments here are analogous to those for the balanced society, except that some restrictions due to the use of the Gamma distribution are necessary. We examine the equilibrium effects of changes in the mean of the skill distribution and in its variance, both with homogeneous and heterogeneous tastes for the public good. This is then followed by a consideration of the effects of changing the distribution of political influence.

We begin by considering a change in the mean of skills when skills are distributed asymmetrically, as shown in Table. This is to be compared with its balanced society counterpart, Table 2 above, which is reproduced here.

TABLE 2 (reproduced)
A balanced society with homogeneous tastes.
Skill variance = 5 x 10^4. Change in mean skills.

mean	***tl***	***tc***	***tl/tc***	***gsize***
700	0.20	0.80	**0.25**	0.51
800	0.25	0.79	**0.32**	0.53
850	0.28	0.78	**0.36**	0.53
900	0.31	0.76	**0.40**	0.54
1000	0.34	0.78	**0.44**	0.56

TABLE 7
An asymmetric (in skills) society with homogeneous tastes. Skill variance = 5 x 10^4 . Change in mean skills.

mean	*tl*	*Tc*	*tl/tc*	*gsize*
800	0.30	0.72	**0.42**	0.53
900	0.32	0.74	**0.43**	0.54
1000	0.36	0.73	**0.49**	0.56
1100	0.40	0.70	**0.57**	0.57
1200	0.41	0.73	**0.56**	0.58

In both Table 7 and Table 2, political influence is uniformly distributed and tastes are homogeneous.[22] We note also that the range of means used in Table 7 is wider than in Table 2, to deal with the specific characteristics of the Gamma distribution used to model skill asymmetry. The problem is that the normal distribution used in Table 1 has long symmetric tails unlike the Gamma distribution, so that an exact comparison for all means is not possible.

The ratio of t_l / t_c has a similar pattern in both charts up to a mean of 1000. The experiment with parameters mean = 1000 for both societies leads to an equilibrium of t_l = 0.34 and t_c = 0.78 for the balanced society, and t_l = 0.36 and t_c = 0.73 for the asymmetric society, a fairly close match. When the mean increases above 1100 in the asymmetric case, we see that the tax ratio begins to reverse itself.

[22] As before, uniform political influence means that all voters have equal per capita weight in the political support function, and each group has a weight that depends on its population size.

To assess the case with heterogeneous tastes, we reproduce Table 3 alongside the new Table 8 which reports the results of changing the mean of skills in the asymmetric society when tastes are heterogeneous. The reader is warned that the variance is double in the asymmetric society case compared to that of the balanced society. The reason is that any lower variance for the Gamma distribution causes it to resemble too closely the normal one used to compute Table 3, thus losing the asymmetry we need.

TABLE 3 (reproduced)
A balanced society with heterogeneous tastes.
Skill variance= 5 x 10^4. Change in mean skills.

mean	*tl*	*tc*	*tl/tc*	*gsize*
700	0.32	0.64	**0.50**	0.50
800	0.35	0.63	**0.55**	0.52
850	0.37	0.63	**0.59**	0.53
900	0.39	0.63	**0.62**	0.54
1000	0.40	0.64	**0.63**	0.55

TABLE 8
An asymmetric (in skills) society with heterogeneous tastes. Skill variance = 2 X 5 x 10^4 . Change in mean skills.

mean	*tl*	*tc*	*(tl/tc)/10*	*gsize*
500	0.33	0.49	**0.072**	0.46
600	0.44	0.46	**0.096**	0.50
700	0.58	0.34	**0.17**	0.48
800	0.7	0.21	**0.33**	0.41
900	0.8	0.09	**0.89**	0.61

Nonetheless, we can make the following observations. When tastes are heterogeneous, the relative size of the public sector loses its smooth rise when mean skills increase (Table 8 vs. Table 3), while the consumption tax rate exhibits a steep fall compared to what happens in the balanced society. Here (Table 8) there are more people concentrated below the average skill level, and these people now have a relatively higher demand for the public good. We see then that the asymmetry of skills interacts with the heterogeneity in tastes to produce a pronounced drop in reliance on consumption taxation as mean income rises and it becomes more attractive to redistribute larger incomes downwards to finance an increase in government size.

Put in the opposite manner, we see that when mean income *falls* in the asymmetric, heterogeneous taste case, voters with incomes below the mean who also have a strong preference for the public good prefer more consumption taxation to the taxation of income. There is then less incentive to use the income tax to redistribute downwards (incomes above those of the poor are lower), and a greater incentive to avoid the excess burden of the tax on labor income. But the numerous poorer voters still want public ser
vices that must be financed.

6.2 Changing the degree of asymmetry in skills with a given mean

As we have pointed out, the influence of the third moment of skills cannot be examined independently of the second moment in the Gamma-distributed asymmetric society, since such empirical distributions are defined by two parameters only. (That is why we shall also not consider what happens when the variance of skills increases in the asymmetric case.) A simple and often used measure of the deviation from a symmetric distribution of skills, which we can adjust, is E = *mean/median,* which is greater than one in the asymmetric society.

The experiments based on changing E are recorded in Table 9 and Chart 3 below, where the distribution of skills is a Gamma distribution with a fixed mean $= 500$, but displaced to the right by 100 to ensure that the supply of work is positive. (This does not affect the calculation of E). For a variance ranging from 50,000 to 150,000 the corresponding indicator E is given in the legend. Here tastes are homogeneous as in Table 7. For comparison purposes, Table 4 from the balanced society is reproduced here.

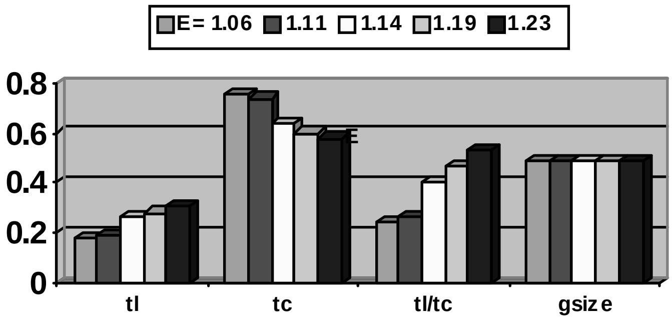
TABLE 4 (reproduced)
A homogenous (in tastes) society.
Mean skill = 850. Change in variance of skills.

variance	*tl*	*tc*	*tl/tc*	*Gsize*
10000	0.22	0.88	**0.25**	0.54
20000	0.23	0.85	**0.27**	0.54
30000	0.24	0.84	**0.29**	0.54
40000	0.25	0.82	**0.30**	0.54
50000	0.27	0.79	**0.34**	0.54

TABLE 9
An asymmetric society with homogeneous tastes.
Mean skill = 500 (Gamma).
Change in skewness of the skill distribution.

E	*Tl*	*tc*	*tl/tc*	*gsize*
1.06	0.18	0.76	**0.24**	0.49
1.11	0.19	0.74	**0.26**	0.49
1.14	0.26	0.64	**0.40**	0.49
1.19	0.28	0.60	**0.47**	0.49
1.23	0.31	0.58	**0.53**	0.49

CHART 3 (for Table 9)
An asymmetric society with homogeneous tastes.
Mean skill = 500 (Gamma).
Change in skewness of the skill distribution.



The experimental setup now is similar to that of a median voter model, such as the one used by Meltzer and Richard (1983), where the income distribution becomes more skewed to the right so that mean income rises relative to its median. However, in contrast to the median voter model, we can determine here how changes in the skewness of the distribution of skills affects tax structure as well as *gsize*.

Table 9 and Chart 3 show that as *E* increases, the labor income tax rate increases and the consumption tax rate falls, while the relative size of the public sector remains the same. As explained above, the latter depends importantly on mean skills which is fixed in these experiments. A large *E* results in an increase in the dominance of lower income voters, even though those at the high end are becoming even richer. This predominance of the poor then translates into greater reliance on income taxation which, given the relatively higher propensity of the rich to work, does not overly discourage work effort. As this experiment shows, the effect is similar to what happened in the balanced society when the variance of skills increased.

The overall effect on tax structure, qualitatively speaking, is also similar to what happened above when we altered mean skills in the asymmetric society, with a given degree of asymmetry in the skill distribution (see Table 7). The difference here is that *gsize* remains fixed because the mean skill level is also fixed. Thus a combination of the two types of experiments (increasing skewness accompanied by increasing average incomes) would lead to greater reliance on income taxation along with growth in the relative size of the public sector.

These results quite sensibly extend the median voter logic to the consumption - income tax mix. As the distribution of income becomes more skewed to the right, the tax mix shifts away from consumption and towards the taxation of labor income.

6.3 Political influence in the asymmetric society

Finally, we consider the importance of asymmetry in the distribution of political influence. In the balanced society, relative political influence was symmetrical and changes in influence had effects that were similar but opposite in direction to changes in the variance of the distribution of skills. To investigate the consequence of political influence for the tax mix, we need to go beyond symmetry. Accordingly, we consider a step function over a Gamma skill distribution.[23] Such an influence function allows a certain degree of influ-

[23] We employ a special influence function, $\left\{ \begin{array}{ll} f = 0.1 & s \in \Lambda \\ f = .99 & s \in \mathbf{R}_{+} - \Lambda \end{array} \right\}$

where Λ is the set of very small political influence, not necessarily connected. In this context, while the welfare of voters in the set Λ are not considered in the policy of the government, they remain present in the economy. The model for this experiment is defined by the Gamma skill distribution $\mu = 600, \sigma^2 = 5 \times 10^3$. In the case where Λ is empty, everyone participates equally in the support function and the influence is called uniform.

ence to all voters but the tables below give the results of a 99% concentration of political influence on the subgroup shown. One should note that the effects of alteration in the distribution of influence cannot be considered in a median voter model of direct democracy where each citizen has one effective vote.

The impact of the asymmetrical distributions of influence has some interesting features, especially with respect to the differences between the homogeneous society and the heterogeneous society. In the former - see Table 10 below - the relative size of the government is unchanged in spite of the radical difference in political influence shown. Moreover, tax structure is affected hardly at all.[24] This stability seems to reflect the condition of identical preferences and the given distribution of skills.

TABLE 10
Homogeneous (taste) society.
Skills distributed asymmetrically.

Income subgroup with heavy influence*	t_l	t_c	***tl/tc***	***Gsize***
All voters, i.e. uniform	0.25	0.66	**0.38**	0.49
Lower 10% of income	0.24	0.68	**0.35**	0.49
Middle 40%	0.27	0.64	**0.42**	0.49
Upper 10%	0.24	0.66	**0.36**	0.49

* 'Heavy' here means 99% of the influence.

[24] In these experiments particularly, the curvature of the objective function in the maximization problem is less than usual so that repeated trials using the non-linear optimization package in Maple gives slightly different answers (to 10 decimals), all within a reasonably small neighborhood. We report the mean of a small number of trials.

TABLE 11
Heterogeneous (taste) society.
Skills distributed asymmetrically.

Income subgroup with heavy influence*	***tl***	***tc***	***tl/tc***	***gsize***
All voters, i.e. uniform	0.44	0.46	**0.96**	0.50
Lower 10% of income	0.23	0.96	**0.24**	0.56
Middle 40%	0.43	0.46	**0.93**	0.50
Upper 10%	0.60	0.60	**1.00**	0.36

* 'Heavy' here means 99% of the influence.

However, when the various income groups have different preferences, the story changes, as Table 11 illustrates. Even when everyone is politically equal, policy outcomes are different reflecting complicated interactions between tastes, skills and the political equilibrium. When the voting influence of the poor with a relatively high preference for the public good is greater than that of other groups, we see the public sector grow (as expected). Moreover, the equilibrium tax mix now leans heavily towards consumption: lower income voters prefer to tax consumption to finance a larger public sector, given the same asymmetric distribution of income, rather than tax their own incomes more heavily along with that of the rich.[25] With influence concentrated in the middle, not surprisingly we see equilibrium tax rates close to the results for the case of uniform influence.

Finally, in contrast to the two cases above, the rich, with a low preference for the public good and a higher taste for private consumption, when influential,

[25] This last result might change if the tax system were more complicated, allowing the poor to tax only the rich with a steeply progressive income tax structure.

desire a more balanced tax mix than do the poor or even middle income voters.

7. CONCLUSIONS

Using simulation of a multi-dimensional spatial voting model, we have explored the determinants of the equilibrium consumption - labor income tax mix and the relative size of government. The simulation model we used allows for selected changes in the first three moments of the distributions of skills, tastes for public versus private goods and of political influence. Some of these moments have been investigated, one or two at a time, in the existing political economy of taxation literature, which with some exceptions has concentrated on the roles of mean income and its skewness, the latter being the center piece of the median vote model. The political economy literature as a whole points at various places to many of these moments, but they have not so far been assembled or investigated in combination in the same place. Moreover, usually the focus of past studies has been on implications for the size of government, or for the rate of tax on aggregate income, while here we study the consumption - labor income tax mix.

To reduce the number of potential experiments, we have defined and investigated tax structure in two types of societies: a *balanced society* where skills, tastes and political influence are distributed symmetrically, except for the preference for the public good which is sometimes assumed to be stronger at lower income levels, and an *asymmetric society* where the skill distribution is skewed to the right and the distribution of political influence may be highly skewed towards either rich or poor. As far as possible, we have used the model as its own control in assessing the consequences for the pattern of taxation of changes in one or another aspect of the underlying distributions.

The nature of heterogeneity is important in determining the equilibrium fiscal system. We find that diversity of tastes for public and private goods influences not just the level of public services, but also tax structure. The key is how such diversity affects the relative tax elasticity of the bases. The variance and skewness of skills interact with the distribution of preferences for public services by altering incentives of various groups to finance desired levels of public services in particular ways. The role of the distribution of tastes - whether it is homogeneous or heterogeneous - and its interaction with the second moment of the distribution of skills, are among the most interesting results of the simulations.

A useful way to summarize the outcome of the experiments is to list the circumstances that give rise to increasing reliance on consumption taxation relative to the taxation of labour income. In the balanced society, the tax rate on consumption is higher in relation to the rate on income in the following circumstances: (i) when average income is low, so that the base for the income tax is relatively small; (ii) when tastes for the public good are homogeneous; (iii) when the preference for the public good is high on average, resulting in a tax elasticity of the consumption base that is relatively lower; and (iv) when there is more income equality, or if the distribution of influence is concentrated in the middle income group. If the variance of skills is very low while the preference for the public good is high, consumption may be the only tax base that is employed.

We see that the consumption tax can be both economically and politically efficient if there is agreement that a substantial part of gross income should be diverted to public production without affecting work-leisure choices. Moreover, the interaction of the distribution of tastes for public services and of skills can be important in determining the elasticities of tax bases, and hence of tax structure.

These results carry over to varying extents to the *asymmetric society*. In addition, we have seen in this society that consumption taxation is more prominent when mean income is low and tastes are heterogeneous (assuming the poor have a relatively high demand for public goods and services). A reduction in the degree of asymmetry in the distribution of skills also leads to increasing reliance on consumption taxation. The opposite case replicates the usual median voter experiment of increasing income inequality, here extended to include the tax mix as well as the size of government.

We also saw that when political influence is skewed towards the poor with a relatively high preference for the public good, with the distribution of skills given, consumption taxation becomes more important in the equilibrium tax mix. This result especially may depend on the specification of policy instruments, which in the present case rules out a steeply progressive tax system that can be used to single out more carefully the incomes of the very rich for special treatment.

The last observation deserves emphasis. The choice of model specification is not innocent in driving the results of our simulations. In particular, whether one adopts the present Cobb-Douglas specification of preferences or a quasi-linear one as in Renstrom (1996) can substantially affect the outcome, as we have pointed out. This lesson, also drawn by Deaton (1987) in his survey of econometric work on optimal tax structures, suggest that we must be careful in drawing conclusions from models of taxation that guide us in certain directions because of our modeling choices alone.

Nonetheless, it does appear to be the case that a full investigation of the equilibrium tax mix will have to take into account more aspects of the distributions of income, preferences for public goods and of influence than have heretofore been considered. Put differently, one can say that a more synthetic approach to the political economy of taxation, incorporating insights from different studies where one or more of the moments included here have been investigated, may be useful.

From a positive perspective, the experiments suggest that we should see considerable variation in the consumption – income tax mix around the world in competitive democracies. In view of our simulations, one may speculate, for example, that the relatively high reliance on consumption taxation in the European Union, compared to, say, North America, may be partly due to greater income equality coupled with a greater preference for public goods. Whether or not, and the extent to which this is so warrants empirical investigation.

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