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POLITICAL INSTITUTIONS AND ECONOMIC GROWTH

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ABSTRACT

Political Institutions and Economic Growth*

We analyze the impact of micro-founded political institutions on economic growth in an overlapping-generations economy, where individuals differ in preferences over a public good (as well as in age). Labour and capital taxes finance the public good and a public input. The benchmark institution is a parliament, where all decisions are taken. Party entry, parliamentary composition, coalition formation, and bargaining are endogenous. We compare this constitution to delegation of decision-making, where a spending minister (elected in parliament or appointed by the largest party). Delegation of decision-making tends to yield lower growth, mainly due to the occurrence of production inefficiency.

JEL Classification: D72, D90, H20, H41 and O41
Keywords: bargaining, endogenous growth, overlapping generations, taxation and voting

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1. INTRODUCTION

In the field of political economy there has been a recent interest in how political institutions, for example parliamentary or congressional systems (and different electoral rules), influence economic policy decisions and economic performance. On the theory side, this literature seeks to combine legislative models (e.g. Austen-Smith and Banks (1988) and Baron and Ferejohn (1989)) with economic models. For example Persson, Roland and Tabellini (2000) present a theory of how a parliamentary system is more able to enhance public spending than a congressional/presidential system. This finding is corroborated by empirical studies (Persson and Tabellini (2003 and 2004)). Battaglini and Coate (2006a,b) incorporate a legislative model into a dynamic economy where either a public good or public debt is accumulated over time.

Further on the empirical side, there is a literature seeking evidence on the impact of political institutions and economic development, as in Hall and Jones (1999), Acemoglu, Johnson and Robinson (2001), Glaeser et al. (2004), Rodrik, Subramanian and Trebbi (2004). Of particular relevance for our paper is Winer (1983), who empirically investigates the effect of separation of spending and taxing decisions for Canada. The results suggest that the separation of decisions increased public spending. More recently, Persson (2005) found empirical evidence suggesting that parliamentary systems and proportional electoral rules both promote economic performance in terms of per-capita GDP. Wang (2005), using the same methodology as Persson (2005), investigated the relationship between political institutions and economic growth. The findings suggest that parliamentary systems promote economic growth more than presidential systems.

However, as Persson (2005) points out "this research has no more than scratched the surface when it comes to structural policies related to long-run economic performances". There is therefore a need for a theoretical model which provides a micro-founded theory of

how constitutional rules work and impact on economic growth.

In our paper we analyse consequences on tax policy and economic growth of variations in underlying institutional arrangements.[1] In particular we analyse the consequences of delegation of decisionmaking in parliamentary democracy (intended to capture one aspect of separation of powers of a congressional system).

Our underlying institution is a parliament and we compare two different arrangements. Under the benchmark constitution, both tax and spending proposals are made by the coalition government. Under the alternative constitution, the spending proposal is delegated to a minister, who is chosen according to a constitutional rule (either appointed by the party with most seats, or elected by the parliament). This delegation creates strategic considerations at all levels of political decision making. When the coalition government works out a tax proposal, it strategically picks policy in order to influence the spending decision by the minister. Since the tax proposal and, indirectly, the spending decision are functions of the composition of the coalition government, voters vote strategically, seeing through the remaining stages of the game.

In order to analyse economic growth, we need an intertemporal model, where individuals accumulate capital. We use an overlapping generations economy, where we also get an interesting conflict across age groups (young prefer a lower labour tax and old prefer a lower capital tax). Endogenous growth is generated through a publicly provided input (e.g. maintaining infrastructure).[2] In this way, economic growth is determined by both the tax

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[1] The theoretical political-economy literature on economic growth sofar has applied the median-voter model and the focus have been on the income-inequality dimension. The idea put forth by Persson and Tabellini (1994) was that unequal societies (in terms of income or income-earning abilities) grow at as slower rate, due to the disincentives caused by distortionary taxation. If the median voter is poorer relative to the average, she finds it optimal to impose a larger tax. See also Renström (1996) for an overlapping generations framework with multidimensional policy.

[2] Here we follow Turnovsky and Fisher (1995).

system (affecting individuals' incentive to accumulate capital) and public spending. There is also a public good, implying a trade-off on the spending side.

If there was just age heterogeneity, the political equilibrium would be very straightforward for most democratic institutional arrangements: the age group in majority (i.e. young if there is population growth, old if population declines) would dictate policy (implying 100% capital taxation if young are in majority, or a Laffer-maximum labour tax if old are in majority). Then, variations in democratic institutions would have no effect on tax policy.

We introduce a second dimension of heterogeneity: preferences over the public good. If preferences are enough disperse, there are equilibria where the government is a coalition between young and old, yielding policy compromises. A particular feature of the coalition equilibria, is that the coalition involves parties of opposite types (across age and across preferences). This happens quite frequently in parliamentary systems.[3] For example, almost half of the governments in post WWII Netherlands have been coalitions between left and right, and between 1989 and 2002 there were only left-right coalition governments.[4]

The reason for the result in our model is that the member of parliament to initiate a coalition, referred to as formateur, may choose a coalition partner of distant preferences if that group is relatively small, so when bargaining over policy, the formateur gets a policy closer to her ideal point. Of course, the size of the groups are endogenous through voting and through party formation (e.g. a group choosing not to run for election will automatically have zero representation in parliament).

The basic parliamentary model we use is in Renström (2002). We formulate the

[3] In majoritarian systems, it seems as if similar heterogeneity is present, but within parties. In the UK it is often difficult to enforce "party discipline" and there is a lot of bargaining within the parties. Levy (2004) and (2005) provides a model of party formation that can capture this aspect.

[4] http://en.wikipedia.org/

bargaining differently and we consider delegation of decision making.[5] The model consists of several stages. First individuals can enter as parties (with possibly the strategic decision of not running for election). Second the electorate vote, rationally anticipating coalition formation, bargaining, and policy, and will vote strategically. Seats are allocated proportionately to the number of votes.[6] Third, the largest party is chosen as formateur (as in Austen-Smith and Banks (1988)) and has to pick coalition partner(s), rationally anticipating the bargaining outcome. Fourth, bargaining in the coalition takes place (and if there is delegation on the spending side, the coalition will rationally anticipate the reaction by the spending minister). Fifth, the policy proposal has to pass a majority vote in parliament (which it will do, if the coalition has more than 50% representation).

Policy is linked to representation through bargaining. We use a simple bargaining game that makes policy closer to a group's ideal point the larger that group is in the coalition.[7] In a two-party coalition, policy choice is one-dimensional because only policies on the contract curve between the partners will be chosen. Consequently varying the relative coalition size, we move along the contract curve. Voters pick a point on that contract curve. This is important in our setting, since we allow the electorate to vote strategically and potentially neutralizing constitutional changes by altering the representation in parliament.

There are other ways of linking representation to policy proposals. In Austen-Smith

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[5] In Renström (2002) Nash bargaining is used with weights proportional to the number of seats, while we employ a simple bargaining game.

[6] Earlier works on the role of alternative electoral rules are Lizzeri and Persico (2001), Milesi-Ferretti, Perotti and Rostagno (2002), Persson and Tabellini (1999), and Persson, Roland and Tabellini (2004). We do not consider majoritarian in this paper, but leave alternative electoral rules for future research.

[7] This is like *legislative bargaining* in Baron and Ferejohn (1989). We, however, use the recognition rule that the largest party makes the first offer (like Austen-Smith and Banks (1988)), while their recognition rule is a random draw. Furthermore, we only allow counter proposals (amendments) within the coalition, while they allow amendments from the entire legislature. In the literature, applications of the Baron and Ferejohn model almost exclusively only consider take-it-or-leave-it proposals, and thus breaks the relationship between representation and policy in bargaining and gives corner solutions that are more difficult to use in economic models.

and Banks (1988) the rank order of representation matters. This is because their recognition rule specifies that the largest party is the formateur, and if the coalition fails, the second largest party becomes the formateur, and so on. In the parliamentary models by Baron and Diermeier (2001) and Baron, Diermeier, and Fong (2006) the link works as follows. There is a probability that a particular group will be picked as formateur, and that probability is directly linked to the number of seats in parliament. Consequently, expected policy can vary on the margin by varying vote shares. In our case we want to avoid the randomness in policies (when everything else in our model is certain).

We focus our analysis on coalition equilibria, where no single party has a majority of the seats in parliament. Those equilibria are attained if preferences are enough apart [see Renström (2002)]. First, we analyse tax policy and economic growth under our benchmark constitution (when all decisions are taken in the coalition). Our main results here are as follows. If population growth is positive, the largest party in parliament consists of old with strong preferences for the public good. The political-equilibrium coalition is between the largest party and a party consisting of young with weak preferences for the public good. Economic growth is larger because the young age group (though being divided) has larger influence. If there is negative population growth the largest party consists of young with strong preferences for the public goods. The coalition is between the largest party and a party consisting of old with weak preferences for the public good. Economic growth is lower.

The paper proceeds in analyzing the sensitivity of constitutional rules to the political equilibrium, in particular delegation of decisionmaking.[8] Here a spending decision maker is either elected in parliament or appointed by the largest party. It turns out that if population

[8] Alternatively, instead of delegating decisions, we could delegate proposal rights. In our model the equilibria are the same.

growth is negative, then economic growth is lower under delegation (and even lower if the spending minister is elected in parliament). If population growth is positive, then there is a possibility that delegation leads to higher growth (in particular if the spending minister is elected). The reason for delegation to tend to produce lower growth is that the public production factor is supplied at a lower than productively efficient level. This is due to the result that the chosen spending minister prefers more public goods rather that productive spending than the tax coalition does. Furthermore, there are several decision externalities present:[9] (1) the tendency of underprovision of the public production factor will cause the coalition to alter its tax decision so as to (partially) counteract the spending minister's choice, (2) voters will alter their behaviour by changing the composition of the equilibrium tax coalition.

We do not argue that political equilibria are characterised by inefficiencies just because they are political equilibria. The inefficiency in our case is due to a particular set of rules of decision making. Other rules, e.g. our benchmark constitution, do not yield inefficiency. For a very lucid survey on these issues, see Dixit and Romer (2006).

Our theory suggests that economies with delegation of decisionmaking (a common feature of presidential systems), because of production inefficiency and decision externalities, would on average grow slower (everything else equal). This is consistent with the empirical findings of Wang (2005). Furthermore, our model shows that equilibrium public spending is greater under delegation than under the benchmark constitution. This is consistent with the empirical findings of Winer (1983).

Finally, our analysis suggests that the underlying distribution (in terms of demographics, or equivalently in our case, factor ownership) is an important factor in

[9] The term "decision externalities" was coined by Hettich and Winer (1995).

determining the effects of different political institutions. Also, for future empirical work it is important to control for the distribution.

The rest of the paper is structured as follows. In section 2 the overlapping-generations economy is introduced, the assumptions are formalised, and the economic equilibrium is solved for. In section 3 we present the political rules that make up our constitutions and solve for the political-economic equilibrium under the benchmark constitution. Section 4 deals with the constitutional experiment of delegation of decisionmaking. In section 5 we analyse consequences for economic growth, and section 6 concludes.

2. THE ECONOMY

Individuals live for two periods, consuming both as young and as old, but work only when young. They have preferences over period-one consumption, period-two consumption, and period-one and period-two provision of public goods. Individuals within each age group differ in preferences over public goods. For simplicity we assume that they are of two types. Let τ_t^l and τ_t^k denote the wage- and the capital-income tax rates, respectively. It is convenient to define the *after-tax* prices as $P_t \equiv (1-\tau_t^k)R_t$ and $\omega_t \equiv (1-\tau_t^l)w_t$. In period one individual i born at t supplies one unit of labour (inelastically) on the market and consume c_t^{it} units of the only consumption good.[10] She is paid ω_t per unit of supplied labour and she saves k^{it}_{t+1} for the next period. In period two she receives after-tax return, P_{t+1}, on her savings all of which is used for consumption c^{it}_{t+1}. The period-one and two per-capita consumption of the public good (equal for all individuals) are denoted g_t and g_{t+1} respectively. The government uses the tax receipts for public goods provision as well as provision of public infrastructure, z_t.

[10] For the preferences we are going to work with (Cobb-Douglas), nothing changes if labour supply was elastic. The income and substitution effects on labour would cancel, and labour supply would just be a constant (provided the after-tax wage is positive).

2.1 Assumptions

A1 Population

The size of generation t is denoted N_t, and grows (declines) at a constant rate n >(<) 0. Within each generation individuals are endowed with either low taste, ε^l, or high taste, ε^h, for the public good. The fraction of total population endowed with low (=no) taste for the public good (ε^l=0) is denoted γ, and is constant over time.

A2 Individual Preferences

For analytical tractability the utility function is assumed to be of the form

$$U^{it}(\cdot) = c_t^{it}\left(c_{t+1}^{it}\right)^{\beta}\left(g_t\right)^{\varepsilon^i}\left(g_{t+1}\right)^{\beta\varepsilon^i} \tag{1}$$

where the parameters β and ε^i are positive.

A3 Individuals' Constraints

The individual budget constraints are

$$c_t^{it} + k_{t+1}^{it} = \omega_t \tag{2}$$

$$c_{t+1}^{it} = \mathrm{P}_{t+1} k_{t+1}^{it} \tag{3}$$

A4 Production

Production is a function of capital K_t and labour L_t, as well as a productivity enhancing factor, Z_t, provided by the government We assume congestion in this factor so only its per-capita level, $z_t=Z_t/N_t$, augments productivity. This factor eventually produces long-run growth. For simplicity we assume that technology is Cobb-Douglas:[11]

[11] The production set can be derived by assuming a two stage production process, where capital and labour are used to produce Z in stage one, and in the second stage the residual capital and labour, together with Z, is used to produce Y. Details are in Appendix C.

$$Y_t = A K_t^{\alpha} (z_t L_t)^{1-\alpha} \tag{4}$$

A5 Government's Constraint

The tax receipts at time *t* are fully used for provision of infrastructure and of the public good

$$G_t + Z_t = Y_t - P_t K_t - \omega_t L_t \tag{5}$$

2.2 Economic Equilibrium

In this section the individual and aggregate economic behaviour are solved for, given any arbitrary sequences of tax rates and public expenditure.

By profit maximisation the before-tax prices (the interest rate and the wage rate) are given by

$$R_t = \alpha y_t (1+n)/k_t \tag{6}$$

$$w_t = (1-\alpha) y_t \tag{7}$$

respectively, where

$$y_t = A\left(k_t/(1+n)\right)^{\alpha} z_t^{1-\alpha} \tag{8}$$

is GDP divided by the size of the young generation, N_t. We have also used the equilibrium condition $L_t = N_t$. Maximisation of (1) subject to (2)-(3) gives the individuals' decision rules

$$c_t^{it} = \frac{\omega_t}{1+\beta} \tag{9}$$

$$k_{t+1}^{it} = \frac{\beta \omega_t}{1+\beta} \tag{10}$$

$$c_{t+1}^{it} = \frac{\beta P_{t+1} \omega_t}{1+\beta} \tag{11}$$

and indirect utility (up to a multiplicative constant)

$$V_t^{it} = (\omega_t)^{1+\beta} (P_{t+1})^{\beta} (g_t)^{\epsilon^i} (g_{t+1})^{\beta \epsilon^i} \tag{12}$$

An old individual's indirect utility is

$$V_t^{jt-1} = (P_t k_t)^{\beta} (g_t)^{\beta \epsilon^j} \tag{13}$$

Finally, the government's budget constraint in per-capita form may be written as

$$g_t \equiv G_t/N_t = \pi_t y_t - z_t \tag{14}$$

where $$\pi_t \equiv 1-\alpha(1-\tau_t^k) - (1-\alpha)(1-\tau_t^l) \tag{15}$$

Anticipating that z_t will be chosen as a fraction of GDP, i.e.

$$z_t = \eta_t y_t \tag{16}$$

we may look at the growth consequences of this fraction. Substituting (16) into (8) gives

$$y_t = A^{1/\alpha}\eta_t^{(1-\alpha)/\alpha}k_t/(1+n) \tag{17}$$

Using (10) and (7) and (17) we have

$$\frac{k_{t+1}}{k_t} = \tilde{A}\frac{1-\tau_t^l}{1+n}\eta_t^{(1-\alpha)/\alpha} \tag{18}$$

where $\tilde{A}\equiv\beta(1-\alpha)A^{1/\alpha}(1+\beta)^{-1}$.

We see from (18) that a lower labour tax gives rise to a higher growth rate. The reason is that the young save more. Furthermore the growth rate is increasing in the level of the public production factor, z_t. However, it is costly to provide this factor, and its productively efficient level is reached when $z_t=(1-\alpha)y_t$, i.e. when $\eta_t=1-\alpha$. It will turn out that under the benchmark constitution production efficiency always holds.

3 POLITICAL INSTITUTIONS

3.1 Political Rules

We view political institutions as rules under which policy decisions are taken. We now outline two set of rules: The benchmark constitution (where all policy decisions are taken in parliament) and delegation of decisionmaking (where the spending decision is taken by a

'spending minister', and the other policies in the parliament).

I Bench mark constitution

The sequence of events under the bench-mark constitution is as follows:

1. Entry of parties (individuals can register parties containing members of their own type only).

2. Electorate vote (each individual casting one vote on a party of her choice), and parties are represented proportionally to the number of votes.

3. Coalition formation in parliament (largest party chooses coalition partner, rationally anticipating the bargaining outcome). Coalition partner can only be chosen once.

4. Bargaining in the coalition takes place (with threat points of parliament dissolving for one period).

5. Tax and spending policy chosen by the majority coalition is implemented.

II Delegation of decisionmaking (spending minister)

For delegation of decisionmaking we modify the sequence of events as follows: At stage 3 a spending minister is chosen (through a majority vote in parliament oar by appointment by the largest party). At stage 5 only tax policy is chosen by the coalition. Finally, after stage 5, the spending minister decides upon the composition of spending.

That only one party (the largest) is allowed to choose coalition partner (and only once) is to some extent crucial. If no such rule was there, one can run into a situation of cycles. That is, for any coalition, one of the partners can do better by forming a coalition with another party. Forming a coalition once, is not a strong assumption. It could be relaxed as long as the party

gets a finite number of tries.

Once individuals have been elected for parliament, they have to form a group and present a policy proposal supported by more than one half of the elected members. Contrary to the legislative bargaining literature, were a chosen legislator makes a take-it-or-leave-it proposal, we assume that both sides have a say. We model this as a simple bargaining game. The largest party can make a policy proposal. If not accepted by the coalition partner, a person in the coalition is chosen randomly to make a final policy proposal. If accepted it is implemented, otherwise no more offers can be made. This simple bargaining game brings a link between relative size in the coalition (the number of seats in parliament) and the equilibrium policy proposal. The larger a party is, the higher is the probability that it would be chosen in the final stage to give the final offer. This lowers smaller party's expected utility of continuing into the second stage. Therefore it would accept a (to them) less favourable proposal than otherwise. Consequently a larger party gets a policy proposal (accepted in the first stage) closer to its ideal point (obviously the time horizon of the game can be made arbitrarily large, but finite, without altering this property).

We define our political equilibrium as follows:

(i) Given any voting outcome, and thereby given any composition of parties in parliament, the largest party must find the choice of coalition partner(s) optimal, rationally anticipating the equilibrium to the bargaining game, for each possible coalition that contains a majority of members of parliament.

(ii) Given the parties that have chosen to run for election, and rationally anticipating the coalition to form, an individual must (collectively) find her choice of party to vote for optimal, given everybody else's vote, knowing that she marginally affect the bargaining

outcome by marginally changing the size of the parties.[12]

(iii) Members of a party (that is a group of people of the same type) must find the entry decision (that is run or not to run for election) optimal, given the other three parties entry decisions.[13,14]

(i), (ii), and (iii) must be mutually consistent.

The equilibrium concept tells us how to solve for the political equilibria. First we characterise the bargaining outcome between various parties. Next we examine which coalitions can form. Given each possible coalition we check whether it is consistent with a Nash equilibrium in the voting game, where voters anticipate the coalition to form. Finally we check whether the entry decisions constitute a Nash equilibrium in the entry game.

In the two dimensional model (age and taste heterogeneity) there are two kinds of equilibria (which one occurs depend on the underlying parameter values). One type of equilibrium is when a single party has majority and does not have to form a coalition at all. This happens when the difference in the taste parameter is small so that the model is close to one dimensional (only age heterogeneity becomes relevant). Then if the young (old) are the largest age group, they will also have single majority in parliament. Policy then becomes the ideal point of one individual and effectively collapses to the median-voter model. These equilibria are of less interest for conducting constitutional experiments. We will instead in this paper focus on the coalition equilibria (when no single party has majority). This involves restrictions on the underlying parameters of the model (see Renström 2002).

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[12] An equilibrium to the voting game is a Nash equilibrium, where individuals of the same type act as if they were one large player. No individual has an incentive to deviate from the collectively optimal voting strategy for the group to which she belongs.

[13] An equilibrium to the entry game is a Nash equilibrium.

[14] In explicitly considering an entry stage, we borrow from the citizen-candidate literature (Besley and Coate (1997), Osborne and Slivinski (1996)).

A particular feature of the model is that the only coalitions that can form (consistent with rational voting) is across preferences and across age. We will therefore only examine the bargaining allocations for those coalitions.

A further feature is that the coalitional equilibrium policy is a compromise (on the contract curve between two individuals). The voters of the same types as the coalition partners have a dominant strategy to vote on themselves (to pull the compromise closer the their ideal points). This implies that one of the groups that are not represented in the coalition must, in equilibrium, be indifferent in altering the relative coalition size. We call this group the *pivotal voter*. If the pivotal group was not indifferent, they would vote on their own age group (as everybody else) and the largest age group would have single majority and the coalition would not be formed. It is necessary that one group is indifferent in altering the relative coalition size (and will vote in mixed strategies), i.e. it is necessary that the pivotal voter exist.

We will proceed as follows. First solving for the bargaining allocation as function of the relative coalition size. Then finding the relative coalition size that maximises the utility of the individual group not represented in the coalition (i.e. the pivotal voter). This pins down the equilibrium.

3.2 The Bargaining Game under Benchmark Constitution

We will only consider equilibrium coalitions. Those are between young and old, and where young and old differ in their preferences over the public good.

Let the young group have public-goods preferences ε^i, and the old ε^j. Let the relative size of the young in the coalition be ρ, and the consequently the old's relative size is $1-\rho$. The default options are specified as the utilities if the parliament is dissolved, and consequently there are no public goods, nor taxes in that period (this gives zero utility for both).

A young individual must realise that the current wage tax will affect the savings, and hence the capital stock in the next period. This will potentially affect the next period's political-equilibrium policies: τ^k_{t+1}, g_{t+1}, and z_{t+1}. We have to treat these as functions of k_{t+1}. We guess those functional forms, then solve the bargaining game, and lastly verify that the guesses were correct. It turns out that the tax rates themselves are independent of the capital stock. The ratios g_{t+1}/y_{t+1} and z_{t+1}/y_{t+1} are also independent of the capital stock k_{t+1}. Since z_{t+1}/y_{t+1} cannot be affected by actions by the present coalition, then R_{t+1} cannot be affected either. Consequently the after-tax return on capital, P_{t+1}, is taken as given by the time-t coalition. The young then only have to predict how g_{t+1}, is affected by the coalition's actions. g_{t+1} is a constant fraction of y_{t+1}, and y_{t+1} is linear in k_{t+1}, which in turn is linear in ω_t $= (1-\alpha)(1-\tau_t^l)y_t$. Therefore, we may write a young individual's indirect utility as

$$V^{it} = \left((1-\tau_t^l)y_t\right)^{1+\beta(1+\epsilon^i)}(g_t)^{\epsilon^i} \tag{19}$$

up to a multiplicative constant. Using (6) we may write an old individual's indirect utility as

$$V^{jt-1} = \left((1-\tau_t^k)y_t\right)^{\beta}(g_t)^{\beta\epsilon^j} \tag{20}$$

3.2.1 Old the largest party

The old party makes an offer to the young party, who may accept or reject. If rejecting, the old will have the final say with probability 1-ρ, and the young with probability ρ. If the old have the final say, they will optimally set $\tau_t^l=1$, and consequently $V^{it}=0$. If a young party member gives the final proposal, she maximises (19), with respect to policy. We denote the young's final offer (and resulting GDP) as $\{\hat{\tau}_t^k, \hat{\tau}_t^l, \hat{z}, \hat{g}, \hat{y}\}$, which is solved for in Appendix A. By rejecting the initial offer, the expected utility of the young is the probability of making the final offer times the utility of the final offer. Therefore, the young party will accept an

offer that gives utility at least as great as the discounted expected utility of the final round, i.e. any policy satisfying:

$$\left[(1-\tau_t^l)y_t\right]^{1+\beta(1+\epsilon^j)} g_t^{\epsilon^j} \geq \delta\rho\left[(1-\hat{\tau}^l)\hat{y}_t\right]^{1+\beta(1+\epsilon^j)} \hat{g}_t^{\epsilon^j} \tag{21}$$

The old party chooses a policy proposal by maximising (20) subject to (25), yielding

Lemma 1 *If one assumes* A1-A5, *and the benchmark constitution, and that the coalition consists of old with* ε^h *and young with* ε^l=0, *old being the largest party, then the bargaining equilibrium is*

$$1-\tau^k = \frac{1-[\delta\rho]^{1/(1+\beta)}}{1+\epsilon^j} \tag{22}$$

$$1-\tau^l = \frac{\alpha}{1-\alpha}[\delta\rho]^{1/(1+\beta)} \tag{23}$$

$$z_t = (1-\alpha)y_t \tag{24}$$

$$g_t = \epsilon^j \alpha y_t \frac{1-[\delta\rho]^{1/(1+\beta)}}{1+\epsilon^j} \tag{25}$$

Proof: See Appendix A.

3.2.2 Young the largest party

Here the young party makes the first proposal. If the old party rejects, then the final proposal will be made by the young with probability ρ and the old with prob 1-ρ. In case the young makes the final proposal, τ_t^k=1, and old's utility is zero. The final proposal of the old maximises (20). Denote this proposal (and resulting GDP) as $\{\hat{\tau}_t^k, \hat{\tau}_t^l, \hat{z}, \hat{g}, \hat{y}\}$. The young have to make a proposal that leaves the old with utility at least as great as the discounted expected utility in the last stage, i.e. the policy proposal must satisfy

$$\left[(1-\tau_t^k)y_t\right]^{\beta} g_t^{\beta\epsilon^j} \geq \delta(1-\rho)\left[(1-\hat{\tau}^k)\hat{y}_t\right]^{\beta} \hat{g}_t^{\beta\epsilon^j} \tag{26}$$

The young maximises (19) subject to (34), yielding

Lemma 2 *If one assumes* A1-A5, *and the benchmark constitution, and that the coalition consists of young with* ε^h *and old with* $\varepsilon^l=0$, *young being the largest party, then the bargaining equilibrium is*

$$1-\tau^k = [\delta(1-\rho)]^{1/\beta} \quad (27) \qquad 1-\tau^l = \frac{\alpha}{1-\alpha}\frac{1+\beta(1+\varepsilon^i)}{(1+\beta)(1+\varepsilon^i)}[1-[\delta(1-\rho)]^{1/\beta}] \quad (28)$$

$$z_t = (1-\alpha)y_t \quad (29) \qquad g_t = \frac{\varepsilon^i \alpha y_t}{(1+\beta)(1+\varepsilon^i)}\left[1-[\delta(1-\rho)]^{1/\beta}\right] \quad (30)$$

Proof: See Appendix A.

The solutions in Lemma 1-2 give linear sharing rules (after tax incomes are linear fractions of GDP). This is intuitive because of the Cobb-Douglas utility specification. The share depends on a group's relative size in the bargaining game. Equations (22)-(23) and (27)-(28) give the tax rates applied to the two generations. It is rather obvious that the larger the young are in relation to the old (i.e. the larger ρ) the lower will the labour tax be. The opposite holds for the capital tax.

The provision of z_t, in the bench-mark constitution is according to the production-efficiency level (a constant, 1-α, of GDP). This is not surprising since Diamond-Mirrlees (1971) production efficiency holds in the second best. However, when the spending decision cannot be taken in the coalition, there is a potential deviation from production efficiency. The reason is that the coalition is deprived of one instrument (i.e. the spending proportion between the public good and the public production factor). It will turn out that there is production inefficiency under delegation of decisionmaking. The reason is that the spending minister uses the spends too little on the public production factor in order to provide more of the public good. The coalition counteracts by taxing less. Furthermore, the pivotal voter will try to

partially unto this effect (but not totally) by voting strategically.

3.3 Pivotal Voter

We will now identify the pivotal voter, i.e. the group outside the coalition that is indifferent (in equilibrium) in altering the relative coalition size. This group is picking their most preferred point on the contract curve between the two coalition partners. If a pivotal voter did not exist, it would imply that agents vote on their own age group, and the largest age group would have majority without forming the coalition. Thus, the pivotal voter is necessary for a coalitional equilibrium.

Lemma 3 *If one assumes* A1-A5*, and the benchmark constitution, and that a group consisting of young i-types form a coalition with a group consisting of old j-types, then individuals with low preference for public goods that are not included in the coalition, vote for the individual in the coalition of their own age group. The pivotal voter is young (old) with high preference for public goods if i-types have low (high) preference, and j-types high (low) preference.*

Proof: An individual with no preference for public goods only has preference over the tax she faces. This individual finds it optimal to support its own age group since this lowers the tax rate. The only group that can be indifferent is the one excluded from the coalition and cares more for the public good. By voting mixed this group is trading off voting for opposite age group to increase public goods provision and voting for own age group to reduce the tax.

QED

If preferences over public goods are distant enough then we have a situation where the young (or old) outside the coalition may or may not favour their own age group in the coalition. For example if ε^h is sufficiently larger than ε^l, then there is an ideal relative coalition size (between young ε^l and old ε^h) preferred by the young ε^h outside the coalition (i.e. the pivotal voter). Thus, if such a coalition were to form the young ε^h have no incentive to try to maximise the size of the young ε^l or of the old ε^h. In fact, there is a relative coalition size which makes the outside group indifferent in altering the relative powers of the partners inside the coalition. Similarly, there is an ideal relative coalition size (between young ε^h and old ε^l) preferred by the old ε^h (pivotal) outside the coalition.

If ε^h and ε^l are too close, then any individual outside the coalition will prefer to increase the size of their own age group. The political equilibrium then reduces to a median-voter equilibrium, with the largest age group dictating policy (and consequently confiscating from the minority age group). This is plausible since when one dimension of heterogeneity disappears (ε), there is only one dimension left (age), and with one dimensional heterogeneity, logically, the model should collapse to a median-voter model.[15]

3.4 Coalition Equilibrium

Proposition 1 *If one assumes* A1-A5, *and the benchmark constitution, and that population growth is positive, then the coalitional equilibrium is characterised by a coalition of young* ε^l *and old* ε^h. *Three parties enter*: *young* ε^l, *young* ε^h, *and old* ε^h. *All old individuals vote for old* ε^h. *The pivotal voter is young with* ε^h *and vote in mixed strategies on the three parties, being indifferent altering the relative coalition size. Equilibrium policy is*

[15] This also happens in a different (multidimensional) model by Banks and Duggan (2001).

$$1-\tau^k = \frac{\epsilon^h}{(1+\beta)(1+\epsilon^h)^2} \quad (31) \qquad 1-\tau^l = \frac{\alpha}{1-\alpha}\frac{1+\beta(1+\epsilon^h)}{(1+\beta)(1+\epsilon^h)} \quad (32)$$

$$z_t = (1-\alpha)y_t \quad (33) \qquad g_t = \frac{(\epsilon^h)^2\alpha y_t}{(1+\beta)(1+\epsilon^h)^2} \quad (34)$$

Proof: Suppose there was a coalition across age groups but with same public-goods preferences. Then all agents have an incentive to vote on their own age group. Then the young ε^i would have majority and the coalition would not form, which is a contradiction. The same argument hold for coalitions within age groups. Finally consider the mirror image of the coalition above: old ε^l and young ε^h. Then by proposition 2 the pivotal voter is old, implying that all young vote young ε^h. But then the young ε^h obtain majority without forming the coalition. The coalition above is the only one consistent with rational voting when $n>0$. The pivotal young with ε^h maximises (19) with respect to the vote share, giving $\rho = \delta^{-1}[1+\beta(1+\varepsilon^h)]^{1+\beta}(1+\beta)^{-1-\beta}(1+\varepsilon^h)^{-1-\beta}$, which substituted into Lemma 1 gives (31)-(34). QED

[Figure 1 about here]

Proposition 1 is illustrated in Figure 1. Representation in parliament is denoted by '*', and the party abstaining from running for election is denoted by 'o'. The line connecting two groups denotes coalition. The arrows denote the direction of votes (voters who are represented in the coalition have a dominant strategy of voting on their own party). The group denoted labelled 'pivotal voter' vote mixed (picking their most preferred point on the contract curve between the coalition partners).

Rather paradoxically, though in Proposition 1 the young are in majority (if we rank according to age) the largest party, who also is choosing coalition, consists of old. The reason is that there is a possibility that the old will get their income confiscated. By entering as one party (as old ε^h), all old votes are concentrated on one party. Whenever there is a possibility that young ε^l can enter in a coalition with the old, they are better off running separately, and splitting the votes of the young. This, at the same time, makes a single young party not in majority. Though the largest party consists of old, redistribution goes from old to young. The reason is that the equilibrium is such that a *young* group is the pivotal voter. The same reasoning holds the other way around when population declines (Proposition 2, below).

Proposition 2 *If one assumes* A1-A5, *and the benchmark constitution, and that population growth is negative, then the coalitional equilibrium is characterised by a coalition of young* ε^h *and old* ε^l. *Three parties enter*: *old* ε^l, *old* ε^h, *and young* ε^h. *All young individuals vote for young* ε^h. *The pivotal voter is old with* ε^h *and vote in mixed strategies on the three parties, being indifferent altering the relative coalition size*. *Equilibrium policy is*

$$1-\tau^k = 1/(1+\varepsilon^h) \qquad (35) \qquad 1-\tau^l = \frac{\alpha\varepsilon^h}{1-\alpha}\frac{1+\beta(1+\varepsilon^h)}{(1+\beta)(1+\varepsilon^h)^2} \qquad (36)$$

$$z_t = (1-\alpha)y_t \qquad (37) \qquad g_t = \frac{(\varepsilon^h)^2\alpha y_t}{(1+\beta)(1+\varepsilon^h)^2} \qquad (38)$$

Proof: For the first part, see the proof of Proposition 2. The pivotal old with ε^h maximises (20) with respect to the vote share, giving $1-\rho = \delta^{-1}(1+\varepsilon^h)^{-\beta}$, which substituted into Lemma 2 gives (35)-(38). QED

Proposition 2 is illustrated in Figure 2.

[Figure 2 about here]

3.5 Tax Pressure

As was shown in the sub-section above, the equilibrium tax policy favours the largest age group. When young are more (less) numerous than old, the labour tax is lower (higher) and the capital tax is higher (lower). However, total tax pressure (tax receipts as a fraction of GDP) is the same in both equilibria:

Corollary 1 *If one assumes* A1-A5, *and the benchmark constitution, and either* $n>0$, or $n<0$, *then in a coalition equilibrium, total tax receipts as a fraction of GDP is*

$$\pi = 1-\alpha+\frac{\alpha}{1+\beta}\left(\frac{\epsilon^h}{1+\epsilon^h}\right)^2 \tag{39}$$

i.e. the same regardless which age group is in majority.

Proof: Follows by substituting (31)-(32) and (35)-(36) into (15). QED

3.6 Growth Consequences

We can compare the per-capita growth rates under population growth (Proposition 1) and population decline (Proposition 2). Since both equilibria give rise to production efficiency ($\eta=1-\alpha$), only the labour tax matters, see equation (18). Using (32) and (36) we see that when population growth/decline differs slightly from zero, the equilibrium in Proposition 1 gives a higher growth rate. The reason is that the pivotal voter is young when population grows, and the pivotal voter has considerable power in picking her most preferred point on the contract curve between the coalition partners. This gives a lower labour tax, which in turn increases savings and growth.

4 DELEGATION OF DECISIONMAKING

4.1 Election or Appointment of Spending Minister

We will now analyze a situation when the tax decision is taken in parliament and the spending decision is taken by an elected or appointed decision maker (spending minister). We consider election in parliament and appointment by the largest party in parliament.[16]

Proposition 3 *If one assumes* A1-A5, *and delegation, then if population growth is positive (negative), the following holds in the coalition equilibrium*:

(i) *then the majority elected (in parliament) spending minister is young (old) with high preferences for the public good, that is, of the same type as the pivotal voter.*

(ii) *then the appointed (by the largest party) spending minister is old (young) with high preferences for the public good, that is, of the same type as the largest party.*

Proof: (i) The spending minister coincides with the median in parliament. The largest party has an incentive to pick a spending minister of the same type. QED

Proposition 3 is illustrated in Figures 3 (for $n>0$) and 4 (for $n<0$).

[Figure 3 about here]

[Figure 4 about here]

[16] Potentially we can consider many constitutional experiments. For example, the tax authority could be appointed/elected. Alternatively, one can consider two legislatures (two-chamber parliament). We leave these experiments for future research.

In either case, the minister is of type ε^h (either median in parliament or same as the largest party). The objective of the minister is either (19) or (20) depending on age. However, because the tax rates are taken as given, we can consider the following objective

$$\ln V^m = \ln y_t + \epsilon^m \ln g_t = \ln y_t + \epsilon^m \ln(\pi_t y_t - z_t) \tag{40}$$

where the latter equality follows from (14), and where

$$\epsilon^m = \begin{cases} \epsilon^h/[1+\beta(1+\epsilon^h)] & \textit{if young} \\ \epsilon^h & \textit{if old} \end{cases} \tag{41}$$

Maximising with respect to z_t (and consequently g_t) gives the minister's optimal choice as functions of the tax rates (recall the definition of π_t in (15)):

$$z_t = \frac{(1-\alpha)(1+\epsilon^m)}{1-\alpha+\epsilon^m}\pi_t y_t \tag{42}$$

$$g_t = \frac{\alpha\,\epsilon^m}{1-\alpha+\epsilon^m}\pi_t y_t \tag{43}$$

4.2 The Bargaining Game under Delegation

4.2.1 Old the largest party

Lemma 4 *If one assumes* A1-A5, *and delegation, and that the coalition consists of old with* ε^h *and young with* ε^l=0, *old being the largest party, then the bargaining equilibrium is*

$$\tau_t^k = \frac{\epsilon^h}{1+\epsilon^h} + \frac{1-\alpha}{\alpha}\frac{1-\tau_t^l}{1+\epsilon^h} \tag{44}$$

$$(1-\tau_t^l)\left[\frac{1+\epsilon^h/(1-\alpha)-\epsilon^h(1-\tau_t^l)}{1+\epsilon^h}\right]^{(1-\alpha)/\alpha} = [\delta\rho]^{1/(1+\beta)}\frac{\alpha}{1-\alpha} \tag{45}$$

Proof: See Appendix B.

Corollary 2 *If one assumes* A1-A5, *and that the coalition consists of old with* ε^h *and young with* $\varepsilon^l=0$, *old being the largest party. Then, given the relative coalition size* (ρ), *the labour* (*capital*) *tax is higher* (lower) *under delegation than under the benchmark.*

Proof: Follows by comparing (45) and (23). Notice that the bracketed term in (45) is greater than unity. QED

The reason is that the old can get a higher labour tax (and lower capital tax) accepted by the young because the spending minister tend to spend too little on the public production factor (lower that the productively efficient level). The young then accepts a higher labour tax because it will increase the public production factor.

4.2.2 Young the largest party

Lemma 5 *If one assumes* A1-A5, *and delegation, and that the coalition consists of young with* ε^h *and old with* $\varepsilon^l=0$, *young being the largest party, then the bargaining equilibrium is*

$$1-\tau_t^l = \frac{\alpha}{1-\alpha}\frac{1+\beta(1+\epsilon^i)}{(1+\beta)(1+\epsilon^i)}\tau_t^k \tag{46}$$

$$(1-\tau_t^k)\left[1+\frac{\alpha\,\epsilon^i/(1-\alpha)}{(1+\beta)(1+\epsilon^i)}\tau_t^k\right]^{(1-\alpha)/\alpha} = [\delta(1-\rho)]^{1/\beta} \tag{47}$$

Proof: See Appendix B.

Corollary 3 *If one assumes* A1-A5, *and that the coalition consists of young with* ε^h *and old with* $\varepsilon^l=0$, *young being the largest party, then, given the relative coalition size* (ρ), *the capital* (*labour*) *tax is higher* (*lower*) *under delegation than under the benchmark.*

Proof: Follows by comparing (47) and (27). Notice that the bracketed term in (47) is greater than unity. QED

The reason is the same as for Corollary 2, i.e. the young can get a higher capital tax (and lower labour tax) accepted by the old because the spending minister tend to spend too little on the public production factor. The old then accepts a higher capital tax because it will increase the public production factor.

4.3 Coalition Equilibrium

First, Lemma 3 holds here as well, implying that the identity of the pivotal voter does not change when moving from the benchmark constitution to delegation. We may solve for the coalition equilibrium the usual way:

Proposition 4 *If one assumes* A1-A5, *and delegation, and that population growth is positive, then the coalition equilibrium is characterised by a coalition of young* ε^l *and old* ε^h.
Three parties enter: *young* ε^l, *young* ε^h, *and old* ε^h. *All old individuals vote for old* ε^h. *The pivotal voter is young with* ε^h *and vote in mixed strategies on the three parties, being indifferent altering the relative coalition size. Equilibrium tax policy is*

$$1-\tau^k = \frac{\epsilon^h}{(1+\beta)(1+\epsilon^h)^2}\left[1-\frac{1-\alpha}{\epsilon^h}\frac{1+\beta(1+\epsilon^h)}{\epsilon^h}\right] \quad (48) \qquad 1-\tau^l = \frac{\alpha}{1-\alpha}\frac{1+\beta(1+\epsilon^h)}{(1+\beta)(1+\epsilon^h)}\left[1+\frac{1-\alpha}{\epsilon^h}\right] \quad (49)$$

Proof: The first part is proven in the same way as the first part of Proposition 1. The pivotal young with ε^h maximises (19) with respect to the vote share. This can be reformulated as maximising (19) with respect to the labour tax, i.e. max $[1+\beta(1+\varepsilon^i)]\ln[(1-\tau_t^l)y_t] + \varepsilon^i\ln(\pi_t-z_t)$,

or equivalently to

$$\max_{\tau_t^l} \; [1+\beta(1+\epsilon^i)]\ln(1-\tau_t^l) \; + \left[(1+\beta)(1+\epsilon^i)\frac{1-\alpha}{\alpha}+\epsilon^i\right]\ln\pi_t \tag{50}$$

subject to (15) and (44). The first-order condition gives (48) and (49). QED

Notice that the tax policy is independent of the identity of the spending minister.

Corollary 4 *If one assumes* A1-A5*, and that population growth is positive, then the capital (labour) tax is larger (smaller) under delegation than under the benchmark constitution. The size of the young in the coalition is also larger under delegation.*

Proof: Follows by comparing (48) and (49) with (31) and (32), respectively. The coalition size follows from Corollary 2. To obtain a lower labour tax the relative coalition size must be larger. QED

Corollary 4 shows that the pivotal voter counteracts the effect of delegation, by increasing the vote share to the young.

Proposition 5 *If one assumes* A1-A5*, and delegation, and that population growth is negative, then the coalition equilibrium is characterised by a coalition of young* ϵ^h *and old* ϵ^l*. Three parties enter*: *old* ϵ^l*, old* ϵ^h*, and young* ϵ^h*. All young individuals vote for young* ϵ^h*. The pivotal voter is old with* ϵ^h *and vote in mixed strategies on the three parties, being indifferent altering the relative coalition size. Equilibrium tax policy is*

$$1-\tau^k = \frac{1}{1+\epsilon^h} + \frac{1-\alpha}{\epsilon^h}\frac{1+\beta(1+\epsilon^h)}{1+\epsilon^h} \quad (51) \qquad 1-\tau^l = \frac{\alpha\epsilon^h}{1-\alpha}\frac{1+\beta(1+\epsilon^h)}{(1+\beta)(1+\epsilon^h)^2}\left[1-\frac{1-\alpha}{\epsilon^h}\frac{1+\beta(1+\epsilon^h)}{\epsilon^h}\right] \quad (52)$$

Proof: For the first part, see the proof of Proposition 2. The pivotal old with ε^h maximises (20) with respect to the vote share. This can be reformulated as maximising (20) with respect to the capital tax, i.e. max $\ln[(1-\tau_t^k)y_t] + \varepsilon^j \ln(\pi_t - z_t)$, or equivalently to

$$\max_{\tau_t^k} \ln(1-\tau_t^k) + \frac{1-\alpha+\epsilon^j}{\alpha}\ln\pi_t \quad (53)$$

subject to (15) and (46). The first-order condition gives (51) and (52). QED

Also here the tax policy is independent of the identity of the spending minister.

Corollary 5 *If one assumes* A1-A5, *and that population growth is negative. Then the capital (labour) tax is smaller (larger) under delegation than under the benchmark constitution. The size of the old in the coalition is also larger under delegation of powers.*

Proof: Follows by comparing (51) and (52) with (35) and (36), respectively. The coalition size follows from Corollary 3. To obtain a lower capital tax, old's relative coalition size must be larger. QED

Corollary 5 shows that the pivotal voter counteracts the effect of delegation, by increasing the vote share to the old.

Finally, the spending decision depends on the identity of the spending minister. However, the decision is independent of whether population is growing or declining. We have

Proposition 6 *If one assumes* A1-A5*, and delegation, then in the coalition equilibrium, the spending decision is independent of whether n*>0 *or n*<0*, and is given by*

$$z_t = \frac{(1-\alpha)(1+\epsilon^m)}{1-\alpha+\epsilon^m}\pi y_t \qquad (54) \qquad\qquad g_t = \left[1 - \frac{(1-\alpha)(1+\epsilon^m)}{1-\alpha+\epsilon^m}\right]\pi y_t \qquad (55)$$

where

$$\pi = 1-\alpha+\frac{\alpha}{1+\beta}\left(\frac{\epsilon^h}{1+\epsilon^h}\right)^2 - \frac{\alpha}{1+\beta}\frac{1-\alpha}{1+\epsilon^h}\frac{1+\beta(1+\epsilon^h)}{1+\epsilon^h} \qquad (56)$$

Proof: (56) follows by substituting (48)-(49) and (51)-(52) into (15). (54) and (55) are restatements of (42) and (43). QED

Corollary 6 *If one assumes* A1-A5*, and delegation, then in the coalition equilibrium the public production factor is supplied at a lower level than the productively efficient one.*

Proof: It follows by (54) and (56) that $z_t<(1-\alpha)y_t$. QED

The production inefficiency is due to the fact that the spending minister tries to obtain a higher level of the public good than the coalition wishes. The coalition tries to (partially but not fully) counter this by increasing the taxes. The productively inefficient level of z_t tends to lower the growth rate, however, we must evaluate the total effect, also taking into account the taxes. This is done in the next section.

Corollary 7 *If one assumes* A1-A5*, then in the coalition equilibrium, tax revenue as fraction of GDP is smaller under delegation than under the bench mark.*

Proof: Follows by comparing (56) and (39). QED

The reason for tax pressure to be smaller under delegation is due to production inefficiency. If tax pressure was the same, public goods would be at a higher level than under the bench mark, and this is not optimal when being inside the production possibilities frontier.

5 GROWTH CONSEQUENCES OF CONSTITUTIONS

5.1 Elected versus appointed spending minister

Given delegation, π is independent of the identity of the spending minister. Then according to (42) the growth rate is decreasing in ε^m. Then (41) implies that under a young spending minister growth is greater (other things equal). Thus we have the following

Proposition 7 *If one assumes* A1-A5*, and delegation, then in the coalition equilibrium, the following is true*

(i) *If* $n>0$ *economic growth is greater under elected than appointed spending minister.*

(ii) *If* $n<0$ *economic growth is smaller under elected than under appointed spending minister.*

(iii) *Highest growth is obtained when* $n>0$ *and spending minister is elected and lowest growth is obtained when* $n<0$ *and spending minister is elected.*

Proof: (i) and (ii) follow from Proposition 3. (iii) follows since the labour tax is smaller when $n>0$ than when $n<0$. QED

In evaluating the growth consequences, population growth becomes critical. The reason is that the identity of the spending minister depends on which age group is in majority in the

population.

5.2 Benchmark versus delegation

Proposition 8 *If one assumes* A1-A5, *then in the coalition equilibrium, the following is true*:

(i) *If* $n<0$ *economic growth is greater under the benchmark than under delegation.*

(ii) *Economic growth is greater under delegation when* $n>0$ *than under the benchmark when* $n<0$.

(iii) *If* $n>0$ *economic growth can be greater or smaller under the benchmark.*

Proof: (i) Corollary 6 gives $z_t<(1-\alpha)y_t$. Corollary 5 states that the labour tax is greater under delegation. Thus, the lowest growth rate is obtained under delegation when $n<0$.

(ii) Substituting (36) and (37) into (18) and comparing to when (49), (54), and (56) are substituted into (18) establishes that growth is greater when $n>0$ and there is delegation than when $n<0$ and the benchmark constitution holds.

(iii) Follows by substituting (32) and (33) into (18) and comparing to when (49), (54), and (56) are substituted into (18). QED

6 CONCLUSIONS

In this paper we have analysed the effects on economic policy and economic growth of delegating spending decisions to a minister in the spirit of separation of powers. As a contribution to the literature, we have carefully modelled a political system (parliament) and underlined the consequences of constitutions. We compared two constitutions: (I) a benchmark case where all policy decisions are taken in parliament, (II) delegation of spending decisions,

where either the parliament elects or the largest party appoints a spending minister, who in turn sets spending policy independently.

The way in which equilibrium coalitions are formed is the key in understanding how growth is influenced. When there is population growth, so that the young are the largest age group, the young split in two parties (and the old enter as one party). The young party with high preferences for public goods will be excluded from the coalition, but has to be indifferent in altering the relative coalition size of the equilibrium coalition. This gives considerable power to the group outside the coalition, who in effect will influence policy the most. Since a young group is the most influential group policy will favour this group. The young have a stronger incentive to spend on the public production factor, which will increase equilibrium savings and consumption possibilities in the next period. Consequently economic growth is higher in this equilibrium. On the contrary, if population growth is negative, the old will split into two parties, and a sub-group of the old will be excluded from the coalition but will have strong influence (when determining relative coalition size). Since the old are more influential equilibrium growth will be lower. We also considered a modified constitution: delegation of spending decisions.

In the first modified constitution the largest party has the right to appoint an individual who will take the spending decision. When population growth is positive, the largest party consists of old (due to strategic voting and electoral entry), and therefore the spending decision maker will be an old individual. However, this individual will choose to spend less on the public production factor than the parliament would have chosen. Similarly when population growth is negative, the largest party (who are young) will appoint a young decision maker. A comparison of the effects of constitutions here is ambiguous. The reason is that delegation gives a lower wage tax (which works positively for growth) but at the same time

the public production factor is supplied below the productively efficient level (and thus lowering growth).

In the second modified constitution the spending decision maker is majority elected in parliament. Here the elected decision maker will always be of the same age group as the dominant age group (i.e. if population growth is positive, the elected decision maker is young, and vice versa). The table below summarises our growth findings.

Table 1 - Level of Economic Growth

	delegation of spending decisions		decision in parliament
	elected	appointed	
pop. growth > 0	highest	second highest	high or highest
pop. growth < 0	lowest	second lowest	high

This suggests that when evaluating effects of constitutions, one should take into account the expected population growth, because this determines factor ownership. We can think about a situation more generally, where individuals differ in factor ownership. Economic growth would then be higher when wage earners are the largest group, and higher when the spending minister is a wage earner.[17]

We have conducted a purely positive analysis. The welfare effects are ambiguous. Moving from the benchmark constitution to delegation induces production inefficiency. However, it also gives lower tax pressure, and benefits the young (old) at the date of reform if population growth is positive (negative). It also gives a higher level of public goods relative to private consumption and would benefit those who care more about public goods. The net

[17] We thank Piergiuseppe Fortunato for suggesting this interpretation.

effect depends on the social weights on different generations and on the size of the individuals with strong preferences for public goods. For example, a higher social discount rate would tend to favour individuals that are old at the date of reform, and would tend to favour the benchmark constitution if population growth is positive, and delegation if population growth is negative. This illustrates the difficulty of doing welfare analysis of constitutions. Some constitutions favour certain groups, and a welfare function caring more for those groups would advocate those constitutions.

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APPENDIX A: Bargaining Game under Benchmark Constitution

Proof of Lemma 1

Policy proposal in the last stage

Define $m_t^i \equiv (1-\tau_t^l)y_t$ and $m_t^j \equiv (1-\tau_t^k)y_t$, then (14) and (15) give

$$g_t = y_t - \alpha m_t^j - (1-\alpha) m_t^i - z_t \tag{A1}$$

Notice that (19) may be written as (since $m_t^j=0$)

$$\begin{aligned} \ln V_t^{it} &= \left[1+\beta(1+\epsilon^i)\right]\ln\left((1-\tau_t^l)y_t\right) + \epsilon^i \ln(\pi_t y_t - z_t) \\ &= \left[1+\beta(1+\epsilon^i)\right]\ln m_t + \epsilon^i \ln(y_t - (1-\alpha)m_t - z_t) \end{aligned} \tag{A2}$$

The first-order conditions are

$$\frac{1+\beta(1+\epsilon^i)}{m_t} - \frac{\epsilon^i(1-\alpha)}{y_t - (1-\alpha)m_t - z_t} = 0 \qquad \text{(A3)} \qquad\qquad \frac{\partial y_t}{\partial z_t} - 1 = 0 \qquad \text{(A4)}$$

Condition (A4) gives

$$\hat{z}_t = (1-\alpha)\hat{y}_t \tag{A5}$$

which substituted into (A3) yields

$$1-\hat{\tau}^l = \frac{\alpha}{1-\alpha}\frac{1+\beta(1+\epsilon^i)}{(1+\beta)(1+\epsilon^i)} \tag{A6}$$

Using $\hat{\tau}_t^k=1$ and (A6) in (A1) gives

$$\hat{g}_t = \alpha\epsilon^i \hat{y}_t (1+\beta)^{-1}(1+\epsilon^i)^{-1} \tag{A7}$$

Policy proposal in the first stage

Log-differentiate the constraint (21) to obtain

$$\frac{dm_t^i}{m_t^i} + \frac{\epsilon^i}{1+\beta(1+\epsilon^i)}\frac{dg_t}{g_t} = 0 \tag{A8}$$

Taking the total differential of (A1) and using (A8) gives

$$\left[g_t - \frac{(1-\alpha)\epsilon^i m_t^i}{1+\beta(1+\epsilon^i)}\right]\frac{dg_t}{g_t} = d(y_t - z_t) - \alpha\, dm_t^j \tag{A9}$$

Maximising $\ln V^{jt-1}=\ln m_t^j+\epsilon^j \ln g_t$ with respect to m_t^j and z_t, using (A9), gives

$$\frac{1}{m_t^j} - \frac{\epsilon^j\alpha}{g_t - (1-\alpha)m_t^i\epsilon^i/[1+\beta(1+\epsilon^i)]} = 0 \tag{A10}$$

and the production efficiency condition $\partial y_t/\partial z_t=1$, in turn implying (24).
The first-order condition (A10) gives

$$g_t = \epsilon^j\alpha m_t^j + (1-\alpha)m_t^i\epsilon^i/[1+\beta(1+\epsilon^i)] \tag{A11}$$

which combined with (A1) gives

$$g_t = \frac{\epsilon^j\alpha y_t - (1-\alpha)m_t^i(\epsilon^j - \epsilon^i/[1+\beta(1+\epsilon^i)])}{1+\epsilon^j} \tag{A12}$$

First, (24) implies $y_t=\hat{y}_t$. Then (21) evaluated at $\epsilon^i=0$ gives (23). (23) in (A12) gives (25). (23) and (25) in (A11) gives (22). QED

Proof of Lemma 2

Policy proposal in the last stage

When old makes the final offer $\hat{\tau}_t^k=1$, implying $m_t^i=0$. Using (A1) in (20) the old's objective is to maximise $\ln V^{jt-1}=\ln m_t^j+\epsilon^j \ln g_t$. The first-order conditions are

$$\frac{1}{m_t^j} - \frac{\epsilon^j\alpha}{y_t - \alpha m_t^j - z_t} = 0 \tag{A13}$$

and the production efficiency condition $\partial y_t/\partial z_t=1$, in turn implying (A5).
(A5) substituted into (A13) gives

$$1-\tau^k = 1/(1+\epsilon^j) \tag{A14}$$

Using (A14) and (A5) in (A1) gives

$$\hat{g}_t = \epsilon^j \alpha \hat{y}_t / (1+\epsilon^j) \tag{A15}$$

Policy proposal in the first stage

Log-differentiate the constraint (26) to obtain

$$\frac{dm_t^j}{m_t^j} + \epsilon^j \frac{dg_t}{g_t} = 0 \tag{A16}$$

Taking the total differential of (A1) and using (A16) gives

$$\left[g_t - \alpha \epsilon^j m_t^j\right] \frac{dg_t}{g_t} = d(y_t - z_t) - (1-\alpha) dm_t^i \tag{A17}$$

Maximising $\ln V^{it}=[1+\beta(1+\varepsilon^i)]\ln m_t^i+\varepsilon^i \ln g_t$ with respect to m_t^i and z_t, using (A17), gives

$$\frac{1+\beta(1+\epsilon^i)}{m_t^i} - \frac{\epsilon^i(1-\alpha)}{g_t - \alpha m_t^j \epsilon^j} = 0 \tag{A18}$$

and the production efficiency condition $\partial y_t/\partial z_t=1$, in turn implying (29). The first-order condition (A18) gives equation (A11). Use (A1) in (A11) to eliminate m_t^i to obtain

$$g_t = \frac{\epsilon^j \alpha}{(1+\beta)(1+\epsilon^i)} \left[y_t + \left(\frac{\epsilon^j}{\epsilon^i}[1+\beta(1+\epsilon^i)] - 1 \right) m_t^j \right] \tag{A19}$$

Equation (29) implies $y_t=\hat{y}_t$. Then (26) evaluated at $\varepsilon^j=0$ gives $1-\tau_t^k=[\delta(1-\rho)]^{1/\beta}(1-\hat{\tau}_t^k)$. Using (A14) and $\varepsilon^j=0$ gives (27). Use (27) in (A19) to obtain (30). QED

APPENDIX B: Bargaining Game under Delegation

Proof of Lemma 3

The relation between GDP and π from the viewpoint of the coalition is as follows

$$\ln y_t = \frac{1-\alpha}{\alpha} \ln \pi_t + constant \tag{B1}$$

A young with $\varepsilon^i=0$ makes final offer so as to maximise $(1-\tau_t^l)y_t$. Since it is optimal to set $\tau_t^k=1$, then $\pi_t=1-(1-\alpha)(1-\tau_t^l)$ and by using (B1) the objective is to

$$\max_{\tau_t^l} \ln(1-\tau_t^l) + \frac{1-\alpha}{\alpha}\ln\left[1-(1-\alpha)(1-\tau_t^l)\right] \tag{B2}$$

The first-order condition gives $1-\hat{\tau}_t^l=\alpha/(1-\alpha)$, and consequently $\pi_t=1-\alpha$. The old can then offer anything that satisfies $[(1-\tau_t^l)y_t]^{1+\beta}\geq\delta\rho[(1-\hat{\tau}_t^l)\hat{y}_t]^{1+\beta}$ or

$$(1-\tau_t^l)\,\pi_t^{(1-\alpha)/\alpha} \geq \left[\delta\rho\right]^{1/(1+\beta)}\frac{\alpha}{1-\alpha}(1-\alpha)^{(1-\alpha)/\alpha} \tag{B3}$$

Old makes initial offer to maximise $\ln[(1-\tau_t^k)y_t] + \varepsilon^j\ln(\pi_t-z_t)$, or equivalently to maximise

$$\ln(1-\tau_t^k) + \frac{1-\alpha+\varepsilon^j}{\alpha}\ln\pi_t \tag{B4}$$

subject to (B3). The first-order condition gives (44). Substitute (44) into (15) to obtain

$$\pi_t = \frac{1+\varepsilon^j-\alpha-\varepsilon^j(1-\alpha)(1-\tau_t^l)}{1+\varepsilon^j} \tag{B5}$$

(B5) in (B3) gives (45). QED

Proof of Lemma 4

An old with $\varepsilon^j=0$ makes final offer so as to maximise $(1-\tau_t^k)y_t$. Since it is optimal to set $\tau_t^l=1$, then $\pi_t=1-\alpha(1-\tau_t^k)$ and by using (B1) the objective is to

$$\max_{\tau_t^k} \ln(1-\tau_t^k) + \frac{1-\alpha}{\alpha}\ln\left[1-\alpha(1-\tau_t^k)\right] \tag{B6}$$

The first-order condition gives $\hat{\tau}_t^k=0$, and consequently $\pi_t=1-\alpha$. The young can then offer anything that satisfies $[(1-\tau_t^k)y_t]^{\beta}\geq\delta(1-\rho)[(1-\hat{\tau}_t^k)\hat{y}_t]^{\beta}$ or

$$(1-\tau_t^k)\,\pi_t^{(1-\alpha)/\alpha} \geq \left[\delta(1-\rho)\right]^{1/\beta}(1-\alpha)^{(1-\alpha)/\alpha} \tag{B7}$$

Young makes initial offer to maximise $[1+\beta(1+\varepsilon^i)]\ln[(1-\tau_t^l)y_t] + \varepsilon^i\ln(\pi_t-z_t)$, or equivalently to maximise

$$\left[1+\beta(1+\varepsilon^i)\right]\ln(1-\tau_t^l) + \left[(1+\beta)(1+\varepsilon^i)(1-\alpha)/\alpha+\varepsilon^i\right]\ln\pi_t \tag{B8}$$

subject to (B7). The first-order condition gives (46). Substitute (46) into (15) to obtain

$$\pi_t = 1 - \alpha + \frac{\alpha \epsilon^i}{(1+\beta)(1+\epsilon^i)} \tau_t^k \tag{B9}$$

(B9) in (B7) gives (54). QED

APPENDIX C: Production Technologies

The aggregate production technology (4) may be derived from a two-stage production process. Let K^y, L^y, K^z, and L^z denote capital and labour use in final goods production, Y, and production of the input, Z. Only per-capita quantity of the intermediate input, $z=Z/N$, augments the productivity of labour L^y. Let the two production technologies be

$$Y = \tilde{A}(K^y)^\alpha (z L^y)^\alpha \tag{C1}$$

$$Z = \tilde{A}^{1/\alpha} K^z \left(L^z/N\right)^{(1-\alpha)/\alpha} \tag{C2}$$

Cost minimisation in production of Z and Y requires

$$\frac{K^z}{L^z} = \frac{K^y}{L^y} = \frac{K}{L} = \frac{\alpha}{1-\alpha}\frac{w}{R} \tag{C3}$$

where total factor supply is $K = K^y + K^z$ and $L = L^y + L^z$. This implies that capital-labour ratios are equalised across sectors and equal to the aggregate ratio. Then (C1) may be written as

$$\begin{aligned} Y &= \tilde{A}(K^y/L^y)^\alpha z^{1-\alpha} L^y \\ &= \tilde{A}(K/L)^\alpha z^{1-\alpha}(L - L^z) \\ &= \tilde{A}K^\alpha (zL)^{1-\alpha} - \tilde{A}(K/L)^\alpha z^{1-\alpha} L^z \\ &= \tilde{A}K^\alpha (zL)^{1-\alpha} - Z \end{aligned} \tag{C4}$$

where the second equality follows from (C3), and the fact that the two sectors make up the aggregate, and the last equality by using (C2).

Figure 1

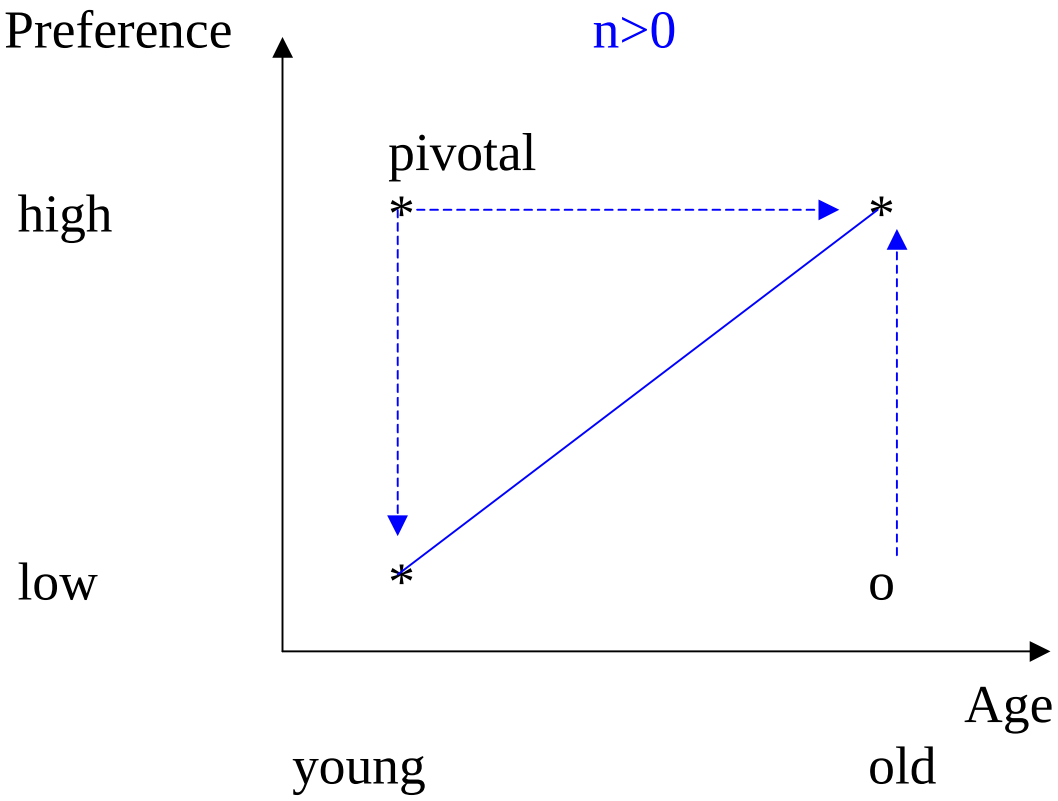


Figure 2

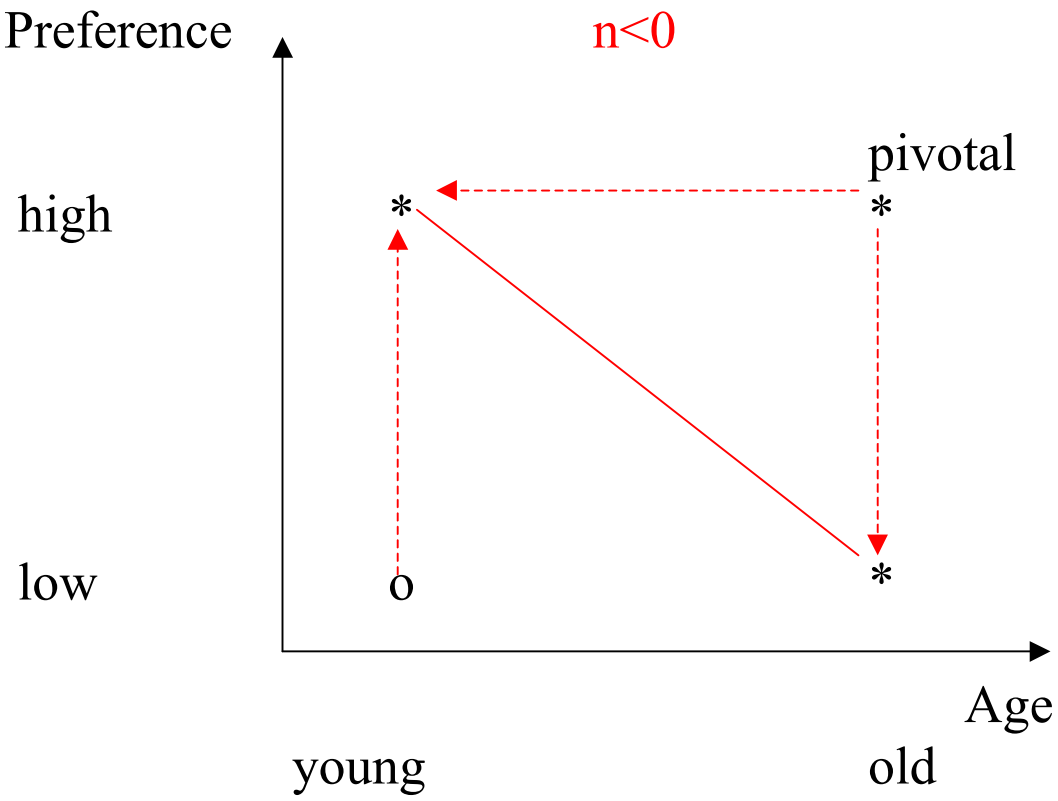


Figure 3

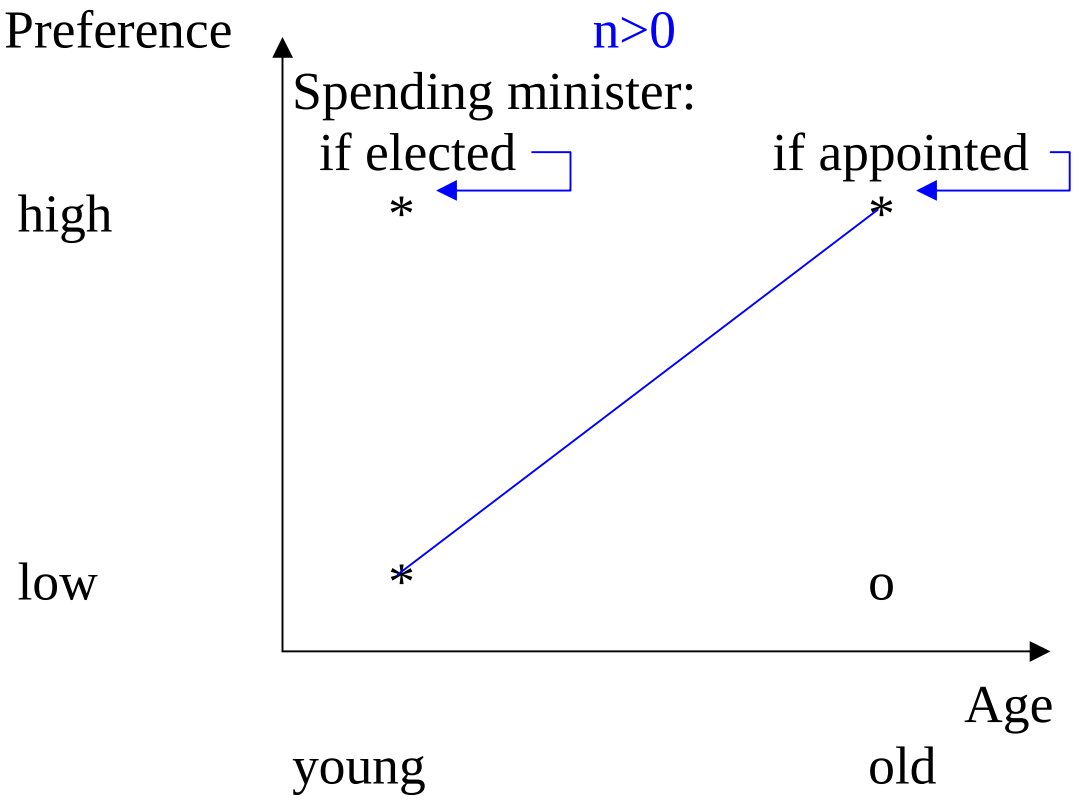
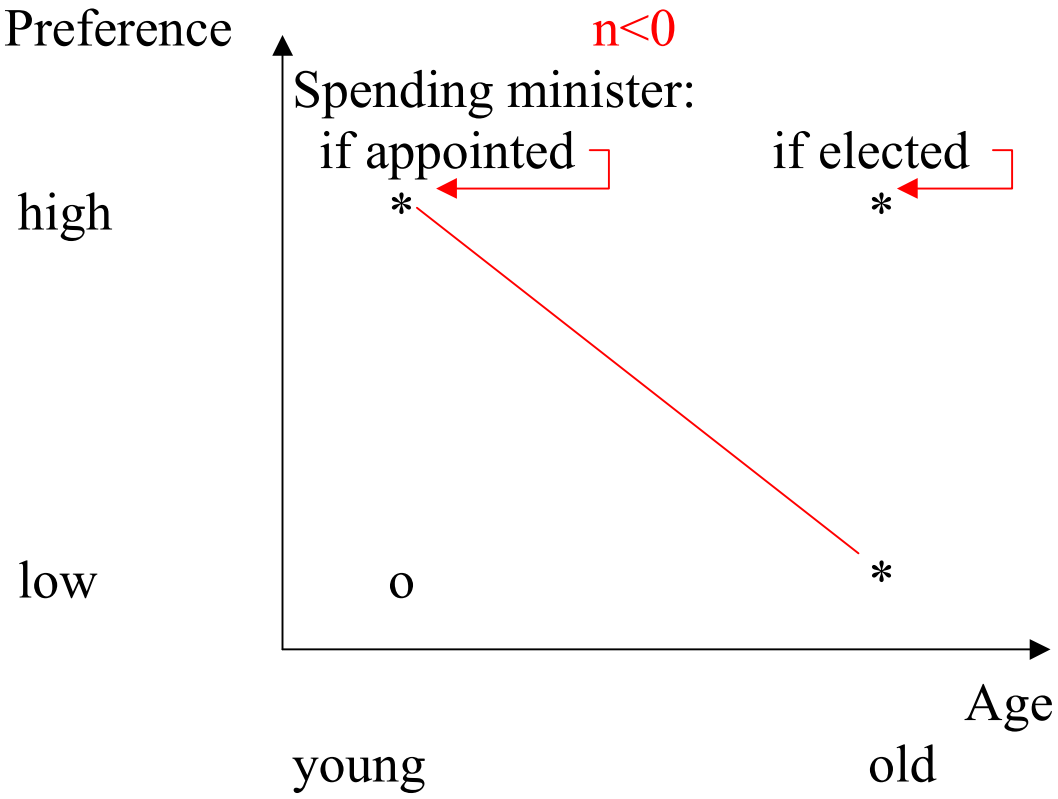

Preference
n>0
Spending minister:
if elected
if appointed
high
*
*
low
*
o
Age
young
old

Figure 4


Preference
n<0
Spending minister:
if appointed
if elected
high
low
o
Age
young
old