Voting on Public Pensions with Family Bargaining

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Abstract

The paper develops a voting model for public pensions based on the assumption that families can coordinate their voting. A family profits from a public pension program if its retired members receive more benefits than the working members pay in taxes. Given a pay-as-you-go budget constraint, net gains accrue to families with above-average ratios of retirees to voters. A majority of voters will belong to such families if enough retirees have a suitable number of working-age relatives—not too few and not too many. Numerical examples suggest that this condition is plausibly satisfied in European countries and the United States.

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1. Introduction

Public pensions and other pay-as-you-go financed pension benefits enjoy strong popular support despite the escalating cost.[1] This is remarkable from a voting perspective because retiree benefits redistribute resources from a majority of working-age voters to a minority of retirees.

This paper develops a simple static voting model based on intra-family bargaining. The main premise is that families the ability to bargain internally so that voting decisions will be Pareto efficient for the family. A family profits from a public pension program if its retired members receive more in current benefits than the working members pay in payroll taxes. Ceteris paribus, this applies if the ratio of retirees to voters in the family exceeds the national average share of retirees in the voting population. Preferences over tax rates and benefits are single peaked in families' retiree shares. Hence a median voter theorem applies.

Retiree benefits are positive in a voting equilibrium if the majority of the population is in families with above-average share of retiree. This condition is satisfied if most families include a positive but not too high number of intergenerational linkages. An important supporting factor is stochastic mortality: For any given structure of family linkages, families with surviving retirees have more voting members than families with higher realized mortality.[2] The conditions for majority support are likely violated, however, in societies with substantial heterogeneity over family linkages, e.g., if most families are have either many children or no children. These countervailing forces are illustrated in numerical examples.

A virtue of the model is its simplicity. The basic model does not require altruism, or income heterogeneity, or dynamic linkages between current votes and future benefits, although all of these could be added as extensions. Static voting is a key simplification. Because voting is repeated, there is no intrinsic link between current taxes and future benefits; this follows Tabellini (2000) but differs

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[1] In the following, the terms public pensions or social security (the label of the U.S. program) are used synonymously to represent pay-as-you-go programs that benefit retirees and are financed contemporaneously by working-age cohorts. The model also applies to non-cash benefits such as retiree health care.

[2] With survival uncertainty, retiree benefits can be interpreted as mutual insurance against uncertainty about longevity. A difficulty with this insurance is that ex post, voters whose relatives have died early have an incentive renege. The conditions for majority support may thus be interpreted as conditions for the political sustainability of mutual longevity insurance.

from much of the social security literature.[3] Moreover, I assume Coasian bargaining to align family interests, which is a simple and widely applicable mechanism.[4] The mechanism does not always ensure majority support for pensions, but it works under plausible conditions. Family bargaining is also noteworthy as general modeling device (potential building block) that converts intergenerational problems into problems of static voting.[5]

To obtain interior solutions for tax rates, I assume that payroll taxes distort labor supply. This technical assumption avoids extreme shifts between zero taxes and confiscatory taxes in response to small changes in population structure. Preferences over payroll taxes are then single-peaked as function of families' retiree shares, or equivalently, retiree-worker ratios. In the voting equilibrium, payroll taxes are set so that the marginal excess burden of taxes equals the net financial benefit for the median family.

Related papers are Breyer and v.d. Schulenburg (1987) and Tabellini (2000). Breyer and v.d. Schulenburg were the first to propose families as relevant decision units for voting on social security. They treat a vote on social security as a once-and-for-all decision and they follow the dynamic literature in assuming that voters base their decisions on a present value of current and expected future taxes and benefits. They also make specific assumptions about family structure, namely that voting-age individuals care about the net taxes of their direct descendents (children, grandchildren, etc.), assuming asexual reproduction (each child having a single parent). Tabellini shows that mutual altruism between parents and children and a skewed income distribution provide majority support for a social security system with proportional taxes and fixed benefits.[6]

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[3] Following Aaron (1966) and Browning (1975), a large literature has examined dynamic voting models for social security, arguing that workers vote for pensions because they expect benefit in the future. The early literature ignored repeated voting. More recent contributions have modeled repeated voting with trigger strategy arguments, e.g., Cooley and Soarez (1999), Bohn (1999), and Galasso (2006). My static model is not meant to deny dynamic arguments but to focus on the stage game.

[4] In comparison, Tabellini (2000) requires bidirectional altruism between parents and children plus assumptions about income effects, redistribution, and the strength of altruism.

[5] One may suspect that in practice multiple factors contribute to the popularity of retirement benefits. This paper's objective is to study the voting implications of family bargaining and not to model everything that might be relevant. While it would be straightforward to combine multiple mechanisms, the resulting "combination" models would obscure the role of family bargaining.

[6] Because altruism largely removes the generational conflict, the voting is essentially over redistributional taxes If a skewed income distribution were added to my model, redistribution would increase voter support for any given pension benefit (by the same arguments as in Tabellini) and the equilibrium benefit would be higher. Thus the empirical implications would be similar, suggesting that Tabellini's empirical findings have theoretical support beyond his model.

The paper is organized as follows. Section 2 reviews relevant demographic facts. Section 3 presents the model. Section 4 examines voting behavior and presents the main propositions. Section 5 provides numerical examples. Section 6 concludes.

2. The Demographics of Families

The share of retirees in the voting population is around 20% in the U.S. and in the 25-35% range in continental Europe. Thus retirees are a strong minority, but far from a majority even in European countries with a history of low fertility.

Most children are born to mothers age 20-35, with a peak around age 25-30. Hence retirees at, say, age 80 will likely have children in the age range 50-55 and grandchildren in the age range 20-30. This suggests that the voting population encompasses more than two generations and would not captured adequately by modeling a nuclear family.

The effective retirement age is about 63 in the U.S. and around 60 in Europe. Life expectancy at age 60 is about 20 years—more for females and somewhat less for males. This is well over half of the average time span between generations. Using U.S. life tables, one also finds that for a child of 25-year old parents, with about 60% probability at least one of the parents reaches age 85. The probability rises to 65% conditional on both reaching age 60. This means that a large majority of working-age voters has living parents. For older workers, these parents are likely retired. For students and younger workers, the same argument suggests that a majority will have retired grandparents or grand-grandparents. Thus a large majority of the population has close relatives who benefit from pay-as-you-go public pensions and other retiree benefits (e.g. health care).

The composition of families is clearly heterogeneous in practice, e.g., with regard to the number and timing of children and the realization of deaths, marriages, and divorces. Wheras models of retirement often impose homogeneity to simplify the analysis, differences in family composition are of the essence here. Hence I employ a flexible definition of family: A ***family*** for the purposes of this paper is any group of voters with sufficiently close personal linkages that they can engage in Coasian bargaining to attain the Pareto frontier of its members' utilities. Importantly, this definition does not require altruism, but merely an ability to align members' interests—including their voting interests. Family linkages in this sense may include direct child-parent-grandparent linkages, higher-order kinship relations (e.g. nephews, uncles), or linkages by marriage. Specific assumptions about family structure are made in the example section but not in the general model.

3. The Individualistic Model

Consider an economy with finitely lived individuals. Time is indexed by time t, and age is indexed by a. Both are treated as discrete. Individuals born at time t form cohort t. They are eligible to vote age V, they become eligible for retirement benefits at an exogenous age R, where R>V, and they live up to a terminal age A. The labor force consists all non-retired voters, the age range $a \in [V,R-1]$. Retirees are the age range $a \in [R,A]$. Let π_a be the survival function; that is, generation-t individuals survive to (at least) age a with probability π_a, where $\pi_{A+1}=0$. Assuming children neither vote nor work, they can be disregarded—their consumption subsumed under their parents consumption—and setting V=0 is without loss of generality. Then cohort t is economically active in the time interval [t, t+A]; and at time t, the living cohorts are those born in [t, t-A].

Let N_t^a denote the number of individuals of age a living in period t. Then

$$\overline{N}_t^W = \sum_{a=0}^{R-1} N_t^a \text{ and } \overline{N}_t^R = \sum_{a=R}^{A} N_t^a$$

are the total working-age population and the retired population, respectively.[7]

The economy is deterministic except for stochastic mortality. Labor has an exogenous marginal product of labor w and savings earn an exogenous real interest r. All workers are assumed have the same labor productivity.[8] At age a, individuals of generation t have preferences

$$U_t^a = \sum_{i=0}^{A-a} \pi_{a+i} \beta^i \overline{u}(c_{t+i}^{a+i}, \lambda_{t+i}^{a+i}) \tag{1}$$

over consumption c_t^a and leisure λ_t^a. I abstract from altruism for simplicity and to emphasize that altruism is not essential for the model (see Appendix for extension).

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[7] The population dynamics can be described by $N_{t+1}^{a+1} = N_t^a \cdot \pi_{a+1} / \pi_a \;\forall a < A$ and $N_{t+1}^0 = \sum_{a=0}^{A} \varphi_a N_t^a$, where φ_a denotes the fraction of age-a individuals having a child (fertility, assumed exogenous). The dynamics are inessential, however.

[8] This is to emphasize that the model does not rely on intra-cohort redistribution or on a particular income distribution. Time variation in wages and interest rates or a cross-sectional wage distribution could be added, but they would just clutter the notation.

Working-age individuals pay payroll taxes at rate τ_t and supply labor $l_t^a = 1-\lambda_t^a$. Retirees receive transfers T_t and do not work ($l_t^a = 0 \forall a \geq R$). Workers' optimality conditions for labor and leisure are

$$\frac{\bar{u}_\lambda(c_t^a, 1-l_t^a)}{\bar{u}_c(c_t^a, 1-l_t^a)}) = w(1-\tau_t) \; \forall a < R. \tag{2}$$

To simplify, assume u has the form $\bar{u}(c_t^a, \lambda_t^a) = u(c_t^a + \phi(\lambda_t^a))$, where u and ϕ are increasing and concave; and as normalization, assume $w = 1$. Then labor supply is characterized by $\phi'(\lambda_t^a) = 1-\tau_t$ for all a<R and can be written as a declining function of the current tax rate, $l_t^a = L(\tau_t)$. Assume ϕ has a shape such that tax revenues $\tau L(\tau)$ are strictly increasing and strictly concave in τ up to an interior maximum at some value $\tau^{\max} < 1$. (That is, assume Harberger triangle and Laffer curve intuition applies.) Then $\tau^{\max}$ satisfies $L(\tau^{\max}) - \tau L'(\tau^{\max}) = 0$; and $L(\tau) - \tau L'(\tau)$ is positive and strictly decreasing τ in for $\tau < \tau^{\max}$.[9]

The government's budget constraint is $T_t \bar{N}_t^R = \tau_t L(\tau_t) \bar{N}_t^W$, assuming taxes and transfers are administered in pay-as-you-go fashion. Every period, the tax rate τ_t is determined by voting decisions, assuming voters understand that transfers $T_t = T(\tau_t) = \tau_t L(\tau_t) \cdot \bar{N}_t^W / \bar{N}_t^R$ depend on the tax rate and on the aggregate worker-retiree ratio. Retiree preferences over current taxes (and implied benefits) are obviously strictly increasing in τ_t, whereas worker preferences are strictly decreasing in τ_t; i.e., both are single peaked.

For reference, suppose voting decisions were made individually, without family coordination. Because voting occurs repeatedly, future taxes and benefits are irrelevant for current voting. Hence all retirees would vote for $\tau_t = \tau^{\max}$ whereas all workers vote for $\tau_t = 0$. Assuming there are more workers than retirees ($\bar{N}_t^W > \bar{N}_t^R$), $\tau_t = 0$ is the unique voting equilibrium.[10] This formalizes the basic puzzle of public pensions in a democracy: Given a majority of voters is in working age, why do we have public pensions?

[9] This admittedly simplistic treatment of work and leisure suffices because the tax distortions only serve as device to avoid extreme solutions to the voting problem (as noted below).

[10] In the empirically unrealistic case $\bar{N}_t^W < \bar{N}_t^R$, one would obtain $\tau_t = \tau^{\max}$.

In practice, opinion polls suggest that public pensions are widely popular among working-age voters. The simple hypothesis pursued here is that voting interests are aligned within families so that the voting is not individualistic.

4. Family Preferences

Now let the economy's population be partitioned into families and consider the Pareto problem of a generic family with J members, indexed by j=1,…,J. As noted above, families units are defined by their ability to reach their members' Pareto frontier. To make the partition complete and unambiguous, individuals unable to bargain are treated as single-member families.

Pareto optimal family allocations can be obtained by maximizing a weighted sum of member utilities

$$V_t = \sum_{j=1}^{J} \omega(j)\, U_t^{a(j)}(j)\,, \tag{3}$$

subject to a combined budget constraint. The ω(j)>0 are weights and a(j) is the age of family member j. (See Appendix for more details and for an extension to altruism.) Because utility functions are assumed time separable, the problem can be decomposed into a sequence of static problems plus a dynamic problem of savings/wealth accumulation.

The period-t payroll tax rate enters only into the period-t static problem, which is to maximize

$$v_t = \sum_{j=0}^{J} \omega(j) u[c_t^{a(j)}(j) + \phi(\lambda_t^{a(j)}(j))] \tag{4}$$

subject to

$$\sum_{j=0}^{J} c_t^{a(j)}(j) + S_t = \sum_{j:a(j)<R} (1-\tau_t)[1-\lambda_t^{a(j)}(j)] + \sum_{j:a(j)\geq R} T(\tau_t)\,, \tag{5}$$

where S_t denotes a given level of period-t family savings.

The tax rate influences v_t through the budget constraint (5). Hence the family's preferences over tax rates do not depend on the weights ω(j).[11] The paper's main question is then: Suppose families have the ability to coordinate their voting to maximize v_t. What are the implications for pensions and payroll taxes?

[11] The intra-family allocation of consumption is clearly influenced by the welfare weights and conditional on savings. Leisure would also depend on welfare weights for general utility functions, it depends only on current taxes for the simple functional form assumed here.

To address this question, differentiate v_t with respect to τ_t to obtain

$$\frac{\partial v}{\partial \tau} = \Phi \cdot [-\sum_{j:a(j)<R}(1-\lambda^{a(j)}(j)) + \sum_{j:a(j)\geq R}\frac{\partial T}{\partial \tau}],$$

where $\Phi > 0$ is the Lagrange multiplier on (5).[12] Optimal leisure choices imply $1-\lambda^{a(j)}(j) = L(\tau)$ for all workers; and the pension system's pay-as-you-go budget constraint implies

$$\frac{\partial T}{\partial \tau} = [L(\tau) + \tau L'(\tau)]\frac{\bar{N}^W}{\bar{N}^R}.$$

Let $\eta = \sum_{j:a(j)\geq R}(1/J) \in [0,1]$ denote the ***share of retirees*** in the family and let $\bar{\eta} = \bar{N}_t^R/(\bar{N}_t^R + \bar{N}_t^W) \in (0,1)$ denotes the share of retirees in the population.[13] Then the net effect of pensions on family welfare can be written as

$$\frac{\partial v}{\partial \tau} = \Phi(1-\bar{\eta})J \cdot \left[[L(\tau)+\tau L'(\tau)]\frac{\eta}{\bar{\eta}} - L(\tau)\frac{1-\eta}{1-\bar{\eta}}\right]. \qquad (6)$$

This condition applies regardless of welfare weights and intertemporal considerations. Noting that $\partial v/\partial \tau$ in (6) increasing in η, one finds:

<u>Proposition 1</u>: Family preferences over payroll taxes are a single-peaked function of the retiree share. The preferred values are $\tau^*(\eta) = 0$ for families with $\eta \leq \bar{\eta}$; $\tau^*(\eta) \in (0, \tau^{\max})$ for $\bar{\eta} < \eta < 1$ with $\tau^*(\eta)$ strictly increasing in η; and $\tau^*(\eta) = \tau^{\max}$ for $\eta = 1$.

Proof: From (6), an interior solution for the preferred tax rate τ^* must satisfy $[L(\tau) + \tau L'(\tau)]\frac{\eta}{\bar{\eta}} = L(\tau)\frac{1-\eta}{1-\bar{\eta}}$. For $\eta = 1$, τ^* this reduces to $L(\tau) + \tau L'(\tau) = 0$, which means $\tau^* = \tau^{\max}$. For $\eta = \bar{\eta} < 1$, the condition reduces to $L'(\tau) = 0$, which implies $\tau^* = 0$. Because $L'(\tau) < 0$ for all $\tau > 0$, $\tau^* = 0$ applies as corner solution for all $\eta < \bar{\eta}$. For $\bar{\eta} < \eta < 1$, $[1 + \tau\frac{L'(\tau)}{L(\tau)}] = \frac{\bar{\eta}/(1-\bar{\eta})}{\eta/(1-\eta)} \in (0,1)$, where the r.h.s. is decreases strictly in η. Because the l.h.s. is strictly decreasing in τ, the preferred value is unique and increasing in η. For all η, preferences are single peaked because $\partial v/\partial \tau$ changes sign only once, from positive to negative at τ^*. QED.

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[12] Time subscripts t are omitted here and below when time is inessential. Note that by the envelope theorem, derivatives of leisure and savings with respect to taxes have zero marginal effect on v.

[13] Note that $\eta/(1-\eta)$ is the retiree-worker ratio, a more commonly used variable. I use the retiree share for the analysis because the retiree share is finite and bounded even for families without workers (the case $\eta = 1$), for which there is no finite retiree-worker ratio.

Because the retiree-worker ratio is increasing in the retiree share, Proposition 1 also implies that family preferences are single peaked in the family's retiree-worker ratio.

In the limiting case of (almost) inelastic labor supply, $L'(\tau) \to 0$ would imply $\tau^{\max} \to 1$ and $\tau^*(\eta) \to 1$ for all $\eta > \overline{\eta}$. That is, preferred tax rates would diverge to the extremes of the unit interval. The assumption of quasi-linear preferences over leisure is meant as a smoothing device, to rule out such extreme solutions and to ensure continuous preferences over the size of the pension system.

The economic intuition for Proposition 1 is based on Coasian bargaining. In countries where retirees are not entitled to family support, retirees may have to compensate working-age relatives to endorse positive payroll taxes. Under realistic conditions, each voter has a near zero probability of being pivotal; hence a small amount of compensation—small favors—should suffice to swing a vote. Regarding the plausibility of such bargaining, note that family life is in practice full of externalities and activities with public goods characteristics. This implies large gains from cooperation and gives families strong incentives to develop efficient internal bargain mechanisms. In the presence of numerous cooperative interactions, it seems plausible that the required compensation is often non-pecuniary and virtually unobservable to outsiders.

To define a voting equilibrium, let individuals be sorted by the retiree shares of the families they belong to. Let F(η) denote the resulting cumulative distribution function of voters. That is, in a multi-person families, the family's η value is counted as many times as the family has members. Single, unattached workers and retirees are interpreted as families of size one with retiree shares $\eta=0$ and $\eta=1$, respectively. Let $\eta_{med} = F^{-1}(1/2)$ denote the retiree share of the median voter's family. Then:

<u>Proposition 2</u>:

(a) A unique voting equilibrium exists and is given by $\tau^* = \tau^*(\eta_{med})$.

(b) The equilibrium payroll tax rate τ^* is strictly positive if and only if $\eta_{med} > \overline{\eta}$.

Proof: Follows from Prop.1 and the definition of η_{med}. QED.

The key condition for the existence of public pensions is that the majority of the population lives in families with retiree share greater than the aggregate retiree share; or equivalently, that the majority lives in families with retiree-worker ratios greater than the aggregate retiree-worker ratio.

5. Examples

A natural next question is which assumptions about demographics are likely to satisfy the condition $\eta_{med} > \overline{\eta}$. A study of the empirical distribution of family sizes is beyond the scope of this paper, and it may not be persuasive anyway because one would have to make ad hoc assumptions about the strengths of various linkages. Hence I focus on examples that illustrate the basic forces driving the voting outcomes.

<u>Example #1</u> [Two point distribution]

Suppose a fraction f of working-age individuals forms lasting bonds with m>0 family members who will be voting age when the person is in retirement—called intergenerational bonds in the following. Natural examples would be bonds with children—some or all—but the bonds could be with other younger relatives like grandchildren, nieces or nephews, or in-laws. Assume a fraction $\pi_R \in (0,1]$ of the working-age population lives to the maximum age A, and fraction 1-π_R dies at the retirement age R. Let $\hat{\eta} = \overline{\eta} / \pi_R$ be the hypothetical retired population if all retirees had survived, expressed as share of the actual population. Assume retirees are not linked to each other and that each working-age voter is linked to at most one retiree. Then f and m are bounded by $fm \le (1-\overline{\eta})/\hat{\eta}$, or $fm \le \pi_R(1-\overline{\eta})/\overline{\eta}$. Also, assume $\overline{\eta} < 1/2$ so retirees are a minority.

The example economy has three types of families. Retirees without intergenerational bonds form single-member families; they account for share $\pi_R \hat{\eta}(1-f) = \overline{\eta}(1-f)$ of the population. A fraction f of retirees lives in families consisting of the retiree plus m workers. Such families have retiree share η=1/(1+m)>0 and their population share is $\pi_R(1+m)\hat{\eta}f = (1+m)\overline{\eta}f$. Finally, families have workers and no retirees, either because the workers never bonded with a retiree (population share $1-\overline{\eta} - fm\hat{\eta}$) or because the retired member has died (population share $(1-\pi_R)fm\hat{\eta}$). The first type prefers $\tau^*(1) = \tau^{\max}$ but is a minority. The second type prefers $\tau^*(\eta) > 0$ if and only if $\eta = 1/(1+m) > \overline{\eta}$. The third type prefers $\tau^*(0) = 0$ and constitutes a majority if and only if

$$F(0) = 1 - \overline{\eta} - fm\hat{\eta} + (1-\pi_R) fm\hat{\eta} = 1 - \overline{\eta} - fm\overline{\eta} > 1/2.$$[14]

With this population structure, taxes are positive if and only if

(A) the median voter's family is a family of retirees with workers: $1 - \overline{\eta} - fm\overline{\eta} < 1/2$*; and*

(B) this type of family prefers positive taxes: $1/(1+m) > \overline{\eta}$.

Condition (A) imposes a lower bound on the number of workers linked to retirees, $fm > (1/2 - \overline{\eta})/\overline{\eta}$. Because $fm \le \pi_R(1-\overline{\eta})/\overline{\eta}$, (A) also requires a sufficiently high survival rate, namely $\pi_R > (1/2 - \overline{\eta})/(1-\overline{\eta})$. Condition (B) imposes an upper bound on the number of workers in each worker-retiree family, $m < (1-\overline{\eta})/\overline{\eta}$. For $\overline{\eta} < 1/2$, the interval $[(1/2-\overline{\eta})/\overline{\eta}, (1-\overline{\eta})/\overline{\eta}]$ has a length exceeding one and therefore includes one or more integers m. For integers m in this interval, (A) holds if π_R is sufficiently close to one, and (B) holds if f is sufficiently close to one. Thus, voting solutions with positive taxes do exist.

Quantitatively, retiree shares in developed countries are in the 0.2 to 0.35 range. Consider $\overline{\eta} = 0.3$ as specific example. One obtains $(1-\overline{\eta})/\overline{\eta} = 7/3$ and $(1/2-\overline{\eta})/\overline{\eta} = 2/3$. Hence conditions (A) and (B) are satisfied for m=1 with f>2/3 and for m=2 with f>1/3. That is, family linkages support public pensions if there are a sufficient number of "small" families—either at least 2/3 of retirees in families with one working-age member or at least 1/3 of retirees in families with exactly two working-age members. Pensions do not have majority support if either too few retirees have intergenerational bonds, or if retirees with intergenerational bonds are linked to too many workers.

Table 1 displays, for a range of retiree shares, combinations of family sizes (m), minimal survival rates (π_R), and minimal frequency of family bonds (f) that support pensions. For retiree-shares in the over-1/4 to near-1/2 range, a significant fraction of one-worker-one-retiree linkages suffices, or a smaller number of multiple linkages. When retiree shares are lower, pensions require a larger number of family linkages (higher m) to bind a sufficient number of workers into families with retirees. In

[14] Throughout, I disregard the case of tied, 50:50 voters, because they would distract from substantive insights and because such cases are non-generic in the parameter spaces considered.

addition, the number of links must not be too high because a family with too many workers would have a retiree share below the national average and prefer zero taxes.

Note that a survival probability of less than ½ suffices in all cases. Because the survivor him/herself can vote, families with retirees can have a majority of votes even if retirees have died in a majority of families. Social security can be interpreted in this context as insurance against the cost of surviving into retirement. Under this interpretation, Table 1 provides conditions under which families with early deaths cannot renege on their insurance payments.

Overall, Table 1 shows that family support for public pensions requires a balance between retiree shares and family sizes. Societies with high fertility rates tend to have large families and low retiree shares. In such societies, static support for public pensions requires that most retiree are linked to a substantial number of working-age family members. In societies with low fertility, where families tend to be small and retiree shares high, support for public pensions requires appropriately smaller number and/or frequency of family bonds. Prior to the demographic transition, survival rates into retirement were probably too low to support public pensions even with large families. Thus the model is consistent with the introduction of public pensions during the demographic transition, when retiree shares and survival rates increased while family size decreased.

Note that the equilibrium tax rate $\tau^*(\frac{1}{1+m})$ is decreasing in m. A social security system backed by size m=1 families has therefore a higher tax rate than a social security system supported by size m>1 families. This suggests that the historical growth of public pensions may be related to the historical trend towards smaller families and not (only) to the aging process.

<u>Example #2</u> [General distribution]

The assumption in Example 1 of a common family size for all worker-and-retiree families is clearly restrictive. Consider now the same setting, but with a distribution over the number of family bonds. Let π_m be the fraction of retirees with m links, with m ranging from zero to some maximum value M. Let $\overline{m}$ be the average number of family bonds per retiree. Note that, analogous to Example 1,

$\overline{m} \leq (1-\overline{\eta})/\hat{\eta} = \pi_R(1-\overline{\eta})/\overline{\eta}$, and that social security requires less than 50% population share of workers-only families, $1-\overline{\eta}-\overline{m}\cdot\overline{\eta} < 1/2$.

Among families with retirees, those with $\eta = 1/(1+m) > \overline{\eta}$ (which always includes m=1) will prefer $\tau^*(\eta) > 0$. Families with $1/(1+m) < \overline{\eta}$ prefer $\tau^*(\eta) = 0$. Support for social security is thus concentrated among relatively small families with a retiree, whereas larger families would be better off supporting their retiree privately. Let $\breve{m} = \lfloor (1-\overline{\eta})/\overline{\eta} \rfloor$ denote the highest m-value for which families support social security. Then a voting equilibrium has positive payroll taxes if and only if [15]

$$\Sigma_0 = \sum_{m=0}^{\breve{m}} \pi_m (1+m)\cdot\overline{\eta} > 1/2. \tag{7}$$

Condition (7) ensures that families with retiree and up to $\breve{m}$ workers constitute a majority. Unless the jump from $(1-\overline{\eta})/\overline{\eta}$ to the next lower integer exceeds $(1-\overline{\eta})/\overline{\eta}-\overline{m}$, the $\breve{m}$ exceeds $\overline{m}$. If (7) is satisfied, let $m^* \in \{1,\ldots,\breve{m}\}$ be the lowest integer for which $\sum_{m=0}^{m^*} \pi_m (1+m)\cdot\overline{\eta} > 1/2$. Then the equilibrium tax rate is $\tau^*(\frac{1}{1+m^*})$ and it is decreasing in m^*.

For a quantitative illustration, consider again $\overline{\eta} = 0.3$, which implies $\breve{m} = 2$. Condition (7) then specializes to $\Sigma_0 = 0.3\cdot\pi_0 + 0.6\cdot\pi_1 + 0.9\cdot\pi_2 > 0.5$. Sufficient conditions are $\pi_2 > 5/9$, or $\pi_1 > 5/6$, or a linear combination where any gap between π_2 and 5/9 is covered by sufficient π_1 and π_0 values. The median voter's family size is $m^* = 1$ if $0.3\cdot\pi_0 + 0.6\cdot\pi_1 > 0.5$, which means that π_1 plus half of π_0 must exceed 5/6; otherwise $m^* = 2$.

Note that families with $m > \breve{m}$ vote against social security. The model is thus consistent with the absence of social security systems in societies with many large families. The least supportive environment for social security would be a combination of disconnected retirees (m=0) and families of size $m = M = \breve{m}+1$. This scenario would maximize the number of retirees in families that vote for no taxes. Only the fraction π_0 of retirees would support social security.

Retiree-only families do help to satisfy condition (7), but because the weight on π_0 is less than ½, their support is insufficient. Families ties between retirees and a small but positive number of workers are therefore central to generating voting support for social security.

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[15] To cover cases with $\breve{m} > M$, formally define π_m=0 for m>M.

Examples 1-2 do not allow for family bonds between retirees. Given the institution of marriage, this is restrictive. Turning to family structures with multiple retirees, key questions are how the number of working-age members grows with the number of retired members, and to what extent the death of a retiree breaks linkages between surviving retirees and working-age members. In some cases, one may suspect multiple bonds that survive the death of one retiree (e.g., married retirees with common children), whereas in other cases each retiree may contribute a separate set of intergenerational bonds. If marriage correlates with children or otherwise helps to coordinate voting among a larger number of members, two-retiree families may even have more than twice the number of family bonds than one-retiree families.

Example #3 [Multiple retirees]

Consider the same setting as in Example 2, but allow for families with two retirees. (A larger number could be modeled along the same lines, but the case of one- and two-retiree families suffices to illustrate the new issues.) Suppose a fraction μ of prospective retirees establishes, during working-age, a family bond with a same-age partner—labeled marriage for brevity—plus up to M bonds to younger members who will be working-age when the senior members are retired, i.e., intergenerational bonds. A fraction 1-μ is never married and forms m intergenerational bonds with probability π_m, as in Example 2. Assume survival into retirement is independent of a partner's survival. Then a fraction $\mu \cdot \pi_R^2 \cdot \hat{\eta} = \mu \cdot \pi_R \cdot \overline{\eta}$ of the population are married retirees, a fraction $\mu \cdot (1-\pi_R) \cdot \overline{\eta}$ are widowed retirees, and $(1-\mu) \cdot \overline{\eta}$ are never-married retirees.

Social security is again supported by families with retirees and with not too many working-age members. Let $\breve{m} = \lfloor (1-\overline{\eta})/\overline{\eta} \rfloor$ and $\breve{m}_2 = \lfloor 2(1-\overline{\eta})/\overline{\eta} \rfloor$ denote the highest m-values for which one- and two-retiree families support social security, respectively. If $\breve{m}_2$ is even, $\breve{m}_2 = 2\breve{m}$, otherwise $\breve{m}_2 = 2\breve{m}+1$. A voting equilibrium has positive social security taxes if single-retiree families with $m \le \breve{m}$ plus two-retiree families with $m \le \breve{m}_2$ constitute a majority.

As benchmark, suppose intergenerational bonds in two-retiree families are additive in the sense that each partner contributes bonds according to the distribution π_m and that these links are broken when the contributing partner dies. Then intergenerational bonds in two-retiree families are distributed $\pi_{2,m} = \sum_{i=\min(m,M)}^{\max(m,M)} \pi_i \pi_{m-i}$ for $m \le 2M$, the distribution of the sum. The condition for positive social security taxes is

$$\Sigma_1 = \sum_{m=0}^{\breve{m}} \pi_m (1+m) \cdot [1-\mu+\mu(1-\pi_R)]\overline{\eta} + \sum_{m=0}^{\breve{m}_2} \pi_{2,m} (1+m/2) \cdot \mu \pi_R \overline{\eta} > 1/2 . \qquad (3)$$

Compared to Example 2, one finds

$$\Sigma_1 = \Sigma_0 + \left\{ \sum_{m=0}^{\breve{m}_2} \pi_{2,m} (1+m/2) - \sum_{m=0}^{\breve{m}} \pi_m (1+m) \right\} \cdot \mu \pi_R \overline{\eta} . \qquad (4)$$

Note that children per retiree in two-retiree families have a distribution with the same mean $\overline{m}$ as one-retiree families, but with only half the variance. Recall that the cutoff $\breve{m}$ tends to be above the mean. This suggests that the fraction of two-retiree families with $m \le \breve{m}_2$ will exceed the fraction of one-retiree families with $m \le \breve{m}$, and thus marriage increases the support for social security. This intuition does not always apply, however, because voting support is lost whenever a retiree with $m \le \breve{m}$ is paired with a retiree who contributes more than $\breve{m}_2 - m$ additional intergenerational bonds.

For a quantitative illustration, suppose $\overline{\eta} = 0.3$, which implies $\breve{m} = 2$ and $\breve{m}_2 = 4$. In addition, assume $\mu = \pi_R = 0.7$ so 49% of retirees are surviving married and 21% widowed.[16] For the distribution π_0=.4 and π_1= π_2=.30, one finds Σ_1=Σ_0=0.57. Marriage does not affect voting outcomes. (One can show that this irrelevance applies in general whenever $\breve{m} \ge M$.) For π_0=.35, π_1= π_2=.30, and π_3=.05, Σ_1=0.5675 exceeds Σ_0=0.5555, so voter support is increased. While the support condition m≤2 fails for 5% of one-retiree families, condition m≤4 fails for only 3.25% of two-retiree families. For π_0=.35, π_1= π_2=.30, and π_5=.05, in contrast, Σ_1=0.5414 is less than Σ_0=0.5555, so voter support is decreased. This is because families with m=5 will voter against social security even with two retirees.

Different assumptions about two-retiree families yield similarly mixed results. For example, suppose marriage does not add intergenerational bonds but creates linkages that survive the other

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[16] Note that because μ and π_R only determine the weight on the bracket expression in (4) and not the sign of Σ_1-Σ_0, they do not matter for the key question if multiple-retiree families retiree partnerships increases or reduces voter support; also note that μ and π_R enter only through their product. The key issue is thus the distribution of family bonds—the shapes of π_m and π_{2m} and their interaction.

retiree's death. Then the distribution π_m applies to all families with retirees, and the condition for positive social security taxes is

$$\Sigma_2 = \sum_{m=0}^{\breve{m}} \pi_m (1+m) \cdot [1-\mu+\mu(1-\pi_R)]\overline{\eta} + \sum_{m=0}^{\breve{m}_2} \pi_m (1+m/2) \cdot \mu\pi_R\overline{\eta} > 1/2 . \tag{5}$$

Compared to the previous cases, one finds

$$\begin{aligned} \Sigma_2 &= \Sigma_0 + \left\{ \sum_{m=0}^{\breve{m}_2} \pi_m (1+m/2) - \sum_{m=0}^{\breve{m}} \pi_m (1+m) \right\} \cdot \mu\pi_R\overline{\eta} \\ &= \Sigma_1 + \left\{ \sum_{m=0}^{\breve{m}_2} (\pi_m - \pi_{2,m})(1+m/2) \right\} \cdot \mu\pi_R\overline{\eta} \end{aligned} \tag{6}$$

In this case, marriage turns families with $m \in [\breve{m}+1, \breve{m}_2]$ workers into social security supporters. But in families with $m \in [1, \breve{m}]$ workers, where one retiree would have been enough to gain the workers' support, a second retiree may represent a lost opportunity to form a separate family that includes additional workers. The net effect can be positive or negative, depending on how much support is gained for $m \in [\breve{m}+1, \breve{m}_2]$ versus support lost for $m \in [1, \breve{m}]$.[17]

Overall, Example 3 suggests that multi-retiree families complicate the analysis without necessarily affecting the results in either direction.

Figure 1 plots the cutoff values $\breve{m}$ and $\breve{m}_2$ against the retiree share $\overline{\eta}$. Two specific scenarios may be instructive, one for the U.S., the other for continental Europe. First, suppose $\overline{\eta}$ is equal or slightly below 0.2, the relevant range for the U.S. Then families with one retiree and up to 4 working-age members plus families with two retirees and up to 8 working-age members will support social security. It seems plausible that these conditions cover the vast majority of American families—all but very large extended families. Second, suppose $\overline{\eta}$ is around 0.3, the relevant range in continental European countries. Then families with one retiree and up to two working-age members, plus families with 2 retirees and up to 4 working-age members, will support social security. Because families with more than two children have become rare in Europe, and because even families with two retirees, two children, and two grandchildren would also satisfy these conditions, the conditions are plausibly satisfied in European countries, too.

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[17] For example, consider again π_0=.4, π_1= π_2=.30, and π_3=.05, with the same other assumptions as above. Then Σ_2=0.5072 is less than Σ_0 and Σ_1, but still above 50%.

6. Conclusions

The paper provides conditions for pay-as-you-go benefits to retirees to be supported as a voting equilibrium in a static model. The key requirement is that a sufficient fraction of retirees are in families with a positive, but not excessively large number of working-age members. Then the median voter lives in a family with above-average retiree share. Numerical examples suggest that this condition is satisfied in Europe and in the United States.

The paper's focus on static family bargaining is not to dispute the relevance of other voting arguments. It would straightforward, for example, to make labor productivity heterogeneous and to show that a skewed wage distribution would increase voter support for public pensions with progressive benefits. The model is also potentially complementary to dynamic models; many such models rely on trigger strategies that (arbitrarily) select one of many equilibrium paths that could have been supported by alternative beliefs about voting in the future. The static argument for social security provides a natural lower bound for expectations about future benefits.

The simplicity of the static family model is arguably a virtue. Given the ubiquity of family linkages, they are a plausible mechanism to explain the popularity of public retirement and retiree health care programs. This is important because understanding these programs' political support is a precondition for a variety of analyses, from estimating future benefits—a vital issue for participants—to designing politically feasible reforms. Even if dynamic arguments play a role, it should be reassuring for participants if old age benefits can also be supported by simple static arguments.

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Appendix: Details on Pareto Optimality and Extensions with Altruism

This appendix provides additional motivation for Pareto optimality and explains why the analysis would remain unchanged if one assumed altruistic individual preferences.

Consider a family with J members indexed by j or k. As in the non-altruistic model, let

$$U_t^a(j) = \sum_{i=0}^{A-a} \pi_{a+i}\beta^i \bar{u}(c_{t+i}^{a+i}(j), \lambda_{t+i}^{a+i}(j))$$

denote member j's utility over ***own*** consumption and leisure (as in (1)). To model altruism, let member k's valuation of j's utility over consumption and leisure be captured by $\gamma_k(j) \geq 0$, with normalization $\gamma_k(k) = 1$. Let

$$\bar{U}_t^a(k) = \sum_{j=1}^{J} \gamma_j(k) \cdot U_t^{a(j)}(j) \qquad \text{(A1)}$$

represent family member k's overall utility. Each family member operates under an intertemporal budget constraint specifying that initial assets, the present value of labor income, and transfers from other family members must finance the present value of own consumption plus transfers to other family members (details inessential hence omitted).

Pareto optimal allocations for the family are allocations of consumption and time so no member can be made better off by a reallocation without another being worse off. By standard arguments, such allocations can be represented by solutions to maximizing a weighted sum of utilities $\bar{U}_t^a(k)$ subject to the family's joint budget constraint. With $\bar{\gamma}_k$ denoting member k's weight, the objective function is

$$V = \sum_{k=1}^{J} \bar{\gamma}_k \cdot \bar{U}_t^a(k) = \sum_{k=1}^{J} \bar{\gamma}_k \sum_{j=1}^{J} \gamma_j(k) \cdot U_t^{a(j)}(j) = \sum_{j=1}^{J} \left(\sum_{k=1}^{J} \bar{\gamma}_k \gamma_j(k) \right) \cdot U_t^{a(j)}(j). \qquad \text{(A2)}$$

Thus V can be written as weighted sum of utilities $U_t^{a(k)}(k)$ over consumptions and leisure with weights $\sum_{k=1}^{J} \bar{\gamma}_k \gamma_j(k) = \omega(j)$, as in (3). In this sense, (3) generalizes to preferences with altruism.

A natural point of reference is the allocation that maximizes each member's utility subject to his/her own budget constraint. Without altruism (meaning $\gamma_j(k) = 0 \forall j \neq k$) and without voting decisions, this allocation is Pareto optimal and involves no intra-family transfers.

With altruism—even without voting—Pareto optimality generally requires voluntary/altruistic transfers that cover the gaps between members own funds and the resources needed to finance the assigned consumption minus wage income. In practice, the determination of such transfers will often require some "bargaining" (say between siblings who all care about a needy parent about who contributes how much), which one can interpret as a fixing the weights $\bar{\gamma}_k$.

Intra-family externalities and "public goods" could be modeled by adding terms to (A1) that capture possible actions member j can take to benefit others and their cost (e.g., helping in home production, organizing joint family activities). A specific algebraic model of such interactions would be cumbersome and distracting. Such interactions are conceptually relevant for this paper, however, because they promise large gains from developing mechanisms that induce intra-family cooperation, and because they likely involve intra-family transfers. These existing mechanisms should help coordinate voting choices in a frictionless and inconspicuous manner.

Turning to policy, Proposition 1 characterizes the payroll tax that maximizes V. Because V has the altruistic interpretation (A2), the proposition applies with and without altruism. It is again a matter of bargaining how the gains from Pareto optimal voting are allocated—say, if retirees compensate working-age family members for approving taxes, and who pays to whom and how much.[18] Regardless of the specific bargaining process, the outcome should be Pareto optimal unless there are frictions in the process.

Possible complications in the analysis above are the birth/addition or death/separation of family members, as they would imply a changing family composition over time. This is immaterial for voting over current period taxes, however, because the cost and benefits apply only to current members. Pareto optimality still requires that optimal choices maximize the weighted sum of current members' utilities, holding constant the (possibly state contingent) future transfers to future members.

[18] For example, laws requiring children to support for needy parents may establish "property rights" that influence the bargaining. If compensation is contingent on the family being the marginal voters, it may be large but very rare; if compensation is unconditional and each voter's chance of being pivotal is tiny, a very small "favor" should suffice to swing a vote.

Table 1: Conditions for Positive Payroll Taxes in Example 1

Retiree Share ($\overline{\eta}$)	Survival Prob. (π_R)	Conditions on the number of family links (m)			Fraction linked (f)
		Lower bound	Upper bound		
Given	Lower bound			Integer m	Lower bound
0.10	0.44	4.0	9.0	5	0.80
				6	0.67
				7	0.57
				8	0.50
				9	0.44
0.15	0.41	2.3	5.7	3	0.78
				4	0.58
				5	0.47
0.20	0.38	1.5	4.0	2	0.75
				3	0.50
				4	0.38
0.25	0.33	1.0	3.0	2	0.50
				3	0.33
0.30	0.29	0.7	2.3	1	0.67
				2	0.33
0.35	0.23	0.4	1.9	1	0.43
0.40	0.17	0.3	1.5	1	0.25
0.45	0.09	0.1	1.2	1	0.11

Figure 1: Maximum number of working-age members for families with one and two retirees to support social security