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SOME INEFFICIENCY IMPLICATIONS OF GENERATIONAL POLITICS AND EXCHANGE*

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This paper explores the implications of generational selfishness in a model in which each generation has its own government. Such selfish generational governments will potentially distort the economy along a number of dimensions. One is the monopolization of factor supplies; another is the under- or overprovision of durable public goods. We demonstrate that selfish generations may place sizable marginal taxes on their factor supplies in order to monopolize their factor markets. We also show that selfish generations will provide inefficient levels of durable public goods both at the local and national levels. Finally, we demonstrate that generational inefficiencies can arise even in models of cooperative bargaining because of the first-mover advantage of earlier generations.

IN THE ABSENCE OF intergenerational altruism one would expect each generation to act in its self interest *vis-à-vis* other generations. For example, one would expect current generations to expropriate as much as possible from future generations. This seems likely even if the membership of each generation is heterogeneous, at least insofar as generational issues are at stake.

While the selfish pursuit of generational objectives would seem the only viable policy for a representative (of the living) government, the literature on intergenerational fiscal policy (e.g., Summers 1981) has, with rare exceptions (e.g., Kotlikoff, Persson and Svensson 1988), ignored this point and modeled government as having its own arbitrary objectives. Our paper addresses this anomaly by considering governments that are concerned solely with their generations' interests. Specifically, we assume that each generation has its own representative government. Each generation's government can, within certain limits, regulate the economic affairs of its members and bargain with other generations, but it cannot unilaterally expropriate from other generations.

One might view as unrealistic the assumption of generation-specific governments. After all, such governments do not correspond to more familiar public choice mechanisms, such as majority voting. But the fact that such mechanisms are familiar, does not make them more realistic. Certainly, the actual political institutions in the U.S. and other countries are much more complex than can be characterized by any simple rule such as majority voting. In addition,

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actual institutions may simply be serving as a cover for more fundamental political and economic forces that are ultimately determining political outcomes in just the same way that majority voting may be a cover for the sale of votes through logrolling.

It seems to us more interesting to try to derive political institutions and public choice mechanisms, rather than assume them, and we think of this paper as a small step in that direction. In a life-cycle model the main political constituents are the different age cohorts, so we take the different age groups—the young and the old at a point in time—as the main political groups. Since the life-cycle model assumes individual agents are selfish, we assume that each generation of identical agents will find ways to look after its common interests (such as organizing into a self-governing entity).[1] We further assume that no generation can coerce/steal from the other. (Alternatively, we could assume that there are limits to how much can be stolen by one generation from another such that, at the margin, no further theft is feasible without a major revolt by the generation being expropriated.) The no stealing dictum means, among other things, that the old cannot tax the young to make transfers to themselves. Ruling out such intergenerational fiscal theft means, in our first model for instance, that each generation can set fiscal policy for itself—hence, the notion of a generational government.

Research on inefficiencies arising from the combination of generational selfishness and the sequential nature of generational interactions has a long tradition in economics beginning with Samuelson's (1958) consumption-loan model. This paper extends that literature by considering two additional efficiency problems. The first is the prospect of factor monopolization by successive generations. The second is the prospect of inefficient provision of durable public goods. In addition to considering these issues, the paper demonstrates that cooperative bargaining by coexisting generations is not, in general, enough to overcome such inefficiencies.

In the simple, two-factor model of factor monopolization analyzed in Section 1, we show that each generation has an incentive to restrict its supply of labor when young and its supply of capital when old (its saving when young) in order to raise the respective market returns to these factors. The government of each generation implements such factor monopolizations by placing distortionary taxes on its members' supplies of labor and savings. The model's utility and production functions are Cobb-Douglas. Given these functions and realistic parameter choices, the equilibrium wage taxes and capital-income taxes turn out to be quite high; indeed, they are high enough to account for the level of distortionary wage and capital-income taxes in the U.S. Our factor-monopolization explanation for distortionary taxation is obviously different from the major alternative

[1] In the U.S. the elderly, at least, are viewed as a powerful and active political block. The AARP, the American Association of Retired Persons, appears to have near veto power on social security legislation. Also, a new group, AGE, Americans for Generational Equity, has arisen to look out for the welfare of the young.

explanation in the literature provided by Mirrless (1971) and Sadka (1976), namely that governments use distortionary taxes to help sort taxpayers of differing, but unobserved, characteristics.

In the analysis of nonexcludable durable public goods (bads) presented in Section 2, we show that changes in asset prices associated with the provision of public goods—capitalization effects—can partly, fully, or more than fully offset the incentives of early generations to underprovide (overprovide) public goods (bads). The capitalization effect we consider is associated with the sale of land from one generation to the next. If the level of the public good (bad) positively (negatively) affects the marginal utility of owning land or housing, early generations will realize that increased provision of the public good will raise the market values of their properties. In the case of local durable public goods, capitalization incentives for providing these goods can arise even if the level of the public good does not affect the marginal utility of land. The reason is that, other things equal, a locality that provides more durable public goods will be more attractive to new residents (in our model new generations), and this added attraction will be reflected in the locality's value of land. While the competition between localities adds an additional element to the analysis, the special conditions under which the provision of durable public goods is efficient are identical in the cases of local and national (non-local) durable public goods.

In our models of factor monopolization and public goods provision, the governments representing the respective generations play noncooperatively; i.e., it is assumed that there is no mechanism through which they can make binding agreements with each other. One might ask whether the inefficiencies in these games are due solely to the noncooperative rules of play. In the third section of the paper we present a simple model in which an older generation, which lives in periods 1 and 2, and a younger generation, which lives only in period 2, bargain co-operatively (i.e., with the ability to establish binding contracts) in period 2. Notwithstanding their period 2 co-operation, the older generation is able to "get the beat" on the younger generation in its first period of life. "Getting the beat" in this model gives the older generation a better period-2 bargaining position, but also leads to an inefficient solution; no matter what efficient, individually-rational bargaining solution is used in period two, as long as it is correctly forecast in period one, the resulting two-period consumption program is not Pareto-optimal among the feasible allocations for the two-period economy. In other words, because the two generations cannot bargain before the first-period consumption occurs, an inefficiency results. This inefficiency is solely due to the lack of synchronicity of the generations and therefore seems inevitable in any intergenerational setting. The point that interest groups will take actions to improve their own and worsen their bargaining partners' subsequent bargaining positions has been made in different contexts by Alesina (1987), Persson and Svensson (1989), Persson and Tabellini (1990), and others.

In the final section, 4, we conclude the paper with some remarks about the realism of generational models of government.

I. FACTOR MONOPOLIZATION BY SUCCESSIVE GENERATIONS

In this section we assume that each generation's government taxes its members' labor and capital incomes, but returns the receipts from these taxes to them in a lump sum. These distortionary taxes reduce each generation's supplies of productive factors, thereby raising the market return to these factors.

The framework is an infinite-horizon, overlapping-generations model. We assume zero population growth, so that the number of young and old are equal at each point in time. All individuals within a generation are identical and selfish, in that each cares only about his own consumption and leisure. The members of each generation live for two periods. They supply labor when young and capital (their accumulated savings) when old. The utility function underlying these supply decisions is Cobb-Douglas in consumption when young, consumption when old, and leisure when young.

When each new generation arrives on the scene, its government, acting in the interest of its members, announces a first-period labor-income tax and a second-period tax on capital income. Given these taxes, the individual members of each generation choose how much to work and consume when young and how much to save (invest) for old age. There are no bequests, so the old consume the entire return on their savings.

Output at any point in time is produced according to a Cobb-Douglas function of capital supplied by the old and labor supplied by the contemporaneous young. The pre-tax returns earned by these factor supplies are determined in competitive factor markets. Hence, while their governments act strategically in setting tax rates, individuals in each generation simply optimize subject to their after-tax budget constraints. This framework captures the notion that each generation's government can collect taxes on factor incomes, but cannot directly control any individual member's sale of factors on the market.

Since each generation's supplies of labor when young and capital when old are effectively determined by decisions made when the generation is young, the government of each generation makes its moves when the generation is young. Hence, the old generation's government does not act strategically; and the old generation passively supplies all its accumulated capital to the production sector and earns the market-determined return. The young generation, however, needs to consider how its second-period supply of capital will influence the supply of labor by the next generation. Thus, each new young generation finds itself moving first in a subgame that it plays with the next generation and, indirectly, with all other future generations.

In setting its compensated taxes each government can effectively induce its members to choose the point on their individual budget constraints that the government desires. This fact permits us to simplify the analysis by having the government choose directly the values of labor supply and consumption that maximize its generation's utility, taking into account the equilibrium effect on

future generations. This planner's problem differs, however, from utility maximization by a representative individual because the government planner takes into account the effect of its choices on factor prices. We show later how the solution to the planning problem can be decentralized through an appropriate set of proportional (and hence marginal) taxes on labor and capital income which are rebated in a lump sum at the time they are paid.

The utility of the typical member of the generation that is young at time t, U_t, is given by:

$$U_t = C_{yt}^{a} C_{ot+1}^{b} \ell_t, \tag{1}$$

where C_{yt}, C_{ot+1}, and ℓ_t are, respectively, consumption of the young at time t, consumption of the old at time t+1, and leisure of the young at time t. The budget constraining the present value of consumption of the representative member of generation t is:

$$C_{yt} + C_{ot+1} R_{t+1}^{-1} = W_t(1 - \ell_t). \tag{2}$$

In (2) R_{t+1} and W_t stand, respectively, for the rental rates on capital in period t+1 and labor in period t. We assume 100 percent depreciation of capital during production; hence, C_{ot+1} in (2) is divided by R_{t+1} and not by $1 + R_{t+1}$. The price of the consumption good at each point in time is normalized to unity. Each individual is endowed with one unit of time when young; hence, $1 - \ell_t$ equals the individual's supply of labor.

Output per unit of labor at time t, y_t, is given by the Cobb-Douglas form $y_t = k_t^{\beta}$, where k_t stands for capital per unit of labor and where β is constant over time with $0 < \beta < 1$. Competition in factor markets ensures that marginal products of labor and capital equal their respective factor rentals, hence:

$$\begin{aligned} W_t &= (1 - \beta) k_t^{\beta} \\ R_t &= \beta k_t^{\beta - 1}. \end{aligned} \tag{3}$$

In choosing ℓ_t, generation t's government takes into account that W_t depends on ℓ_t, since W_t depends on $k_t = K_t/(1 - \ell_t)$, where K_t stands for capital per old person at time t. In choosing C_{yt} as well as ℓ_t, generation t's government also takes into account that R_{t+1} depends on $k_{t+1} = K_{t+1}/(1 - \ell_{t+1}) = [W_t(1 - \ell_t) - C_{yt}]/(1 - \ell_{t+1})$. The last equality reflects the fact that capital per old person at time t+1 equals the saving done when young at time t. Rewriting W_t and R_{t+1} to reflect their dependencies on C_{yt} and ℓ_t yields:

$$W_t=(1-\beta)k_t^{\beta}=(1-\beta)\left[\frac{K_t}{1-\ell_t}\right]^{\beta} \tag{3'}$$

$$R_{t+1}=\beta k_{t+1}^{\beta-1}=\beta\left[\frac{K_{t+1}}{1-\ell_{t+1}}\right]^{\beta-1}=\beta\left[\frac{(1-\beta)(K/1-\ell_t)^{\beta}(1-\ell_t)-C_{yt}}{1-\ell_{t+1}}\right]^{\beta-1}.$$

We can now state the planning problem of the government of generation t: choose C_{yt}, C_{ot+1}, and ℓ_t to maximize (1) subject to (2) and (3′). In this maximization generation t, whose members are young at time t, takes as given K_t, the capital supplied by the old at time t.

In addition to taking account of the dependency of W_t on ℓ_t and of R_{t+1} on ℓ_t and C_{yt}, generation t's government must consider how its choices of these variables will influence $(1-\ell_{t+1})$, the time $-(t+1)$ labor supply chosen by generation $t+1$. We hypothesize that since K_{t+1} summarizes all relevant information at time $t+1$, if ℓ_{t+1} depends on ℓ_t and C_{yt}, it depends on them only through their effect on K_{t+1}. We therefore study only subgame-perfect equilibria in which strategic actions at t can depend on the history of play only through K_t—so that punishments, for example, are ruled out. In the derivation of the optimal choices of ℓ_t and C_{yt} we further hypothesize that the solution involves $d\ell_s/dK_s=0$ for all $s>t$. We then verify that this hypothesis is consistent by showing that it implies $d\ell_t/dK_t=0$. Both of these hypotheses serve to focus attention on what we believe to be the interesting equilibrium. Other equilibria can be expected to exist as well.

The maximization with respect to C_{yt}, C_{ot+1}, and ℓ_t of (1) subject to (2) and (3′) leads to the following first-order conditions:

$$\frac{aC_{ot+1}}{bC_{yt}}=R_{t+1}(1-(1-\beta)) \tag{4}$$

$$\frac{C_{yt}}{a\ell_t}=W_t(1-\beta). \tag{5}$$

Equations (2), (4), and (5) can be solved for the optimal values of C_{yt}, C_{ot+1}, and ℓ_t which are given, respectively, in (6), (7), and (8):

$$C_{yt}=W_t\frac{a(1-\beta)}{1+(1-\beta)(a+b\beta)} \tag{6}$$

$$C_{ot+1}=W_tR_{t+1}\frac{b\beta(1-\beta)}{1+(1-\beta)(a+b\beta)} \tag{7}$$

$$\ell_t=\frac{1}{1+(1-\beta)(a+b\beta)}. \tag{8}$$

From (8) we verify that $d\ell_t/dK_t=0$.

This solution can be decentralized with the government of generation t instituting a wage tax at rate β, a capital income tax at rate $1-\beta$, a first period lump-sum payment M_{yt} equal to $W_t(1-\ell_t)\beta$, and a second period lump-sum payment M_{ot+1} equal to $(W_t-\ell_t)R_{t+1}(1-\beta)$. The individual's budget constraint in this case is given by:

$$C_{yt}+C_{ot+1}(R_{t+1}\beta)^{-1}=W_t(1-\beta)(1-\ell_t)+M_{yt}+M_{ot+1}(R_{t+1}\beta)^{-1}. \tag{9}$$

Taking R_{t+1}, W_t, M_{yt}, and M_{ot+1} as given, the individual's maximization of (1) subject to (9), leads to the first-order conditions (4) and (5). Since (9) is equivalent to (2) given the definitions of M_{yt} and M_{ot+1}, the individual's demands for C_{yt}, C_{ot+1}, and ℓ_t are those in (6)−(8).

In the U.S., capital's share of net national product is roughly 25 percent.[2] If we use that value for β the solution calls for a 25 percent tax on labor income and a 75 percent tax on capital income. The intuition behind this solution is that the first-order conditions involve the elasticity of R_{t+1} with respect to k_{t+1} and the elasticity of W_t with respect to k_t. The former elasticity equals $\beta-1$, while the latter elasticity equals β. Since the interest rate is more elastic with respect to changes in relative factor supplies than is the wage, it follows that the optimum includes a larger distortion of saving than of labor supply.

We next compare (6) through (8) with their counterparts (10), (11), and (12) below, which are the equilibrium values when no strategic behavior on the part of generations is assumed.

$$C_{yt}=W_t\frac{a}{1+a+b} \tag{10}$$

$$C_{ot+1}=W_tR_{t+1}\frac{b}{1+a+b} \tag{11}$$

$$\ell_t=\frac{1}{1+a+b}. \tag{12}$$

Since $\beta<1$, ℓ_t is larger when generations are strategic; hence, there is a monopolization (reduction) of labor supply. Under strategic behavior, saving by the young at time t, $W_t(1-\ell_t)-C_{yt}$, equals $W_t(1-\beta)\beta b/[1+(1-\beta)(a+b\beta)]$, while it equals $W_tb/(1+a+b)$ with no strategic behavior. It is easy to see that the former quantity is less than the latter quantity. Thus, there is also a monopolization of the supply of capital. While the supplies of labor and capital are reduced by strategic behavior, consumption

[2] If one assumes that labor's share of proprietorship income is the same as its share of total net national product, then labor's 1989 share of net national product is 72.6 percent. *Source:* Economic Report of the President, 1990.

when young and old, C_{yt} and C_{ot+1}, may be larger or smaller depending on parameter values.

To get an idea of the magnitude of factor monopolization, suppose $a = 0.333$, $b = 0.333$, and $\beta = 0.25$. For these parameters monopolization leads the young to reduce their labor supply by 41 percent and their saving by 76 percent. This huge reduction in saving reflects both the reduction in labor supply and the fact that the young save a smaller fraction of their earnings. The young save half their labor earnings in the absence of monopolization, but only a fifth of their earnings with monopolization.

While these results are based on our particular utility- and production-function assumptions, it appears that the strategic manipulation of factor supplies would arise for virtually all nicely behaved preferences and production technologies. It appears unlikely, however, that one would be able to derive closed-form solutions with assumptions that are less specific than those made here. The reason is that in equilibrium $d\ell_t/dK_t$ is generally nonzero, and its value will depend on all future values of this derivative. Unless a consistent stationary pattern exists for these derivatives, there is no hope for an explicit solution.

To summarize, our model of factor monopolization by successive generations delivers an explanation for distortionary taxation. The particular Cobb-Douglas example suggests that generational factor monopolization can account for quite high marginal tax rates as well as capital income taxes in excess of labor income taxes.

2. INEFFICIENT PROVISION OF DURABLE PUBLIC GOODS

One of the government's presumed functions is to overcome the inefficiencies of *laissez faire* in the presence of economic externalities—for example, the free-rider problem associated with public goods. Some nonexcludable public goods (such as highways) are durable enough to service multiple generations. But if successive governments attend only to the selfish interests of their own generations and cannot force future generations to pay part of the cost of the public good, one might expect to observe an underprovision of durable public goods. A possible ameliorating factor is that generations might be able to recoup their investments in durable public goods if such investments lead to higher values of land or other assets. Such asset capitalization might be of particular relevance in the case of durable local public goods since locational choice—the choice of where to buy or rent land and housing—is influenced by the availability of local public goods.

In this section we explore two capitalization models. The first is a "national" model in which the durable public good is available to anyone owning land in the society. The second is a two-region model in which the durable public good is available only to individuals owning land in the region (locality). While the capitalization effects differ somewhat across the two models, both models suggest an underprovision of durable public goods unless there are strong utility complementarities between public goods and land. While there is an extra source of capitalization in the two-region model as compared with the national model, it turns out that there is underprovision (overprovision) at the symmetric equilibrium of the regional model if and only if there is underprovision (overprovision) at the equilibrium of the national model.

Stiglitz (1983) also examines the provision of local public goods in light of land-capitalization effects. His conclusion that land capitalization leads to an efficient provision of public goods hinges on his assumption that each locality takes the utility level offered by alternative localities as given. In contrast, we assume that each locality takes the level of taxation and therefore the level of the public good provided by other localities as given. Since in the simplest versions of local-public-goods models each region offers the same level of utility in equilibrium, each region knows that if it raises its utility level (attractiveness to new residents), the utility levels of all other regions, no matter how many and how large, adjust through the process of individuals "voting with their feet". Accordingly, in our model, we assume that each region takes the actions (tax rate and level of the public good) of the other region as given, rather than the utility level in the other region, and assumes that prices will adjust in response to its own strategic move so as to equate utilities anew across the localities.

2.1 *The National Model*

To keep things as simple as possible, we assume that there are only two periods and two generations. Only the early generation lives in the first period, while the two generations coexist in the second period. There are three goods: a public good, a private consumption good, and land. Each of the n identical members of the early generation is endowed with one unit of the private good and one unit of land. Private goods not consumed can be used to produce public goods in the first period only. The technology is simple; one unit of the private good is sufficient to generate one unit of the public good. The public good does not depreciate and is non-excludable. The private good is storable with no depreciation or appreciation across the two periods.

To focus on the essential issues, we assume that the members of the early generation gain no direct benefit from the public good, so that none will be provided absent some compensation mechanism. The utility function of the typical member of the early generation is $u(c_1,c_2) = c_1 + c_2$, where c_t is consumption of the private good in period t ($t = 1,2$). In addition to any savings, second-period consumption comes from the sale of land to the later generation, whose n identical members are endowed only with one unit of the consumption good in the second period and whose utility functions are given by $w(c,s,q)$, where c is consumption of the private good, s is the amount of land purchased, and q is the quantity of public good that has been provided in the first period.

The land market is competitive: if the price of land relative to the private good is p, the typical second-generation member's budget constraint is $c + ps = 1$, and the first-order condition for his utility maximization problem is

$$-pw_1(1-sp,s,q)+w_2(1-sp,s,q)=0, \tag{13}$$

where subscripts indicate partial derivatives in (13) and below where obvious.

Land is assumed to be supplied inelastically (the first generation's government cannot strategically confiscate land to drive up its price); so at an interior competitive equilibrium $s=1$ and

$$p=\frac{w_2(1-p,1,q)}{w_1(1-p,1,q)}. \tag{14}$$

Recognizing the dependence of p on q, the first generation's government can levy a tax of τ per capita on its members and use it to produce $n\tau$ units of the public good.[3] The budget constraint of each member of the first generation is then $c_1+c_2=1+p-\tau$. Since utility of the first generation also equals c_1+c_2, the government of the first generation chooses τ to maximize $1+p(\tau)-\tau$, where $p(\tau)$ is defined by (14) for $q=n\tau$. Thus the first-order condition for the provision of the durable public good in this problem is $dp/d\tau=1$, or

$$-w_1^2+nw_1w_{23}-nw_2w_{13}+w_2w_{11}-w_1w_{21}=0. \tag{15}$$

Equation (15) may be compared with the efficiency (Samuelson's) condition

$$-w_1+nw_3=0. \tag{16}$$

Equations (15) and (16) are not the same, and, except in very special circumstances, the strategically-acting first-generation government will not supply an efficient amount of the public good. For example, if the function w is separable in its three arguments, the price of land in (13) will not depend on the level of the public good; so the first generation will provide none of the public good (a corner solution so (15) does not hold). At the other extreme, we can have a corner solution with $\tau=1$ if the term w_{23} is sufficiently large. Since w_{23} does not appear in (16) it is not hard to construct examples in which equilibrium involves overprovision of the durable public good.

2.2 *The Regional Model*

Now suppose that there are two localities, α and β, each with a first generation of n members as specified above, and suppose that the public good's benefits accrue only to those in the second generation (of size 2n) who live in the locality where it is provided. Second-generation members may purchase land and live in either locality, but not in both. Let n_α and n_β stand, respectively, for the number of second-generation members locating in regions α and β; so $n_\alpha+n_\beta=2n$. Let s_α stand for the amount of land purchased by a second-generation member locating in region α. In equilibrium $s_\alpha=n/n_\alpha$. Hence, by analogy with equation (13), the equilibrium prices p_α and p_β of land in localities α and β, respectively, satisfy

[3] The second-generation's government is assumed to play no role in this model.

$$p_\alpha=\frac{w_2\left(1-\frac{n}{n_\alpha}p_\alpha,\frac{n}{n_\alpha},n\tau_\alpha\right)}{w_1\left(1-\frac{n}{n_\alpha}p_\alpha,\frac{n}{n_\alpha},n\tau_\alpha\right)} \tag{17}$$

$$p_\beta=\frac{w_2\left(1-\frac{n}{2n-n_\alpha}p_\beta,\frac{n}{2n-n_\alpha},n\tau_\beta\right)}{w_1\left(1-\frac{n}{2n-n_\alpha}p_\beta,\frac{n}{2n-n_\alpha},n\tau_\beta\right)}, \tag{18}$$

where τ_α and τ_β are the respective taxes. At an interior equilibrium the second-generation members must be indifferent between locating in either locality, hence,

$$w\left(1-\frac{n}{n_\alpha}p_\alpha,\frac{n}{n_\alpha},n\tau_\alpha\right)=w\left(1-\frac{n}{2n-n_\alpha}p_\beta,\frac{n}{2n-n_\alpha},n\tau_\beta\right). \tag{19}$$

Equations (17) and (18) implicitly define functions $p_\alpha=p^\alpha(n_\alpha,\tau_\alpha)$ and $p_\beta=p^\beta(n_\alpha,\tau_\beta)$. These can be substituted into equation (19), with the result being an expression for n_α as a function $n^\alpha(\tau_\alpha,\tau_\beta)$ of the tax rates.

We now assume that the two first-generation governments choose their respective tax rates as simultaneous moves in a noncooperative game. Recall that the utility of the typical first-generation resident of region A is $1+p_\alpha-\tau_\alpha=1+p^\alpha(n^\alpha(\tau_\alpha,\tau_\beta),\tau_\alpha)-\tau_\alpha$. Differentiating this expression with respect to the strategic variable τ_α and equating to zero yields

$$p_1^\alpha n_1^\alpha+p_2^\alpha=1. \tag{20}$$

A comparison of equations (20) and (16) indicates that an interior symmetric equilibrium will be efficient only if the left-hand side of (20) equals nw_3^α/w_1^α, where w_i^α stands for the ith partial derivative of w evaluated as in the left-hand side of (19). Differentiating (19) with respect to τ_α, substituting (17) and (18) in the result, evaluating at the symmetric equilibrium where $n_\alpha=n$ and (19) holds, and simplifying yields:[4]

[4] It is easy to see that this same expression arises regardless of the relative size of the two regions. Hence, even if one region is tiny relative to the rest of the country, this relationship will hold.

$$p_1^\alpha n_1^\alpha + p_2^\alpha = \frac{n w_3^\alpha}{w_1^\alpha} + p_1^\beta n_1^\alpha. \tag{21}$$

Since the right-hand side of (21) differs generally from nw_3^α/w_1^α, the provision of durable local public goods will not, in general, satisfy the efficiency condition. Solving (21) for n_1^α and substituting the resulting expression into (20) yields

$$\frac{n w_3^\alpha}{w_1^\alpha} + p_2^\alpha = 2, \tag{22}$$

using the fact that in the symmetric equilibrium $p_1^\alpha = -p_1^\beta$. Note that if $p_2^\alpha = nw_3^\alpha/w_1^\alpha$, we have from (22) that $nw_3^\alpha/w_1^\alpha = 1$, which is the efficiency condition. But the conditions under which $p_2^\alpha = nw_3^\alpha/w_1^\alpha$ are simply those required for efficiency in the national model. In addition underprovision (overprovision) occurs exactly under the same circumstances in both models.

Since (15) indicated no reason to expect efficient provision of the public good in the national model, there is no reason to expect efficient provision of the public good in the regional model. The regional model, however, appears to deliver more of the public good than the national model in certain interesting cases. Consider, for example, the case of separable utility. In this case $p_2^\alpha = 0$ and, while there will be no public goods provided in the national model, a positive, but less than efficient level of the public good will be provided in the regional model.

3. INEFFICIENCIES IN INTERGENERATIONAL BARGAINING

So far, all the inefficiencies in this paper have been associated with equilibria of intergenerational noncooperative games. In this section we exhibit an inefficiency arising in the context of an intergenerational cooperative bargaining model. At first glance this seems paradoxical, since the solution concepts of cooperative-game theory typically assume Pareto optimality. The resolution of the seeming paradox is that although the analysis assumes that the generations bargain to an efficient solution, this bargaining can only take place once the generations coexist. When one generation precedes another prior to an overlapping era, there are times before the existence of the later generation when the members of the earlier generation take actions that have economic consequences, and these economic consequences, in turn, affect the initial positions in the bargaining game.[5] Thus the earlier generation has incentives to take actions strategically before the bargaining begins so that it will be better positioned for the bargaining game, even though the strategic actions may cause an inefficiency. (In this sense, the inefficiency results from noncooperative aspects of the rules of the game.)

[5] Of course, if the generations do not overlap at all, they cannot ever bargain.

On one level, the result is no surprise; for instance, if the efficient allocations all involved the earlier generation investing in some durable public good, which it would not do by itself, the absence of the later generation during the efficient investment time period means that the earlier generation can extract no *quid pro quo* and therefore will not find it in its interest to undertake the investment. What is perhaps surprising is that the same effect can be obtained without public goods, in fact without production at all. All that is necessary is an intertemporal consumption complementarity.

We exhibit a simple example in which all cooperative bargaining solutions (i.e., solutions for the Nash bargaining problem) satisfying minimal assumptions give rise to the inefficiency. There are two players (generations)—A and B. As in the previous section, player A lives for two periods, while B lives only in the second period. There are two goods—X and Y. A is endowed with one unit of good X in the first period, any part of which can be consumed then, with the rest stored for consumption or exchange (or some of each) in the second period. B is endowed with one unit of good Y (in the second period, of course), which can be consumed and/or exchanged then. Denoting A's consumption of X in the two periods by x_{1A} and x_{2A}, respectively, and A's consumption of Y in the second period by y_A, we take A's utility of consumption to be

$$u_A(x_{1A}, x_{2A}, y_A) = (x_{1A}x_{2A})^{1/2} + y_A.$$

B's utility for consumption is taken to be

$$u_B(x_B, y_B) = x_B + y_B,$$

where x_B and y_B are B's consumption of X and Y, respectively, in the second period. Feasibility requires

$$x_{1A} + x_{2A} + x_B = 1, y_A + y_B = 1, \text{ and nonnegativity of all variables.}$$

Individual rationality *ex ante* requires that the consumptions satisfy

$$u_A(x_{1A}, x_{2A}, y_A) \geq 1/2 \text{ and } u_B(x_B, y_B) \geq 1,$$

since A can assure himself utility of 1/2 by consuming the vector (1/2,1/2,0) without trade, and B can assure 1 by consuming (0,1) without trade. The utilities that result from all the allocations that are both individually rational and *ex ante* Pareto optimal are $\{(z, 2-z)\colon 1/2 \leq z \leq 1\}$ obtained by A consuming $z \geq 1/2$ units of good Y and B consuming all of good X and $(1-z)$ units of good Y.

The bargaining game begins after x_{1A} is consumed, so fixing $x_{1A} = \lambda$, the threat levels of utility in the bargaining game are $(\lambda(1-\lambda))^{1/2}$ and 1, for the two players respectively, and the *ex post* individually-rational and Pareto optimal bargains are obtained by maximizing

$$(\lambda x_{2A})^{1/2} + y_A \text{ subject to } (1 - y_A) + (1 - \lambda - x_{2A}) = \text{constant}$$

and nonnegativity constraints. The solutions all involve

$$x_{2A} = \min\{\lambda/4,\ 1 - \lambda\}.$$

If $\lambda = 0$, the bargaining problem is simply one of sharing one unit of surplus, since Player A's threat level of utility is zero, Player B's is one, and the extra unit of surplus can be split unrestrictedly between them. All serious solutions to this Nash bargaining problem involve a 1/2–1/2 split of the surplus, bringing Player A back to his ex-ante individual-rationality bound. If $\lambda > 0$, any solution to the bargaining game is ex-ante inefficient, so it only remains to show that under any bargaining solution, Player A is better off setting $\lambda > 0$ and then bargaining rather than setting $\lambda = 0$ and settling for the utility of 1/2 he could have earned by ignoring the later generation. Of course, the optimal value of λ for Player A depends on the specific bargaining solution to be employed, but it is easy to see that by setting $\lambda = 1/2$ Player A guarantees that he receives utility more than 1/2 unless the bargaining solution is completely unresponsive to him. To see this, note that if $\lambda = 1/2$ and x_{2A} is set to 1/8 (see above) the sum of the two utilities is $1/4 + 3/8 + 1 > 3/2$. Since the threat utilities sum to 3/2 (1/2 and 1, respectively), there is surplus to be shared, and, so long as A gets some of it (as all solutions to Nash's bargaining problem prescribe), the argument is complete.

One lesson from this example is that a potential *ex ante* inefficiency arises from the simple fact that all generations cannot be present at the beginning of time to bargain, or indeed at any time in which there are efficiency gains to be had from coordinated action. A second lesson is that the coordinated actions can range from the fairly obvious case of production of a durable public good linked to a subsequent transfer as *quid pro quo* at one extreme, to the (perhaps) less obvious case of pure exchange when there are intertemporal consumption complementarities at another extreme.

4. CONCLUSION

This paper develops some implications of selfish generational behavior. Its message is pessimistic. In seeking their own advantages, generations are likely to monopolize their factor supplies, provide inefficient levels of durable public goods, and act strategically in producing or consuming private goods. One can think of additional inefficiencies associated with the sequential nature of generational exchange, such as inefficient risk sharing.

If the implications of representative generational government are pessimistic, are they realistic? After all, one does not observe separate elections for different age groups. We argue that the decisions made by observed political institutions should often mimic those that would be made by representatives of different generations. Consider, for example, the monopolization of factor supplies. If elected officials know that young constituent workers favor compensated wage and capital-income taxes and that their older constituents are indifferent to the perpetuation of such compensated taxes, they will, presumably, enact such taxes. Elected politicians might also emulate the behavior of generational governments in cases of conflict between different contemporaneous generations. If the elderly favor policy x, while the young favor policy y, and policy z would be the equilibrium outcome determined with generational representation, a typical politician might choose policy z because he realizes that any other choice of policy would lead to the emergence of candidates for his office appealing to particular age groups. Alternatively, failure to adopt z could lead the age group that fared less well than under policy z to withdraw support for the politician.

One way out of generational inefficiencies of the sort considered here is to hypothesize an infinite horizon and an equilibrium in which generations punish their elders if the elders fail to provide a *quid pro quo* (or fail to punish an earlier generation for failing to provide a *quid pro quo*, or . . .) as in Kotlikoff, Persson, and Svensson (1988). This seems implausible, somehow. Another way out is to assume that intergenerational altruism is built into the collective human psyche. While we certainly observe altruistic behavior in everyday life that seems almost instinctive (Frank 1988), recent empirical research (e.g., Altonji, Hayashi, and Kotlikoff 1992) suggests that observed altruistic behavior is far from the Becker (1974)–Barro (1974) perfect intergenerational altruism needed to overcome the efficiency problems raised here. It seems likely therefore that the intergenerational inefficiencies described here arise to some degree.

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REFERENCES

Alesina, A., 1987, Macroeconomic Policy in a Two-Party System as a Repeated Game. Quarterly Journal of Economics 52, 651–78.

Altonji, J., F. Hayashi, and L. J. Kotlikoff, 1992, Is the Extended Family Altruistically Linked? American Economic Review 82, 1177–98.

Barro, R., 1974, Are Government Bonds Net Wealth? Journal of Political Economy 82, 1095–1118.

Becker, G., 1974, A Theory of Social Interactions. Journal of Political Economy 82, 1063–1094.

Frank, R. H., 1988, *Passions Within Reason* (W. W. Norton Company, Inc., New York).

Kotlikoff, L. J., T. Persson, and L. Svensson, 1988, Social Contracts as Assets: A Possible Solution to the Time Consistency Problem. American Economic Review 78, 662–677.

Mirrless, J., 1971, An Exploration in the Theory of Optimum Taxation. Review of Economic Studies 38, 175–208.

Persson, T. and L. Svensson, 1989, Why a Stubborn Conservative Would Run a Deficit: Policy with Time Inconsistent Preferences. Quarterly Journal of Economics 104, 325–345.

Persson, T. and G. Tabellini, 1990, *Macroeconomic Policy, Credibility and Politics* (Harwood Academic Publishers, New York).

Sadka, E., 1976, On Income Distribution, Incentive Effects, and Optimal Income Taxation. Review of Economic Studies 43, 261–268.

Samuelson, P. A., 1958, An Exact Consumption-Loan Model With or Without the Social Contrivance of Money. Journal of Political Economy 66, 467–482.

Stiglitz, J. E., 1983, The Theory of Local Public Goods Twenty-Five Years After Tiebout: A Perspective, in: G. R. Zodrow, ed., *Local Provision of Public Services: The Tiebout Model After Twenty-five Years* (Academic Press, New York), 17–53.

Summers, L. H., 1981, Capital Taxation and Capital Accumulation in a Life Cycle Growth Model. American Economic Review 71, 533–544.

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