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Income Inequality, Bequest Constraints, and Long-Term Public Investment

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Income Inequality, Bequest Constraints, and Long-Term Public Investment

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Abstract

We propose a model of altruistic dynasties and stochastic intergenerational income mobility in which a government faithfully aggregates household preferences. Inefficient short-termism in the provision of long-lived public goods then arises solely from binding *bequest constraints* – the legal impossibility of borrowing against one's children's future income. When favorable realizations of the children's productivity process make bequest constraints bind, parent households are reluctant to give up current consumption for their children's future consumption at the market rate. Whenever a constrained dynasty carries political weight, this opens a wedge between the market-revealed rate and a higher politically-revealed rate that aggregates household preferences. This wedge holds public investment at a positive but inefficiently low level, reconciling such underprovision with positive dynastic altruism. Marginal transfers that relax bequest constraints raise provision, and a golden rule of public finance, with the debt redeemed along a future benefit principle, attains efficient provision in a Pareto-improving way for current voters. In a calibration to five US income quintiles and carbon emission abatement, the politically-revealed rate exceeds the yearly market rate of 2.84% by more than 1.5 percentage points. This wedge holds the carbon price about 27% below the domestic social cost of carbon.

Key words: bequest constraints, dynastic altruism, discount rate, long-term public investment, climate policy

JEL codes: H43, H54, H63, D64, D72, Q54

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1 Introduction

Cost-benefit analysis is a cornerstone of public policy evaluation. For long-term investment programs in infrastructure, education, climate policy, etc., the discount rate applied to future benefits is often the single most consequential parameter. Small differences in it can reverse the sign of the net present value of projects whose benefits accrue over decades or centuries. In climate policy, the discount rate largely determines the social cost of carbon (SCC), and with it the carbon price that cost-benefit analysis recommends. The so-called *positive* approach to discounting advocates the use of the market interest rate for policy appraisal (Nordhaus, 2007; Burgess and Zerbe, 2013). One argument for it is that it captures the rate at which society is willing to trade off consumption over time (United States Environmental Protection Agency, 2010). In other words, it reveals societal preferences, a strong argument for using it, in particular if political support for the respective policy is at stake. In this article we argue that the market interest rate does not reflect societal preferences for the provision of long-term public investment spanning multiple generations, even if these are linked by dynastic altruism. At the root of this are binding *bequest constraints*, the legal impossibility of obligating one's children's future income in order to borrow (Drazen, 1978; Becker and Tomes, 1986; Cukierman and Meltzer, 1989; Bakış et al., 2015).

We present a model in which heterogeneous dynasties are linked by altruism but face bequest constraints. The dynasties differ by wage income and assets. The children's future wage income follows a stochastic productivity process. The future realization of the process, together with the degree of dynastic altruism and the parent's own resources, determines how much a parent wishes to bequeath to its child. A parent would like to leave a negative bequest when its child ends up sufficiently better off than itself. Empirically observed upward income mobility makes this likely for poorer dynasties. Since the bequest constraint forbids borrowing against its child's income, the parent leaves a zero bequest instead. However, this constraint does not prevent the parent from acting based on its dynastic allocative preferences in the public sphere. When a constrained parent compares cost and benefit of long-term public investment, it does so based on its implicit discount rate – the intergenerational marginal rate of substitution, relevant for long-term public investment projects. This implicit rate is higher than the market rate because a binding bequest constraint prevents it from adjusting through private transfers between parents and children. In other words, the parent needs a gain in its child's consumption larger than the market rate implies before it gives up a unit of its own. If constrained altruists wield power in the polity, this affects the level of long-term public investment: the *politically-revealed* discount rate, the rate at which a cost-benefit analysis would have to discount future benefits to rationalize the realized level of provision, exceeds the *market-revealed* rate derived from private savings.

We thus provide an explanation for inefficient short-termism in the provision of long-lived public goods that does not rely on government present bias or a principal-agent problem. Under binding bequest constraints, politically responsive governments underinvest relative to the market-discounted efficiency benchmark even though voters are

altruistic toward their descendants and the government faithfully aggregates their preferences. Moreover, we reconcile positive dynastic altruism with two observations often read as evidence against it: the departure from Ricardian equivalence in private savings and the inefficiently low provision of long-lived public goods. In the private sphere, agents that are altruistic toward their descendants but face binding bequest constraints in every state of the world behave as if they were intergenerational egoists, as in the canonical model of overlapping generations (OLG). In the public sphere, this equivalence breaks down: constrained altruists *do* value benefits accruing to their children, yet less so than their unconstrained counterparts.

The microfoundations of our model entail a novel role for policy interventions such as redistribution and public debt. Marginal transfers from unconstrained to constrained households increase the provision of the public good, whatever the political weights, as long as the constrained carry positive weight. While the unconstrained adjust their saving and bequest decisions to a marginal tax, leaving their implicit discount rate unchanged, a marginal transfer to the constrained directly lowers their implicit discount rate. A policy that improves upward mobility, by contrast, raises a constrained parent's implicit discount rate, although its effect on realized provision is ambiguous. Debt-financed transfers circumvent private bequest constraints, as in Cukierman and Meltzer (1989), but additionally reduce the implicit discount rates of constrained households. Alternatively, a *golden rule* of public finance that debt-finances the entire cost of provision, with the debt redeemed along a benefit principle in the future, places both benefit and cost on the children's generation. The discount-rate wedge then drops out of the provision decision, and the realized level is efficient, whatever the households' discount rates and political weights. This scheme makes the deciding generation better off. The effect on the children of constrained households is ambiguous: they gain the benefit of higher provision but now bear their share of the entire efficient cost. They are better off only if the initial shortfall in provision was large enough.

In a calibration to climate policy in the US for five income quintiles, we find that the quintiles' premia – the amounts by which their implicit discount rates exceed the calibrated yearly market rate of 2.84% – monotonically decrease in income and range from 3.53 to 0.33 percentage points per year. In our main scenario, which aggregates the quintiles' preferences with equal political weights, the politically-revealed rate exceeds the market rate by 1.54 percentage points per year. Isolating the discount-rate channel, the realized carbon price is 27.3% below the baseline domestic SCC of 16.8 $\$/tCO_2$, a figure that is largely insensitive to the contested level of the SCC: it rises by 2.2 percentage points at an SCC ten times as high. On top of being quantitatively relevant, our mechanism is consistent with a well-documented positive income gradient in climate-policy support (Carlsson et al., 2012; Löschel et al., 2013; Diederich and Goeschl, 2014; Bergquist et al., 2022) as well as an empirical literature that shows poverty raises effective discount rates, inter alia through liquidity constraints (Haushofer and Fehr, 2014), and documents a negative income gradient of implicit discount rates in the context of investment in energy efficiency (Wada et al., 2012; Schleich et al., 2016).

With this article, we contribute to the literature on the connection between individual

time preferences and the societal discount rate. Some articles advance explanations of why the market rate does not satisfy the revealed preference criterion for public project appraisal, including retrospective time inconsistency (Caplin and Leahy, 2004) and cross-dynastic altruism (Marglin, 1963; Nesje, 2024), implying that society is more patient than the market rate reflects. Closely related is Caplin and Leahy (2023), who identify borrowing-constrained households, missing from the asset market, as a reason why society may be more impatient than the market rate implies, but abstract from political feasibility. We take the liquidity constraint to the intergenerational margin, relevant for long-term investment, and embed bequest-constrained altruists into a model of collective choice. A separate strand studies the aggregation of heterogeneous time preferences themselves. Its starting point is the diversity of discount rates that can be traced back to different preference primitives. There, efficient aggregation yields a representative rate that declines over time toward the lowest rate in the population (Gollier and Zeckhauser, 2005; Heal and Millner, 2014), and collective intertemporal choice becomes time-inconsistent (Jackson and Yariv, 2015). The heterogeneity we aggregate is constraint-driven instead: household rates all (weakly) exceed the market rate, and the aggregate inherits both the direction of the deviation and – because a constraint, unlike a preference, can be relaxed – its policy amenability. We also derive an augmented Ramsey rule that features a bequest-constraint premium, thus connecting to the discounting literature based on the Ramsey equation (Drupp et al., 2018). Our rule is close in spirit to the one identified in Goussebaïle (2024). Where the latter emphasizes time inconsistency and intergenerational conflict in the presence of altruism, our work isolates the effect of bequest constraints.

We further contribute to the literature on government short-termism concerning public investment and debt. Implicit discount rates above the market rate are themselves familiar from the political economy literature, where short-termism arises from government present bias caused, inter alia, by electoral distortions (see Yared, 2019, for an overview). In contrast, the wedge between our *politically-revealed* rate and the market rate emerges under a benevolent aggregation of household preferences, with no political distortion involved. This property is shared with the canonical OLG model, where the underprovision of long-lived public goods (Bassetto and Sargent, 2006) and climate policy (Bovenberg and Heijdra, 1998; Sachs, 2014; Kotlikoff et al., 2021) originates in the lack of dynastic altruism of the households. Our model nests the canonical OLG model as a limiting case where altruism is nil. The closest ancestor to our work is Cukierman and Meltzer (1989). Their model shares our bequest-constrained households, upward mobility, and collective intertemporal choice, but is used to study the political determination of public debt and deficits, whereas our object is the discount rate for the provision of long-lived public goods. We also contribute to the literature that studies how public investment (such as carbon emission abatement) and debt interact (Peletier et al., 1999; Boly et al., 2022; Bergmann and Moretti, 2026). The financing scheme we propose in Section 4 is a golden rule of public finance: the cost of the long-lived public good is debt-financed and redeemed by those who enjoy its benefits. In Bassetto and Sargent (2006), the golden rule corrects the underprovision that arises because finitely lived voters disregard benefits accruing after their lifetime; in Edenhofer et al. (2025a), a green-golden rule that ties ad-

missible debt to the return on abatement neutralizes a government's present bias. In our setting, the case for a golden rule rests on neither source of underprovision but on binding bequest constraints. Combined with a benefit principle in debt redemption, the golden rule moreover makes the scheme a Pareto improvement for the deciding generation.

The rest of this article is structured as follows. Section 2 sets out the analytical model. Section 3 derives households' implicit discount rates and aggregates them into the politically-revealed rate, closing on an augmented Ramsey rule. Section 4 analyzes the effect of transfers and debt, as well as the Pareto-improving packages that move provision toward the efficient level. Section 5 extends the analytical model. Section 6 calibrates a numerical version of the model. Section 7 discusses limitations of our model before Section 8 concludes.

2 A Model of Income Heterogeneity, Bequest Constraints, and Long-Term Public Investment

In this section, we introduce a two-period, two-dynasty model of overlapping generations. The two dynasties L and H consist of three generations A, B and C linked by dynastic altruism, similar to Goussebaïle (2024). We analyze a small open economy where agents can transfer resources intertemporally in two ways. First, they can save privately at an exogenous interest rate. Second, they can "save" collectively through a long-lived public good.[1] While our motivation makes it natural to identify this public good with the reduction in greenhouse gas emissions, the results are transferable to other investment goods with long time horizons. In this formulation of the model we refer to an abstract public good. The subsequent numerical version of the model is calibrated to the example of carbon emission abatement for climate policy.

2.1 The Households

In both periods, the economy is populated by two generations, each consisting of the two dynasties L and H. Every dynasty comprises a continuum of ex ante identical households. In the first period, households A_j are old while households B_j represent the working population, each rigidly providing a unit of labor. In the second period, households B_j are old while households C_j are young. The index $j \in \{L, H\}$ indicates the dynasty to which a household belongs. Since all households of a given dynasty and generation are ex ante identical, we refer to a generic member as household A_j, B_j, or C_j. We assume no population growth, so each dynasty's mass is constant across generations, and we take the two dynasties to be of equal mass, normalized to one; sums over j below thus denote economy-wide aggregates. The equal-mass assumption can be relaxed at the

[1] Bassetto and Sargent (2006) call such a good a *durable* public good. In their model it yields services from the period in which it is built onward. In our main model, it yields its benefit only in the future period $t = 2$, which is why we also speak of long-term public investment. Section 5.2 adds an own-benefit to the generation that pays for the good in $t = 1$. What matters for our results is that part of the benefit accrues to the next generation.

cost of carrying population weight parameters through the transfer analysis in Section 4. Up to that point, results are unchanged because our model setup implies no interactions between dynasties other than in the political sphere.

Household preferences. Let $j \in \{L, H\}$. Preferences are defined over consumption only and given by

$$U_{A_j} = u(c_{A_j,1}) + a\, U^*_{B_j}, \tag{1}$$

$$U_{B_j} = u(c_{B_j,1}) + \beta \mathbb{E}_j \left[u(c_{B_j,2}) + a\, U^*_{C_j} \right] \tag{2}$$

for the first period. Here, $U^*_{B_j}$ and $U^*_{C_j}$ denote indirect utility of generations B and C, dynasty $j \in \{L, H\}$, respectively. The parameter $a \in [0, 1]$ denotes dynastic altruism. The time discount factor is given by $\beta \in (0, 1]$. Utility takes the constant-relative-risk-aversion (CRRA) form $u(c) = \frac{c^{1-\eta}}{1-\eta}$ for $\eta > 0$, $\eta \neq 1$, and $u(c) = \ln c$ for $\eta = 1$; in particular, u is twice continuously differentiable with $u' > 0$ and $u'' < 0$. The source of the stochastic period transition is an exogenous labor productivity process that is discussed below. For dynasty $j \in \{L, H\}$, the preferences in the second period are given by

$$U_{B_j,2} = u(c_{B_j,2}) + a\, U^*_{C_j}, \tag{3}$$

$$U_{C_j} = u(c_{C_j,2}). \tag{4}$$

The preference structure implies that parents care for their children while the opposite is not true. Because only generation B bears the cost of public investment (see below), this assumption can be relaxed for the first period without any qualitative change. We will later discuss how results change when there is altruism of the children toward their parents with positive probability in the second period.

Household budget constraints. When old, households split their available resources between consumption c and bequest b to their child. Hence, generation A's resource constraint in the first period reads

$$c_{A_j,1} + b_{A_j,1} = Y_{A_j,1}, \quad j = L, H, \tag{5}$$

where $Y_{A_j,1}$ represents A_j's savings for retirement from a previous period (outside of this model), A's only source of income. Bequest is modeled as an inter-vivos transfer from the old to the young. This is necessary for generation C to receive a bequest in the terminal second period. We assume that generation A makes this transfer at the beginning of the first period, before the government chooses the level of public investment (Section 2.2); throughout, we therefore take its bequest $b_{A_j,1}$ as given.

Generation B is alive in both periods – young in $t = 1$ and old in $t = 2$. When young, it inelastically provides a unit of labor and its budget constraint is given by

$$c_{B_j,1} + s_{B_j,1} = w_{B_j,1} + b_{A_j,1} - \gamma_j\, \Gamma(g), \tag{6}$$

where $w_{B_j,1}$ are lifetime earnings, $s_{B_j,1}$ are savings for retirement and $\gamma_j\, \Gamma(g)$ is the household's lump-sum tax, its share γ_j of the cost $\Gamma(g)$ of public good provision (Section 2.2).

We consider $g \in [0, \bar{g}]$, where $\bar{g}$ is a level of g at which every dynasty can still bear its cost share out of its first-period resources, $\gamma_j \, \Gamma(\bar{g}) < w_{B_j,1} + b_{A_j,1}$ for $j \in \{L, H\}$. Since Γ is increasing, every dynasty can then bear its cost share at every level in this domain. When old, household B_j's budget constraint is given by

$$c^i_{B_j,2} + b^i_{B_j,2} = R \, s_{B_j,1}, \; i = L, H, \tag{7}$$

where the superscript denotes the realization of the labor productivity process of B_j's offspring (see below).

Finally, the budget constraint of generation C for realization $i \in \{L, H\}$ of the productivity process is given by

$$c^i_{C_j,2} = w^i_{C,2} + b^i_{B_j,2} + \xi^i_j \, g, \quad j = L, H, \tag{8}$$

where ξ^i_j is the realization of the dynasty-specific random variable ξ_j, the monetized marginal benefit from public investment g that has been made in $t = 1$. The marginal benefit may vary with the child's productivity, for instance, when g represents emission abatement and avoided climate damages scale with the child's income.

All households face a bequest constraint, making it impossible to leave a negative bequest to their children[2]

$$b_{A_j,1}, b_{B_j,2} \geq 0, \quad j = L, H. \tag{9}$$

Labor productivity process. We assume that each young household has a labor productivity $\theta \in \Theta := \{\theta^L, \theta^H\}$ which can be low or high and results in wages $w_t(\theta^H) > w_t(\theta^L)$ for $t = 1, 2$. The labor productivity of each household is revealed at the beginning of its working life. We will assume that at the beginning of $t = 1$, the type of B_L is revealed to be θ^L while the type of B_H is revealed to be θ^H. In contrast, the type of their children C_L and C_H is unknown in $t = 1$. In other words, the index L of second-period household C_L means that *its parent* was a low productivity type, $\theta_{B_L} = \theta^L$, but it does not tell us about C_L's own productivity type θ_{C_L} (similarly, generation A is indexed by the productivity type of their child B_j). For each first-period household B_j, the relevant contingency in the second period is the productivity realization $\theta_{C_j} \in \{\theta^L, \theta^H\}$ of its child C_j, which we call the dynasty's second-period *state*, unknown in $t = 1$.

Denote the probability of the child C_L to be of the same type as its parent B_L as $\mathbb{P}[\theta_{C_L} = \theta^L] := P_{LL}$. Since there are only two productivity types, the probability of C_L's type being θ^H is given by $P_{LH} = 1 - P_{LL}$. Define the probabilities P_{HL} and P_{HH} analogously. We assume that all probabilities are positive, i.e., $P_{LL}, P_{LH}, P_{HL}, P_{HH} \in (0, 1)$. Across the continuum of households of dynasty j, the children's types are independent draws from this distribution. By a law of large numbers, the transition probabilities P_{jL} and P_{jH} are therefore also the realized population shares of low- and high-productivity

[2]Because we model bequest as inter-vivos transfers, the usual interpretation of bequest constraints as the legal impossibility of borrowing against one's children's *future* income does not fit our setting. However, the essential feature for bequest constraints to influence the parents' decision problem is that they prevent the intergenerational marginal rate of substitution between parent and child consumption from adjusting, which they do in our setting (see Section 3.1).

children within dynasty j: each household faces uncertainty about its own child, while second-period aggregates are deterministic.[3]

When generation B makes its savings-for-retirement decision, there is uncertainty about the productivity type and thus the labor income of its child. To formulate its decision problem, we will denote second-period contingencies with a superscript i for the case that the child is of productivity type $i \in \{L, H\}$. For example, we denote the bequest of parent B of type H in the second period for the case that its child household C_H is productivity type θ^L as

$$b^L_{B_H,2} := b_{B_H,2}|_{\theta_{C_H}=\theta^L}.$$

The operator $\mathbb{E}_j$ is defined as the dynasty-specific expected value of a random variable over its child's type, relying on probabilities P_{ji}. We define

$$\xi := \sum_j \mathbb{E}_j [\xi_j] = \sum_j \sum_i P_{ji} \xi^i_j. \tag{10}$$

Because of the law of large numbers, ξ is the aggregate marginal benefit from the public good in the second period.

Optimality conditions. We solve the model by backward induction. Since at this point the two dynasties act independently of each other, we omit dynasty subscript j to improve readability. In $t = 2$, household C consumes its whole endowment. Old household B maximizes utility (3) subject to budget constraint (7) and the bequest constraint (9). Denote μ_B the Lagrange multiplier on the bequest constraint. Then, the optimality condition to the bequest problem is given by

$$u'(c_{B,2}) = a\, u'(c_{C,2}) + \mu_B. \tag{11}$$

A solution with $\mu_B > 0$ indicates that the bequest constraint is binding and therefore $b_{B,2} = 0$. By the same token, the result of old household A's maximization of utility (1) subject to budget constraint (5) and bequest constraint (9) results in

$$u'(c_{A,1}) = a\, u'(c_{B,1}) + \mu_A, \tag{12}$$

where μ_A denotes the Lagrange multiplier on old household A's bequest constraint. The only private intertemporal savings decision in this model is made by young households B. They maximize their intertemporal utility (2) subject to the budget constraints (6) and (7) with uncertainty about their second-period state. CRRA utility satisfies the Inada condition $u'(c) \to \infty$ as $c \to 0$; consequently, we will always have an interior solution to the savings problem, $s_{B_j,1} > 0$. The optimality condition is then given by

$$u'(c_{B,1}) = \beta R\, \mathbb{E}[u'(c_{B,2})]. \tag{13}$$

[3]Pathwise integration over a continuum of independent draws is not well-defined. For instance, the share of low-productivity children within dynasty L, computed realisation by realisation as an integral over households, need not exist; we follow Uhlig (1996), who defines cross-sectional aggregates as Pettis integrals instead – a modeling device that is innocuous when, as here, only shares and aggregates are the objects of interest.

It equates the interest rate R and the intertemporal MRS of generation B. Appendix A derives the bequest first-order condition (11) and the savings Euler equation (13), and shows in particular that the latter continues to hold despite the kink the bequest constraint introduces in household B's second-period bequest decision.

Binding bequest constraints. When is one of the bequest constraints binding, or, equivalently, when is $\mu_A > 0$ ($t = 1$) or $\mu_B > 0$ ($t = 2$)? It is binding if – in the absence of a bequest – the marginal utility of consumption of the parent household is higher than the marginal utility of consumption of the child household weighted by dynastic altruism. Hence, low levels of dynastic altruism make bequest constraints more likely to be binding. Furthermore, the wealthier the child is compared to its parent, the likelier the bequest constraint binds. These two effects drive the inefficiently low support for climate policy in this model. In the limiting case of vanishing altruism, $a \to 0$, the first channel becomes extreme: the parent attaches no value to its child's consumption, so the bequest constraint binds in every state, the household never leaves a bequest ($b_{B,2} = 0$) and consumes $c_{B,2} = R\, s_{B,1}$. At this corner B_j is exactly the canonical, intergenerationally egoistic household of the OLG literature: our model *nests* that egoist at $a = 0$ and *generalizes* it for $a > 0$.[4] We return to this corner in the subsequent analysis. Before we analyze this channel more explicitly in the section about *implicit discount rates*, we complete our model by explaining the role of the government.

2.2 The Government

Due to the assumption of a small open economy, the two dynasties in our model are independent of each other when it comes to private savings and bequest decisions. That is, (by construction) there are no general equilibrium effects through which the decisions of one dynasty influence the other. We return to this assumption in Section 7. We make these assumptions to focus on an interaction in a different sphere: the polity. Because of the public good character of g, decisions about its provision must be coordinated collectively. Thus, the aggregation of individual preferences is essential.

Government objective. We assume that a government sets the level of the public good g^* by solving the following maximization problem, thus taking into account the preferences of all households alive at $t = 1$

$$\max_{g} \; W = \omega_L \, U^*_{B_L} + \omega_H \, U^*_{B_H}, \tag{14}$$

with $\sum_j \omega_j = 1$. Here, $U^*_{B_j}$ denotes the indirect utility of household B_j at the time of decision making and ω_L denotes the weight of dynasty L. The model setup entails that household A_j has the exact same preferences about the provision of g as its offspring B_j, the reason being that only B_j is taxed by the government to finance the public good and that A only cares about the benefits of public good provision because B cares about

[4] *Intergenerational* egoism is the term used in the OLG literature. It implies the absence of altruism toward *all* members of future generations, including one's descendants.

it. Hence, maximizing B_j's indirect utility is sufficient to include A_j's preferences. The weights ω_j could be interpreted both normatively, as welfare weights, and positively, as political economy weights. Here, we interpret them as positive parameters that describe the actual collective decision processes. The government finances the public good through lump-sum taxes $\gamma_j \Gamma(g)$ on generation B in $t = 1$ that together cover the cost $\Gamma(g)$ of public good provision, where $\gamma_j \in (0, 1)$ is dynasty j's cost share imposed by taxation, with $\sum_{j\in\{L,H\}} \gamma_j = 1$. Alternatively, γ_j can be read as dynasty j's share of the cost under decentralized provision, for instance through a carbon price that induces costly behavioral adjustments. Section 6 adopts this reading. The cost function Γ is strictly convex and continuous. The assumptions $\Gamma(0) = 0$, $\Gamma'(0) = 0$ and $\lim_{x\to\infty} \Gamma'(x) = \infty$ ensure an interior solution for the provision of the public good g. Unless stated otherwise, the government pursues no fiscal or redistributive goals other than the provision of g.

Efficiency benchmark. To assess the realized level of the public good g^* obtained from the maximization of Equation (14), we define the efficiency benchmark level denoted g^{BM} as the level maximizing aggregate intertemporal resources:

$$\Gamma'(g^{\text{BM}}) = \frac{\xi}{R}, \tag{15}$$

where ξ is the aggregate marginal benefit from Equation (10). We assume that $g^{\text{BM}} < \bar{g}$, where $\bar{g}$ is a level of public good provision for which every dynasty can still bear its cost share out of first-period resources (Section 2.1). In Appendix B, we show that g^{BM} is a feature of every first-best Pareto-efficient allocation. Moreover, we show that it is chosen by the government for any weights ω, if it has three things at its disposal: the possibility of incurring public debt at rate R, dynasty-specific lump-sum transfers in $t = 1$, and perfect commitment over lump-sum transfers that are both dynasty-specific and specific to the realization of the productivity process in $t = 2$.

By construction, g^{BM} is the level of g a government would choose when grounding its decision on a cost-benefit analysis based on the market rate R. Our benchmark thus conforms to the ideals of the positive approach to discounting (Nordhaus, 2007; United States Environmental Protection Agency, 2010; Burgess and Zerbe, 2013) that relies on the market-revealed rate. Whether this is the correct approach for cost-benefit analysis, in particular in the context of long-term projects, is subject to debate (Groom et al., 2022; Millner and Heal, 2023). However, because the market rate generally exceeds the rate implied by the ethical arguments of the normative camp (Stern, 2008), our politically-revealed rate exceeds this rate a fortiori.

3 Implicit Discount Rates and the Politically-Revealed Rate

In this section we will use our model to analyze three central concepts: the household's implicit discount rate for benefits accruing to its offspring; the household's preferred

level of public good provision; and the politically-revealed rate, the result of political aggregation, for which we formulate an augmented Ramsey rule.

3.1 Implicit Discount Rates

Whether a household is willing to fund a public good whose resource-augmenting benefits accrue only to its children depends on the MRS between its own consumption today and its child's consumption tomorrow. We call this rate the household's implicit discount rate and characterize it here, before turning to the level of public good provision it influences in Sections 3.2 and 3.3.

For dynasty $j \in \{L, H\}$, define the *implicit discount rate* of household B_j as

$$\widetilde{R}_j := \frac{u'(c_{B_j,1})}{\beta\, a\, \mathbb{E}_j\left[u'(c_{C_j,2})\right]}. \tag{16}$$

For any given policy g, $\widetilde{R}_j$ is pinned down by the household's optimal savings and bequest decision. We now show that a positive probability of a binding bequest constraint raises $\widetilde{R}_j$ above the market interest rate R, and characterize how the resulting wedge responds to the primitives of the model.

Proposition 1 (The discount-rate wedge and its determinants)**.** *(a)* The wedge. *The implicit discount rate of household B_j satisfies*

$$\widetilde{R}_j = R\left(1 + \frac{\mathbb{E}_j[\mu_{B_j}]}{a\, \mathbb{E}_j[u'(c_{C_j,2})]}\right) \;\geq\; R, \tag{17}$$

with equality, $\widetilde{R}_j = R$, if and only if B_j's bequest constraint is slack in every second-period state occurring with positive probability ($\mathbb{E}_j[\mu_{B_j}] = 0$), and strict inequality, $\widetilde{R}_j > R$, if and only if the constraint binds with positive probability.

(b) Altruism. *Suppose dynasty j's bequest constraint binds with positive probability, so that $\widetilde{R}_j > R$ by (a). A decrease in the dynastic altruism parameter a raises its implicit discount rate, $\partial \widetilde{R}_j / \partial a < 0$.*

(c) Upward mobility. *Maintaining part (b)'s assumption that leads to $\widetilde{R}_j > R$, an increase in dynasty j's upward-mobility probability P_{jH} raises its implicit discount rate, $\partial \widetilde{R}_j / \partial P_{jH} > 0$.*

If instead dynasty j's bequest constraint is slack in every state, its implicit discount rate $\widetilde{R}_j = R$ is unaffected by changes in either a or P_{jH}, so long as the dynasty remains unconstrained.

The proof is in Appendix C.

The intuition behind part (a) is that a binding bequest constraint is equivalent to the parent expecting its child to be relatively better off than itself. Its willingness to forego consumption to the benefit of its child is therefore limited and its dynastic MRS is higher than the market rate. In other words, it discounts the child-accruing benefits more heavily than the market rate.

This discount-rate wedge has a precedent in the incomplete-markets and liquidity-constraint literature (Zeldes, 1989; Deaton, 1991; Huggett, 1993; Aiyagari, 1994). In those frameworks, a binding borrowing constraint introduces a positive shadow-price multiplier into the household's intrapersonal Euler equation, whereas in our setting it enters the bequest condition (11), so the wedge is dynastic. In both cases, this forces the marginal rate of substitution – intrapersonal there, dynastic here – above the market interest rate. Whereas standard life-cycle borrowing constraints bind in bad states, when current income is low relative to future expectations, the bequest constraint here binds in good future states. The wedge does not require risk: it suffices that, absent a bequest, the child is well enough off relative to its parent for the bequest constraint to bind. However, with stochastic mobility, an economy that is unconstrained on average (a representative household with mean endowments would leave a positive bequest) can harbor bequest-constrained dynasties.

Parts (b) and (c) trace the wedge back to the primitives. Altruism is what gives the child-accruing benefit any weight in the parent's valuation in the first place. A less altruistic parent values its child's future consumption less, is pushed against the bequest constraint in more states and more deeply, and demands a larger expected gain in its child's consumption before parting with a unit of its own – its implicit discount rate rises. It is worth highlighting that this does not hold for a parent household that leaves a positive bequest to its children in all states occurring with positive probability. The level of altruism affects such a household's bequest but not the fact that its implicit discount rate is equal to the market rate.

Greater upward mobility raises the implicit discount rate $\widetilde{R}_j$ of a constrained parent by the same logic: a higher chance that the child draws the high-productivity type makes the child more likely to end up richer than the parent, so the bequest constraint binds more often and more deeply.

The implicit discount rate also responds to the provision of g itself, because the latter shifts resources intertemporally: the parent bears the cost share of g today, while the benefit accrues to the child tomorrow. Thus, a higher level of g tightens the bequest constraint and increases the implicit discount rate for a constrained parent. Lemma D.1 in Appendix D makes this precise: each dynasty's implicit discount rate $\widetilde{R}_j(g)$ is continuous and non-decreasing in g – equal to R below a dynasty-specific threshold of provision at which the constraint starts to bind, and strictly increasing beyond it. The lemma secures the existence and uniqueness of the preferred provision levels of Section 3.2 and underpins the transfer lemma below.

In the limit $a \to 0$, the parent places no weight on its child at all. The constraint binds in every state, and $\widetilde{R}_L$ diverges to the egoist's rate $\widetilde{R}^{\text{egoist}} = \infty$, the OLG corner introduced in Section 2.1. The next proposition makes this nesting precise.

Proposition 2 (Equivalence and breakdown)**.** *Let $a > 0$ and fix a policy g. Each dynasty's implicit discount rate satisfies*

$$R \;\leq\; \widetilde{R}_j \;<\; \widetilde{R}^{\text{egoist}} := \infty,$$

with equality $\widetilde{R}_j = R$ if and only if the bequest constraint is slack in every second-period

state, and $\widetilde{R}_j \to \widetilde{R}^{\text{egoist}}$ *as* $a \to 0$*. Moreover, whenever the constraint binds in every state,* B_j*'s privately chosen saving, consumption and bequest coincide with those of the intergenerationally egoistic agent of Section 2.1, even though its implicit discount rate stays strictly below the corner,* $\widetilde{R}_j < \widetilde{R}^{\text{egoist}}$*.*

Proof. The lower bound is Proposition 1(a). For $a > 0$, the denominator $\beta\, a\, \mathbb{E}_j[u'(c_{C_j,2})]$ in Equation (16) is strictly positive and the numerator finite, so $\widetilde{R}_j < \infty$; as $a \to 0$ the denominator vanishes while the numerator stays bounded away from zero, giving $\widetilde{R}_j \to \infty$. If the constraint binds in every state then $b^i_{B_j,2} = 0$ for all i, so by Equation (7) $c^i_{B_j,2} = R\, s_{B_j,1}$ and, by Equation (8), $c^i_{C_j,2}$ no longer depends on $s_{B_j,1}$; the saving problem reduces to $\max_s u(c_{B_j,1}) + \beta\, \mathbb{E}[u(R\, s)] + \text{const}$, which is the egoist's problem under the same budget (6). Hence $s_{B_j,1}$, $c_{B_j,1}$ and $\{c^i_{B_j,2}\}_{i\in\{L,H\}}$ coincide across the two agents. □

The proposition says the bequest-constrained altruist and the OLG egoist are two routes to the same private behavior. The egoist never bequeaths because it does not value its child; the constrained altruist of dynasty j does not bequeath in those states in which its child is better off than itself, which may be the case in all states. On the private margin – saving, consumption, and bequest – the two agents are observationally indistinguishable.

The finding that a binding borrowing constraint can make an infinitely-lived (here, dynastic) agent behave like a finitely-lived one is not new: a parallel result appears in Woodford (1986) for a within-period finance constraint, and the more general principle that borrowing constraints shorten the effective planning horizon is well established (Mankiw, 2000; Galí et al., 2007). Our contribution is to identify its *breakdown* once the relevant investment is determined collectively.

That breakdown is visible in the rate: however tightly the constraint binds, for any $a > 0$, the altruist's rate stays strictly below the egoist's, $\widetilde{R}_j < \widetilde{R}^{\text{egoist}} = \infty$. In other words, the constraint shuts down the private *transfer* channel ($b_{B,2} = 0$) but leaves the altruistic *valuation* of the child's consumption intact ($a > 0$ still multiplies the future benefit).

Next, we show how transfers affect the implicit discount rate $\widetilde{R}_j$ of household B_j. The discount-rate heterogeneity in our model stems from the heterogeneously binding bequest constraint and not from differing fundamental preference parameters as in Gollier and Zeckhauser (2005), Jackson and Yariv (2015), and Heal and Millner (2014). Therefore, the resulting aggregate rate is *policy-amenable*: transfers influence households' implicit discount rates. We investigate two stylized schemes. The first is an *intra*generational transfer that redistributes from B_H to B_L in the first period. The second is an *inter*generational transfer – a transfer $T_1 > 0$ to all of generation B in the first period and a tax $T_2 = -R\, T_1 < 0$ on all of generation C – emulating a debt-financed lump-sum transfer. Their effects are the content of the next lemma, which prepares the analysis of the effect of transfers on the politically aggregated level of provision in Proposition 4.

Lemma 1 (Transfers and the implicit discount rate)**.** *Let* $a > 0$ *and maintain* $\widetilde{R}_H = R < \widetilde{R}_L$ *with* B_H *at an interior solution for bequest.*

(a) Intragenerational transfers. *A marginal intragenerational transfer from B_H to B_L in $t = 1$ lowers $\widetilde{R}_L$, while leaving $\widetilde{R}_H = R$ unchanged.*

(b) Intergenerational transfers. *A marginal intergenerational transfer $T_1 > 0$ to all of generation B, financed by $T_2 := -RT_1$ on generation C, lowers $\widetilde{R}_L$, while leaving $\widetilde{R}_H = R$ unchanged.*

The proof is in Appendix E.

Intuitively, a transfer that reaches the constrained dynasty relaxes the very friction that inflates its rate and makes the constrained household B_L more generous toward the child C_L. The intergenerational scheme lowers $\widetilde{R}_L$ by more still: taxing generation C reduces the child's second-period consumption, which raises the parent's marginal valuation of providing for its descendant and reinforces the first-period effect. In contrast, the unconstrained dynasty is unmoved: B_H sits at an interior bequest optimum, so a marginal change in its resources is absorbed by adjusting saving and bequest and leaves its rate at $\widetilde{R}_H = R$. In the intergenerational scheme, it neutralizes the transfer by increasing savings and bequest one-for-one in Ricardian fashion. Both effects require positive altruism: at the egoistic corner $a = 0$, implicit rates are pinned at $\widetilde{R}^{\text{egoist}} = \infty$ independently of first-period resources and, thus, of transfers. We exploit the asymmetric effect of transfers on the implicit rates of constrained and unconstrained dynasties at the political aggregate in Section 3.3.

3.2 The Preferred Level of Public Good Provision

The *preferred level of public good provision* of dynasty j, denoted g_j^*, is the level that maximizes household B_j's indirect utility $U_{B_j}^*(g)$: the level B_j would choose if it decided alone about provision, while bearing its cost share γ_j of the cost $\Gamma(g)$, as defined in Section 2. Appendix F derives the decomposition below and the associated first-order condition from B_j's two-stage saving-bequest problem

$$\gamma_j \, \Gamma'(g_j^*) \, u'(c_{B_j,1}) = \beta a \, \mathbb{E}_j \big[u'(c_{C_j,2}) \, \xi_j \big] . \tag{18}$$

Writing the expectation as a level term plus a covariance,

$$\mathbb{E}_j[u'(c_{C_j,2}) \, \xi_j] = \mathbb{E}_j[\xi_j] \, \mathbb{E}_j[u'(c_{C_j,2})] + \mathrm{Cov}_j(\xi_j, u'(c_{C_j,2})),$$

and substituting the implicit discount rate (16), the first-order condition can be rearranged into the following decomposition

$$\Gamma'(g_j^*) = \underbrace{\frac{\xi}{R}}_{\text{benchmark}} \times \underbrace{\frac{R}{\widetilde{R}_j}}_{\text{discount}} \times \underbrace{\frac{\mathbb{E}_j[\xi_j]/\xi}{\gamma_j}}_{\mathrm{BC}_j \ \text{(dynastic benefit-cost)}} \times \underbrace{\left(1 + \frac{\mathrm{Cov}_j(\xi_j, u'(c_{C_j,2}))}{\mathbb{E}_j[\xi_j] \, \mathbb{E}_j[u'(c_{C_j,2})]}\right)}_{\chi_j \ \text{(insurance)}}, \tag{19}$$

where ξ is the aggregate marginal benefit (Equation (10)). The first factor, ξ/R, is the marginal cost at the efficiency benchmark g^{BM} of Section 2.2 (Equation (15)).

The decomposition splits preferred provision into the benchmark and three dimensionless factors. The *discount-rate factor* $R/\widetilde{R}_j \leq 1$ is the friction of Section 3.1: a binding bequest constraint lifts $\widetilde{R}_j$ above R and discounts the future benefit more heavily. The *benefit-cost factor* $\mathrm{BC}_j = (\mathbb{E}_j[\xi_j]/\xi)/\gamma_j$ compares dynasty j's expected share of the benefit with the share of the cost it bears; a value above one means the dynasty's benefit share exceeds its cost share, which raises the level it prefers. The *insurance factor* χ_j weights the benefit by the child's marginal utility across states. Because the household cannot otherwise insure its child's income risk, a benefit that co-moves with $u'(c_{C_j,2})$, i.e., that becomes larger when the child is poorer ($\mathrm{Cov}_j(\xi_j, u'(c_{C_j,2})) > 0$, henceforth Cov_j), provides incidental insurance: it pays off in high-marginal-utility states, so the household values it above its expected level and $\chi_j > 1$. Public transport (Paulley et al., 2006) or public health, whose benefit incidence is documented to be increasingly pro-poor as national income rises (O'Donnell et al., 2007), are examples of such public goods. A benefit that moves against $u'(c_{C_j,2})$ ($\mathrm{Cov}_j < 0$), i.e., that becomes larger when the child is richer, is valued below its expected level, $\chi_j < 1$. Climate policy, where avoided damages scale with income and assets at risk (Gilli et al., 2024), are an example of such a public good.[5] The insurance factor is the dynastic counterpart of the risk adjustment that asset-pricing approaches to public discounting apply to long-term benefits (Dietz et al., 2018; Cherbonnier and Gollier, 2023), which weight a benefit by the covariance of its return with consumption. The difference is that those contributions analyze co-movement with *aggregate* consumption, whereas χ_j arises from the *idiosyncratic* risk of the child's income that the bequest-constrained household cannot otherwise insure.

The multiplicative separation of preferred provision into a discount-rate, a benefit-cost, and an insurance factor isolates three forces – the allocation of costs and benefits, the bequest-constraint friction, and the uninsurability of the child's income risk – that bear on long-term public investment but are usually entangled. The decomposition (19) is general, but two of its three factors are not this paper's object, and we switch them off for the analysis that follows:

Assumption 1. *(i) The cost share of each dynasty γ_j is equal to its expected share in benefits $\gamma_j = \mathbb{E}_j[\xi_j]/\xi$. This implies $\mathrm{BC}_j = 1$.*

(ii) The distribution of benefits ξ_j and generation C second-period consumption $c^i_{C_j,2}$ is independent for all dynasties. This implies $\mathrm{Cov}_j := \mathrm{Cov}_j(\xi_j, u'(c_{C_j,2})) = 0$ and, equivalently, $\chi_j = 1$.

Assumption 1(i) implies $\mathrm{BC}_j = 1$ by assuming that the cost is proportional to the benefit each dynasty draws, $\gamma_j = \mathbb{E}_j[\xi_j]/\xi$. This is the dynastic analogue of the *benefit principle* of public finance. Closely related to Lindahl pricing (e.g., Atkinson and Stiglitz, 2015, p. 427), except that the share is tied to dynastic rather than individual benefits, it carries that principle's normative appeal: each dynasty pays for what it gains. It is also what isolates the discount channel, this paper's object, from heterogeneity in relative cost and benefit across dynasties.

[5]Note that this is not at odds with evidence pointing toward climate damages being distributed regressively *internationally*.

Similarly, Assumption 1(ii) eliminates the insurance channel. Because the channel is contingent on the type of public good and empirically determined, we also set it aside assuming that the benefit is independent of the child's realized state, $\xi_j^i \equiv \xi_j$, so that $\text{Cov}_j = 0$ and $\chi_j = 1$. For climate policy, where $\chi_j < 1$, this is conservative: restoring the channel would deepen the underprovision below. We discuss this in Section 7 and maintain the two assumptions throughout Sections 3.2 and 3.3.

Taking these two assumptions together, the preferred level reduces to $\Gamma'(g_j^*) = \xi/\widetilde{R}_j$, turning on the discount channel alone. Note that $\widetilde{R}_j$ itself depends on g through the effect of cost and benefit of g on the resources of the constrained households. As long as this effect is sufficiently small relative to the respective period earnings and bequest, we can treat $\widetilde{R}_j$ as independent of g.[6] In this case, g_j^* exists, is unique, and is given by the map

$$g_j^* = (\Gamma')^{-1}\left(\frac{\xi}{\widetilde{R}_j}\right),$$

which is strictly decreasing and continuous in the implicit discount rate. Lemma D.1 shows that this map remains valid when $\widetilde{R}_j$ varies with g.[7] Everything in the remainder of this subsection follows from Proposition 1 through this map. First, because $\widetilde{R}_j \geq R$, the preferred level sits weakly below the benchmark: for $a > 0$, $g_j^* \leq g^{\text{BM}}$, with equality if and only if the bequest constraint is slack in every state (Proposition 1(a)). Under quadratic costs $\Gamma(g) = \kappa g^2$, the preferred level relative to its benchmark counterpart is equal to the market rate relative to the implicit discount rate,

$$\frac{g_j^*}{g^{\text{BM}}} = \frac{R}{\widetilde{R}_j}.$$

Second, the preferred level falls to the egoistic floor as altruism vanishes: as $a \to 0$, the implicit discount rate diverges, driving provision to the egoistic floor, $g_j^* \to g^{\text{egoist}} = 0$. Third, the comparative statics of Section 3.1 carry over with the opposite sign: whatever raises a dynasty's implicit discount rate – lower altruism, greater upward mobility (Proposition 1(b),(c)) – lowers the dynasty's preferred provision, and whatever lowers the rate, in particular the transfer schemes of Lemma 1 acting on B_L, raises it.

3.3 The Politically-Revealed Discount Rate

The dynasties' implicit discount rates aggregate, through the model's political process, into a single rate at which society is revealed to trade present against future consumption. The realized level of public good provision g^* solves the government's problem of maximizing the weighted utility of generation B (14).

[6] At the baseline calibration of Section 6, the average cost of benchmark provision amounts to 0.18% of the first-period resources of the poorest quintile (Section 6.4).

[7] By Lemma D.1 the right-hand side, $\xi/\widetilde{R}_j(g)$, is continuous and non-increasing in g, while $\Gamma'(g)$ increases strictly from $\Gamma'(0) = 0$ to $\Gamma'(g^{\text{BM}}) = \xi/R$, and $\xi/R \geq \xi/\widetilde{R}_j(g)$ at every g, so the preferred level g_j^* exists and is unique. Moreover, anything that raises $\widetilde{R}_j(g)$ at every g shifts $\xi/\widetilde{R}_j(g)$ down and the intersection between the expression and $\Gamma'(g)$ to the left, thus reducing g_j^*.

The aggregation inherits the same expectation refactoring as the individual problem and thus contains a covariance term Cov_j, suppressed by the maintained assumption $\mathrm{Cov}_j = 0$. With the benefit principle ($\mathrm{BC}_j = 1$) likewise maintained, the government's first-order condition reads

$$\Gamma'(g^*) = \frac{\xi}{\widetilde{R}_{\mathrm{pol}}}, \qquad \frac{1}{\widetilde{R}_{\mathrm{pol}}} := \sum_j \frac{\nu_j}{\widetilde{R}_j}, \tag{20}$$

where $\widetilde{R}_{\mathrm{pol}}$ is the *politically-revealed discount rate*, a weighted harmonic mean of the dynastic rates with effective weights

$$\nu_j := \frac{\omega_j \, \xi_j \, u'(c_{B_j,1})}{\sum_k \omega_k \, \xi_k \, u'(c_{B_k,1})} \qquad \Big(\nu_j \geq 0, \ \textstyle\sum_j \nu_j = 1\Big). \tag{21}$$

Equivalently, $\widetilde{R}_{\mathrm{pol}}$ is the rate at which a cost-benefit analysis of the form (15) would have to discount future benefits to rationalize the realized level of g. In other words, it is the discount rate the political process reveals. The derivation is in Appendix G. Each ν_j rises with dynasty j's political power ω_j, its share ξ_j/ξ in aggregate benefits, and its first-period marginal utility $u'(c_{B_j,1})$. Section 6 also considers political processes that fix the ν_j directly, aggregating preferred levels of provision.

The next proposition locates the realized level between two important benchmarks and gives the wedge a transparent Ramsey form. For the latter, note that under the assumed isoelastic preferences the unconstrained dynasty's Euler equation takes the canonical Ramsey form, extended by a precautionary term (e.g., Groom et al., 2022),

$$\ln R = \rho + \eta \, g_c - \psi, \tag{22}$$

with $\rho := -\ln \beta$ the pure rate of time preference, η the elasticity of marginal utility, and $g_c := \mathbb{E}_H[\Delta]$ household B_H's expected consumption growth rate, where $\Delta := \ln(c_{B_H,2}/c_{B_H,1})$. The term $\psi := \ln \mathbb{E}_H\big[\exp(-\eta(\Delta - g_c))\big]$ is a precautionary (prudence) correction: although B_H's bequest constraint never binds, its state-contingent bequest shares the child's wage risk, so its own second-period consumption is stochastic – the model counterpart of the dynastic precautionary saving documented empirically by Boar (2021).

Proposition 3 (Realized underprovision and the augmented Ramsey rule)**.** *Let $a > 0$.*

(a) Underprovision. *The realized level is positive and lies weakly below the benchmark,*

$$0 \ < \ g^* \ \leq \ g^{\mathrm{BM}},$$

with strict inequality $g^* < g^{\mathrm{BM}}$ if and only if at least one dynasty whose bequest constraint binds with positive probability ($\widetilde{R}_j > R$) carries strictly positive weight ($\omega_j > 0$).

(b) The wedge in multiplicative form. *If B_H is unconstrained, $\widetilde{R}_H = R$, the politically-revealed rate is the market rate inflated by a multiplicative wedge determined by*

constrained B_L alone,

$$\widetilde{R}_{\text{pol}} = R\,\Phi, \qquad \Phi = \frac{1}{1-\nu_L\Big(1-R/\widetilde{R}_L\Big)} \geq 1, \tag{23}$$

with $\Phi = 1$ and $\widetilde{R}_{\text{pol}} = R$ exactly when B_L carries no weight ($\nu_L = 0$) or is unconstrained ($\widetilde{R}_L = R$).

(c) Augmented Ramsey rule. *Because u is isoelastic, the politically-revealed rate is the Ramsey rate* (22) *of the unconstrained household augmented by a bequest-constraint premium,*

$$\widetilde{r}_{\text{pol}} := \ln \widetilde{R}_{\text{pol}} = \underbrace{\rho + \eta\, g_c - \psi}_{=\ln R} + \underbrace{\Pi}_{\substack{\textit{bequest-constraint}\\ \textit{premium}}}, \qquad \Pi := \ln \Phi \geq 0. \tag{24}$$

Proof. (a) Equation (20) writes $1/\widetilde{R}_{\text{pol}}$ as a weighted harmonic mean of the $\widetilde{R}_j$. By Proposition 1(a) each $\widetilde{R}_j \geq R$, so $\widetilde{R}_{\text{pol}} \geq R$, with strict inequality iff some dynasty with $\nu_j > 0$ has $\widetilde{R}_j > R$; by Equation (21), $\nu_j > 0 \Leftrightarrow \omega_j > 0$. Since $g^* = (\Gamma')^{-1}(\xi/\widetilde{R}_{\text{pol}})$ is decreasing in $\widetilde{R}_{\text{pol}}$, the claim follows. (b) With $\widetilde{R}_H = R$ and $\nu_H = 1 - \nu_L$, the harmonic mean (20) gives $R/\widetilde{R}_{\text{pol}} = \nu_L\, R/\widetilde{R}_L + 1 - \nu_L = 1 - \nu_L\big(1 - R/\widetilde{R}_L\big)$, which is Equation (23); $\Phi \geq 1$ since $\widetilde{R}_L \geq R$ and $\nu_L \in [0,1]$, with equality exactly in the two stated cases. (c) Taking logs of Equation (23) and substituting the Ramsey form (22) for $\ln R$ yields Equation (24). □

Whenever the polity gives weight to a bequest-constrained dynasty, the revealed rate $\widetilde{R}_{\text{pol}}$ exceeds R by a wedge that a cost-benefit analysis at R would omit. As a result, the benchmark g^{BM} sits above the level the polity supports: the friction that lifts household rates above R is transmitted, through aggregation, into a society that invests inefficiently little.

Parts (b) and (c) make the transmission transparent. The wedge factor Φ is governed by the product of B_L's weight ν_L and its relative discount-rate wedge $1 - R/\widetilde{R}_L$; the premium $\Pi = -\ln[\,1 - \nu_L(1 - R/\widetilde{R}_L)\,] \approx \nu_L(1 - R/\widetilde{R}_L)$ is the constrained dynasty's contribution, rising in *both* its political weight ν_L and its discount-rate wedge $1 - R/\widetilde{R}_L$.

The augmented discount rate does not stem from preferences but from a binding constraint. Hence, appropriate policy interventions can, in principle, restore the efficient provision level g^{BM}. For the following comparative statics of the realized level with respect to mobility and transfers, we treat both $\widetilde{R}_j$ and ν_j as independent of g, by the argument given in Section 3.2 for $\widetilde{R}_j$: g affects them only through the effect of its cost and benefit on households' resources, which is small relative to their period earnings and bequests. Proposition 1(c) suggests that policies affecting intergenerational income mobility might influence g^* in an unexpected way, because higher mobility *increases* a constrained dynasty's implicit discount rate. However, the overall effect on g^* is ambiguous in general, because higher intergenerational mobility can shift the weights in the government's maximization problem, too, as we show in Appendix H. If the constrained household's bequest

constraint binds in both states, its first-period consumption and the weights do not change, and higher mobility lowers g^*. If instead it binds in only one state, higher mobility raises its first-period consumption and the government puts relatively more weight on the unconstrained dynasty – the *weight* channel – thus, potentially offsetting the constrained dynasty's higher implicit discount rate – the *rate* channel. Hence, every member of a more upwardly mobile society weakly prefers *less* long-term public investment, yet it might be the case that the political outcome is a strict *increase* in long-term public investment, if political power is shifted to unconstrained households. Which effect dominates ultimately is a quantitative question. In contrast, the effect of transfers on implicit discount rates described in Lemma 1 aggregates unambiguously into effects on the level of provision realized in the political process, the content of the next proposition.

Proposition 4 (Transfers raise provision)**.** *Let $a > 0$, maintain $\widetilde{R}_H = R < \widetilde{R}_L$ with B_H at an interior solution for bequest and assume that the effect of g on both $\widetilde{R}_j$ and ν_j is negligible, then*

(a) Intragenerational transfers. *A marginal intragenerational transfer from B_H to B_L in $t = 1$ raises g^*;*

(b) Intergenerational transfers. *A marginal intergenerational (debt-like) transfer $T_1 > 0$ to all of generation B, financed by $T_2 := -RT_1$ on generation C, raises g^*.*

In both cases $\widetilde{R}_H$ is unchanged, while $\widetilde{R}_L$ falls and effective weight ν_j shifts toward B_H.

The proof is in Appendix I.

For both transfer schemes, the two channels *reinforce*: the constrained dynasty's rate falls and the effective weight shifts toward the unconstrained dynasty, and both raise g^*. The underlying asymmetry – a constrained household responds to a transfer while an unconstrained one neutralizes it – is what makes redistribution and debt-financed transfers effective instruments for raising long-term public investment.

In sum, a positive probability of binding bequest constraints raises implicit discount rates and depresses preferred and realized public investment; higher upward mobility operates in the same direction through the rate channel; and both intra- and intergenerational transfers can raise provision by relaxing the constraints of those who face them.

4 Efficient Provision as a Pareto Improvement

Proposition 4 established that transfers raise provision at the margin. We now turn to a central question of this article: which of the instruments available in the first period can lift realized provision all the way to the benchmark g^{BM}, defined by $\Gamma'(g^{\mathrm{BM}}) = \xi/R$ (Section 2.2), in a Pareto-improving way?

We hold each instrument to one of two standards. The *generation-B* criterion requires that both B_L and B_H be weakly better off; since generation B decides policy in the first period, this is the politically relevant test. Note that any such policy weakly increases the government's objective function contained in Equation (14) for any ω and is preferred

in every scenario described in Section 6.2, thus constituting a robust reform option. The *intergenerational* criterion is more demanding: it asks that every household – B_L, B_H, and their children C_L, C_H – be weakly better off.

Throughout, we maintain Assumption 1, as well as the assumptions that dynasty H is unconstrained, entailing $\widetilde{R}_H = R$, while dynasty L's bequest constraint binds with positive probability, leading to $\widetilde{R}_L > R$. We also continue to assume that the two dynasties are of equal mass. This assumption can be relaxed at the cost of carrying population weight parameters through the analysis.

Intragenerational transfer. The first instrument is a one-off intragenerational transfer from B_H to B_L in the first period – the lever of Proposition 4(a). At first glance, it is attractive as the cost of the transfer is borne entirely by the generation that also makes the respective decision in the first period. It requires neither commitment nor debt, and it imposes no burden on generation C.

However, we now argue that it may fail the generation-B criterion. More specifically, for a relatively small initial discount-rate wedge, the transfer makes the unconstrained dynasty B_H worse off, under a condition on the provision response stated below. The intuition is that the benefit of the increased provision decreases as provision approaches the efficient level while the cost of the transfer is constant (in marginal utility terms). This can be seen by computing the effect of the transfer on B_H's indirect utility at $g = g^*$:

$$\begin{aligned}\frac{\mathrm{d}U^*_{B_H}}{\mathrm{d}T_1} &= \frac{\partial U^*_{B_H}}{\partial T_1} + \frac{\partial U^*_{B_H}}{\partial g}\,\frac{\mathrm{d}g^*}{\mathrm{d}T_1} \\ &= u'(c_{B_H,1})\left[-1 + \frac{\xi_H}{R}\left(1 - \frac{R}{\widetilde{R}_{\mathrm{pol}}}\right)\frac{\mathrm{d}g^*}{\mathrm{d}T_1}\right],\end{aligned}$$

where we used $\Gamma'(g) = \xi/\widetilde{R}_{\mathrm{pol}}$ and the envelope theorem to obtain the second line. Intuitively, measured in terms of $u'(c_{B_H,1})$, the effect of the transfer from B_H to B_L has a constant, negative effect on B_H while the indirect impact through the induced increase in the public good $\mathrm{d}g^*/\mathrm{d}T_1$ increases B_H's utility. The size of this gain is increasing in the discount-rate wedge. This wedge decreases in T_1, because both B_L's implicit rate $\widetilde{R}_L$ as well as the realized weight ν_L are decreasing in B_L's endowment and thus in T_1 and $\widetilde{R}_{\mathrm{pol}}$ increases in both arguments while $\widetilde{R}_H$ is unaffected. If the provision response $\mathrm{d}g^*/\mathrm{d}T_1$ does not grow as the wedge shrinks, the argument closes: For a sufficiently small initial discount-rate wedge $1 - R/\widetilde{R}_{\mathrm{pol}}$, the net utility effect of the transfer T_1 on B_H is negative and stays so for every further marginal transfer up until $g^* = g^{\mathrm{BM}}$. We expect this condition to hold in general, but proving it analytically is beyond the scope of this paper.

For a large initial wedge, B_H may gain initially, until the transfer has sufficiently reduced the wedge such that any further increase becomes strictly utility-decreasing for it. Whether a non-marginal transfer is *globally* generation-B-improving is a quantitative question.

Note that, if the intragenerational transfer-scheme constitutes a Pareto improvement for generation B, it also constitutes an intergenerational Pareto improvement. An altruistic B_H, being better off and at an interior solution for its bequest, leaves C_H weakly

better off: with the bequest interior, B_H divides a single dynastic budget between its own consumption and its child's resources, so the two move together. Second-period household C_L collects the benefit of higher provision, $\xi_L(g^* - g_0^*)$ with g_0^* the pre-transfer level, with no additional cost – cost is borne by first-period households while bequest for C_L was and is nil. Consequently, it is strictly better off.

Public debt. The second instrument we consider is public debt – the instrument under scrutiny in Proposition 4(b). Let $\hat{b}_L^H > 0$ denote the size of B_L's "forbidden bequest", the negative bequest a constrained parent would like to leave in the state where the constraint binds strongest, evaluated at the benchmark g^{BM}, i.e.,

$$u'\big(R\, s_{B_L,1}(\hat{b}_L^H) + \hat{b}_L^H\big) = a\, u'\big(w_{C,2}^H + \xi_L\, g^{\mathrm{BM}} - \hat{b}_L^H\big), \tag{25}$$

where $s_{B_L,1}(\cdot)$ is the saving that satisfies the Euler equation (13) given the reallocation, so that $\hat{b}_L^H$ solves both first-order conditions of B_L's unconstrained problem. Moving $\hat{b}_L^H$ from child to parent in present value therefore replicates exactly the trade the bequest constraint forbids.

Consider a scheme where the government issues debt to fund a uniform transfer $T_1 = \hat{b}_L^H/R$ to every generation-B household, and redeems it with a uniform tax $T_2 = -R\,T_1 = -\hat{b}_L^H$ on every generation-C household. The transfer frees B_L exactly, so its preferred level rises to the benchmark. Note that the same distributional effect is obtained by an intragenerational transfer of $\hat{b}_L^H/R$ from B_H to B_L in the first period if the government was able to perfectly commit to forcing an intragenerational transfer $\hat{b}_L^H$ from C_L to C_H in the second period.

The scheme makes both B_H and C_H better off. To see this, note that, holding g constant, B_H would save its transfer and raise its bequest by $R\,T_1$ in a Ricardian way, exactly covering C_H's tax, so neither B_H nor C_H is affected by the debt-scheme. In addition, as long as B_H is at an interior solution for bequest, both benefit from the increase in g to its efficient level. With B_L at its preferred level and B_H strictly better off, the generation-B improvement is secured.

This scheme attains efficiency by helping the constrained dynasty circumvent the bequest constraint, shifting the repayment onto its children. Public debt here substitutes for a missing private credit market, the *dynastic* credit market. It thereby parallels Woodford (1990), where public debt also substitutes for missing private credit to the benefit of precisely the constrained households – with the difference that there the constrained hold the debt for its liquidity services, whereas here they receive the proceeds of its issuance.

However, one may reasonably not want the government to create this market. Plausibly, bequest constraints exist because most legal systems do not consider dynasties as legal entities and protect individuals' rights instead, for instance individuals' property rights over their own labor against potential claims from their parents. Taking a more consequentialist ethical standpoint, Becker and Tomes (1986, p. S10) advance the hypothesis that bequest constraints may exist "perhaps because the minority of parents who do not care much about the welfare of their children would raise their own consumption by leaving large debts to children". In both cases, bequest constraints exist for a reason.

Hence, to avoid unintended consequences of the policy scheme, it is important to verify whether the intergenerational Pareto criterion holds for the scheme.

We now argue that the debt scheme discussed might fail the intergenerational Pareto criterion. Debt redemption is uniform across generation C, but its burden settles on C_L alone. While B_H shields C_H via higher bequests, B_L takes advantage of the transfer and lets C_L bear the full redemption $\hat{b}_L^H$, for which C_L receives only the benefit of higher provision, $\xi_L(g^{\mathrm{BM}} - g^*)$, in return. Hence

$$C_L \text{ is worse off} \quad \Longleftrightarrow \quad \xi_L \left(g^{\mathrm{BM}} - g^*\right) < \hat{b}_L^H.$$

That the scheme might be to C_L's disadvantage is illustrated by an example: The cost of freeing B_L – the extraction $\hat{b}_L^H$ that C_L repays – is independent of B_L's political power, whereas the benefit C_L receives runs through the effect on realized provision, $\xi_L(g^{\mathrm{BM}} - g^*)$, which depends on that power directly: the less weight B_L carries, the closer realized provision already sits to the benchmark and the smaller the increment C_L stands to gain. If B_L is sufficiently powerless, the scheme does not make C_L better off.

The golden rule of public finance and a benefit principle in the future. The debt scheme in the last paragraph achieved efficient provision by relaxing B_L's bequest constraint. As we explained, there are normative reasons for wishing not to do so. On top of that, the policy scheme presupposes knowing the size of the bequest $\hat{b}_L^H/R$. For these reasons the last scheme we discuss here acts on the other margin instead: rather than enabling B_L to move resources across periods, it adjusts the cost it must bear for provision. The scheme thereby addresses a trade-off that bequest constraints entail: they protect the children of constrained households against claims from their parents, but, by raising their parents' implicit discount rates, they also lower the provision of the long-lived public goods these children benefit from.

The way to act on this other margin is a golden rule of public finance: debt-finance the entire first-period cost of provision and repay it in the second period, allocating the repayment across generation C along a benefit principle *in the future*.[8]

The effect is to make the trade-off *intra*temporal. With the cost deferred, both the benefit of provision and its financing fall on generation C within the second period, and nothing about g any longer crosses the boundary between periods for the deciding generation B. The bequest constraint binds only across that boundary, so it no longer touches the provision decision. The discount-rate wedge it generates drops out. The logic parallels the green-golden rule of Edenhofer et al. (2025a), where tying admissible debt to the return on abatement makes a present-biased government's abatement decision static. The following proposition formalizes a scheme based on this idea.

Proposition 5 (Efficient provision through a future benefit principle)**.** *Let $a > 0$ and suppose the entire first-period provision cost $\Gamma(g)$ is debt-financed and repaid in the second*

[8] A common criticism of the golden rule of public finance in practice is that the blurry definition of public investment invites "creative accounting" by the government (Milesi-Ferretti, 2004), so that the rule fails to limit debt-financed consumptive expenditure. Edenhofer et al. (2025a) suggest a modified version for the context of climate policy – our application in Section 6 – that addresses this criticism.

period by a tax on generation C levied along the benefit principle. Then every dynasty most prefers the level that maximizes the intratemporal surplus $\xi\, g - R\,\Gamma(g)$, so the realized level is the benchmark, $g^* = g^{\mathrm{BM}}$, whatever the dynasties' discount-rate wedges and political weights.

Proof. Under the scheme, generation B bears no first-period cost, so provision reaches a generation-B household only through its child's second-period consumption. Child j receives the benefit $\xi_j\, g$ and pays the benefit-principle share ξ_j/ξ of the debt service $R\,\Gamma(g)$, a net contribution to its consumption of

$$\xi_j\, g - \frac{\xi_j}{\xi}\, R\,\Gamma(g) = \frac{\xi_j}{\xi}\left(\xi\, g - R\,\Gamma(g)\right),$$

where the term in parentheses is the intratemporal surplus. Since $\xi_j/\xi > 0$ and altruism makes each parent prefer more of its child's consumption to less, every generation-B household most prefers the level that maximizes the intratemporal surplus – the same level for all of them, irrespective of implicit rates or altruism intensities – and so does any political aggregate of their preferences. The first-order condition $\xi - R\,\Gamma'(g) = 0$ is $\Gamma'(g) = \xi/R$, which defines g^{BM}. □

Efficiency is thus attained without observing any discount-rate wedge. When it comes to the distribution of the efficiency gains, the deciding generation B is favored; it is relieved of the first-period cost of provision altogether. The unconstrained dynasty H captures its share of the efficiency gain by adjusting its bequest, leaving C_H weakly better off. So B_L, B_H and C_H all gain weakly, and the scheme is once more a clean generation-B Pareto improvement.

For C_L, the net benefit of the scheme is the extra benefit of higher provision less its benefit-principle share of the efficient cost,

$$\Delta c_{C_L,2} = \xi_L\,(g^{\mathrm{BM}} - g^*) - \frac{\xi_L}{\xi}\, R\,\Gamma(g^{\mathrm{BM}}),$$
$$\Delta c_{C_L,2} \geq 0 \iff g^* \leq g^{\mathrm{BM}} - \frac{\Gamma(g^{\mathrm{BM}})}{\Gamma'(g^{\mathrm{BM}})},$$

the threshold equalling $g^{\mathrm{BM}}/2$ for quadratic costs of public good provision $\Gamma(g)$. The intergenerational improvement is therefore conditional: C_L pays the benefit-principle share of the *entire* efficient cost (while previously, the parent household B_L bore the complete cost of the inefficiently low level of g) but gains only the benefit *increment* over the lower status-quo level, making it better off only if the pre-existing underprovision was large enough. Whether the realized g^* clears the threshold is, once again, a quantitative question.

An appealing feature of the scheme is that the repayment of the debt is determined by the benefit principle: the second-period tax is linked to the benefits households receive and not to the descent from B_L which would violate fundamental norms of non-discrimination against a person's origin. The appeal stems from the fact that if generation C pays for the benefits it enjoys, this may be perceived as legitimate also by C_L households. Consequently, the commitment to such a debt-repayment scheme can be regarded as more

credible. This legitimacy rests, however, on the benefit principle being applicable – on the benefits of provision being attributable to an observable characteristic against which the second-period tax can be levied. Whether this is possible, depends on the application. To summarize, the scheme has advantages both on its informational requirements and – through the future benefit principle – its legitimacy, but it might fail as an intergenerational Pareto improvement.

5 Model Extensions

This section presents extensions of the analytical model that test the mechanisms of Sections 3.1–3.3. Their main role is to show that the effect of bequest-constraints on implicit discount rates and public good provision is not contingent on the main simplifying assumptions of the baseline. Specifically, we relax the restriction of the political process to generation B; the assumption that benefits accrue only to the future young; and the assumption of one-directional altruism. The own-benefit formulation of Section 5.2 is picked up in the calibrated model of Section 6.

5.1 Including Generation A in the Polity

Let generation A also bear part of the cost of g and participate in the political process, as it does under broad-based policies such as carbon or energy taxes, which fall on all living households, not only the working-age generation. Generation A values the benefits of g, which accrue to its grandchild C, through a repeated altruism chain: A cares about B at rate a and B cares about C at rate a. Define A_j's implicit discount rate toward generation C_j as

$$\widetilde{R}_{A_j} := \frac{u'(c_{A_j,1})}{\beta\, a^2\, \mathbb{E}_j\big[u'(c_{C_j,2})\big]},$$

the analogue of B_j's rate $\widetilde{R}_{B_j} := \widetilde{R}_j$ but discounted across two altruistic links rather than one. Using A_j's bequest optimality condition (12), the two rates are related by

$$\widetilde{R}_{A_j} = \widetilde{R}_{B_j}\left(1 + \frac{\mu_{A_j}}{a\, u'(c_{B_j,1})}\right) \;\geq\; \widetilde{R}_{B_j} \;\geq\; R, \tag{26}$$

where the first inequality is strict if and only if A_j's bequest constraint binds ($\mu_{A_j} > 0$) and the second inequality is the baseline wedge from Proposition 1(a). The bequest-constraint wedge thus enters once for each binding link, and the wedges compound multiplicatively. In other words, if both A_j and B_j are bequest-constrained, Equation (26) entails $\widetilde{R}_{A_j} > \widetilde{R}_{B_j} > R$.

The rate $\widetilde{R}_{A_j}$ responds to transfers by the same logic as $\widetilde{R}_{B_j}$. A transfer that raises A_j's first-period resources lowers $u'(c_{A_j,1})$. If A_j's own constraint is binding, this relaxes the constraint and lowers the corresponding wedge in Equation (26), thus lowering $\widetilde{R}_{A_j}$. As in the baseline, a policy intervention becomes ineffective when agents are egoistic. As $a \to 0$, we have $\widetilde{R}_{A_j} \to \infty$, and faster than $\widetilde{R}_{B_j}$ since a enters squared.

Summarizing, including generation A in the polity adds agents whose implicit discount rates are weakly higher than those of their children in generation B (Equation (26)). We do not carry the comparison through to the politically-revealed rate or to realized provision, which would require assumptions about the relative cost shares and about how the political weights aggregate A's and B's preferences.

5.2 Public Investment with Own-Benefits to B

Let generation B enjoy an own-benefit δ times the second-period benefit $\xi_j\, g$ already in $t = 1$, with $\delta > 0$ finite. The own-benefit captures the more immediate returns that a long-term public investment typically yields. For instance, in the climate context, emission abatement avoids some climate damages already in the near term (though the bulk of avoided damages accrues in the distant future) and brings co-benefits such as a reduction in local air pollution.

Specifying the own-benefit as a multiple of the second-period benefit scales every dynasty's benefit by the same factor $1+\delta$ and thus leaves the benefit-principle cost share $\gamma_j = \xi_j/\xi$ unchanged. The own-benefit then adds a term to both generation B_j's preferred-level first-order condition (Appendix F) and to the condition determining the benchmark level of public good provision (Appendix B), which become

$$\Gamma'(g_j^*) = \frac{\xi}{\widetilde{R}_j} + \delta\,\xi, \qquad \Gamma'(g^{\mathrm{BM}}) = \xi/R + \delta\,\xi. \tag{27}$$

The own-benefit enters both first-order conditions identically, so the comparison between g_j^* and g^{BM} still depends solely on the discount rates: since $\widetilde{R}_j \geq R$ (Proposition 1(a)), we have $\Gamma'(g_j^*) \leq \Gamma'(g^{\mathrm{BM}})$, and because Γ' is strictly increasing this gives $g_j^* \leq g^{\mathrm{BM}}$, with equality if and only if $\widetilde{R}_j = R$. The conclusion holds for every δ, irrespective of how $\widetilde{R}_j$ itself responds to it (δ affects resources in $t = 1$ and thus the marginal utility of a constrained parent). Own-benefits leave the underprovision result intact.

The own-benefit does change the amount of g an egoistic agent prefers. As $a \to 0$, the future-benefit term vanishes ($\widetilde{R}_j \to \infty$, so $\xi/\widetilde{R}_j \to 0$), thus reducing the preferred level of g as in the baseline model. Still, because Equation (27) implies $\Gamma'(g^{\mathrm{egoist}}) = \delta\,\xi > 0$, an egoist would prefer a positive amount of g. Intuitively, whereas the intergenerational egoist does not support public good provision in the baseline, an own-benefit gives even the egoist a private stake and, hence, a strictly positive preferred level.

The first-order condition (27) separates provision into two motives: a *future-benefit motive* $\xi/\widetilde{R}_j$ and an *own-benefit motive* $\delta\,\xi$. Transfers act only through $\widetilde{R}_j$, hence, only on the first motive. The second is built from primitives and is rigid. Policy amenability is a property of the future-benefit motive alone. Two consequences follow. First, the egoist's preferred level, while now positive, is still not policy-amenable. Second, the altruist's provision still responds to transfers, but the rigid own-benefit component reduces the share that policy influences: the larger is δ, the smaller the fraction of g_L^* that a transfer can shift.

It does not matter whether B's own-benefit accrues in $t = 1$ or in $t = 2$. If instead B enjoys a benefit $\xi_j^{\mathrm{old}}\, g$ when old, then – as long as its saving is interior – B values it at

$\xi_j^{\text{old}}\, g/R$ in present terms, so setting $\xi_j^{\text{old}} = R\,\delta\,\xi_j$ reproduces Equation (27) exactly. The results depend on the *presence* of an own-benefit, not on its timing.[9]

5.3 Bilateral Altruism

Let the child be altruistic toward its parent with the same intensity a as the parent toward the child, but uncertainly so: at the start of $t = 2$, together with its productivity type, the child turns out to be either altruistic (intensity a, probability q) or egoistic (intensity 0, probability $1 - q$). An altruistic child may then make a voluntary transfer $\tau_{C_j} \geq 0$ to its parent, a form of eldercare. In the absence of bequest b and child transfer τ, denote parental resources as m and child resources as e. Start with the case where the child is altruistic with certainty, $q = 1$. In any second-period state at most one transfer flows: the parent bequeaths when it is relatively rich ($u'(m) < a\,u'(e)$); an altruistic child transfers when the parent is relatively poor ($u'(e) < a\,u'(m)$); in between, neither does ($u'(e)/a > u'(m) > a\,u'(e)$), a *zone of inaction* that is non-empty whenever $a < 1$.[10]

Note that, for imperfect altruism $a < 1$, a positive transfer from child to parent means that the parent's bequest constraint *is* binding. Because for $a \in (0, 1)$,

$$u'(c_{C_j,2}) = a\,u'(c_{B_j,2}) \quad \Longleftrightarrow \quad u'(c_{B_j,2}) = u'(c_{C_j,2})/a > a\,u'(c_{C_j,2}),$$

the parent's bequest-constraint multiplier is positive,

$$\mu_{B_j} = u'(c_{B_j,2}) - a\,u'(c_{C_j,2}) = (1 - a^2)u'(c_{B_j,2}) > 0.$$

Nevertheless, the child's transfer imposes a cap on B's multiplier μ_{B_j} in states where the child is sufficiently better off. If such states occur with positive probability, the parent, counting on its child there, saves less for retirement, which weakly raises μ_{B_j} in all other states. The net effect on the implicit discount rate (Equation (17)) compared to the case without reciprocity is unclear. What is clear is that introducing imperfect bilateral altruism does not eliminate binding bequest constraints for parents who are constrained in the baseline: the discount-rate wedge vanishes only if the parent leaves a bequest in every state, as without reciprocity. Hence, as soon as a parent with positive political weight is bequest-constrained in a state that occurs with positive probability, public good provision is inefficiently low.

A positive probability of the child being egoistic ($q < 1$) adds states in which the parent's bequest-constraint multiplier μ_{B_j} is not capped. This can keep the parent's rate above R even for perfect altruism $a = 1$. In summary, bilateral altruism leaves the underprovision result intact for any $a\,q < 1$: the channel closes only at perfect symmetric altruism ($a = 1$ and $q = 1$), where transfers equalize intergenerational consumption in every future state of the world and $\widetilde{R}_j = R$.

[9] If the own-benefit were large enough to drive saving to the corner $s_{B_j,1} = 0$, the inability to borrow against one's own future public-good benefit would add a second borrowing-constraint channel, pushing implicit rates up further. We regard this case as empirically marginal.

[10] The analogous regime – bilateral altruism but no transfers due to binding constraints for parents and children – arises for a non-empty subspace of the parameter space in the bilateral-altruism economy of Altig and Davis (1993).

6 A Calibrated Model

In this section, we extend the two-agent model from the previous section to encompass five income quintiles[11] and calibrate it to the United States. Our application is climate policy: we interpret g as the reduction in emissions induced by a carbon price, and $\Gamma_j(g)$ as the monetized cost climate policy imposes on household B_j – the cost of the behavioral adjustments the carbon price induces. We assume that the revenue of the carbon price is recycled through lump-sum transfers equal to the average payment of the households in the same quintile. Because each household is atomistic, it takes its transfer as given and the price signal is preserved, while in equilibrium the transfer equals the amount the household has paid, so that the payments themselves cancel from the budget. Realized emission abatement g^* and the carbon price p^* are related through $p^* = \Gamma'(g^*)$. Because we assume quadratic cost (see Section 6.1), carbon price and emission abatement are proportional. Moreover, any shortfall in the price as compared to the benchmark price is equal to the shortfall in emission abatement as compared to its benchmark counterpart (see Equation (30)).

We adopt the own-benefit extension of Section 5.2: emission abatement avoids a portion of climate damages already in the near term, so a share of the benefit accrues in $t = 1$ to generation B itself, at an intensity δ that we calibrate to the US age structure. Furthermore, we maintain Assumption 1, that is, we abstract from the insurance motive and impose the benefit principle. We also maintain the small open economy of the analytical model, although the United States is a large economy. Households take the market rate as given in a closed economy as well, and we assume that the government does, too. Based on these assumptions, we compute quintile-level implicit discount rates and the corresponding carbon price for different distributions of political power. We further discuss, in partial equilibrium, the constraint-relaxing debt policy from Section 4.[12] The effects of relaxing Assumption 1 and of an endogenous interest rate are discussed in Section 7.

6.1 Five Income Quintiles

Our model structure makes it straightforward to extend the analysis from two to five dynasties – one per income quintile, each again a continuum of households of unit mass. The assumption of a small open economy ensures that the dynasties included in the model interact only in the political sphere. Hence, up to that point the generalization is

[11] We form the quintiles from the distribution of earnings among working-age households (Appendix J). A household's lifetime resources, the sum of its earnings and the bequest it receives, increase from one earnings quintile to the next, so the quintiles order the households by lifetime income as well. We refer to them as income quintiles throughout.

[12] We do not verify the quantitative effects of the intratemporal transfer scheme presented in Section 4, because our calibration does not allow us to. In contrast to the assumption underlying that section, namely that household B_H is unconstrained in all states, every income quintile is constrained for some realization of the income process in our calibration. To analyze a situation with a household that is never constrained, we would have to further split up the top income quintile, which our current calibration does not allow.

straightforward.

In the political sphere, the government's objective function (14) is extended to the weighted sum of the indirect utilities $U^*_{B_j}$ of the five income quintiles, $j \in \{1, \ldots, 5\}$, with non-negative political power weights ω_j that sum to one.

Future consumption share. To ease the calibration of the two-period model, we assume that generation C consumes a constant fraction $0 < \phi < 1$ out of its disposable income $Y^i_{C_j,2} = w^i_{C,2} + b^i_{B_j,2} + \xi^i_j\, g$, thus emulating the positive savings-for-retirement and bequests a multi-period model would include. We set ϕ equal to the fraction of its resources that a forward-looking generation C consumes in the first period of its own life. Solving C's saving-bequest problem under log utility, with C valuing its own child by the same altruism a and discount β as generation B, and with zero earnings of that child, gives

$$\phi = \frac{1 - \beta a}{1 + \beta}.$$

As a robustness check, we also report the other polar case, in which the earnings of C's child are large relative to C's resources, so that C leaves no bequest and consumes the two-period life-cycle share $\phi = 1/(1+\beta)$ (Section 6.4). This is also the share of an egoist ($a = 0$). Appendix K derives both shares from C's saving-bequest problem.

Future benefit. The benefit in $t = 2$ is the avoided climate damage, which accrues to generation C. It is assumed to scale with the child's *realized income* through a constant income elasticity ε_b. Generation C's income in state i of dynasty j is its own earnings plus the bequest it inherits, evaluated in absence of climate policy, $g = 0$,[13]

$$Y^i_{j,0} := w^i_{C,2} + b^i_{j,0}, \qquad \xi^i_j = \xi\, N_b \left(Y^i_{j,0}\right)^{\varepsilon_b}, \qquad N_b := \frac{1}{\sum_{k,l} P_{kl} \left(Y^l_{k,0}\right)^{\varepsilon_b}}, \tag{28}$$

where $b^i_{j,0}$ is the bequest dynasty j leaves to a child who draws earnings state i, evaluated at $g = 0$, and N_b is a fixed constant. The dynasties' expected marginal benefits $\mathbb{E}_j[\xi_j]$ sum up to the aggregate marginal benefit ξ.

In order to maintain Assumption 1(ii), we impose that each dynasty's benefit is state-independent and equal to its expectation, $\xi^i_j := \mathbb{E}_j[\xi_j]$ for all i. This preserves the dynasty-level benefit distribution and the aggregate ξ, but sets $\mathrm{Cov}_j = 0$, so the insurance factor is $\chi_j = 1$.

Cost. The cost of climate policy falls on household B_j in the proportion $\Gamma_j(g) = \gamma_j\, \Gamma(g)$, where $\gamma_j \in (0, 1)$ with $\sum_j \gamma_j = 1$ is the cost *share* of Section 2.2. We maintain Assumption 1(i): the cost follows the benefit principle, $\gamma_j := \mathbb{E}_j[\xi_j]/\xi$, so the dynastic benefit-cost factor is $\mathrm{BC}_j = 1$.

[13] At $g = 0$, the benefit term $\xi\, g$ vanishes, so the income base – subsequently used to compute marginal benefits ξ^i_j – excludes the benefit itself. This prevents circularity. In our baseline calibration, the effect of g on resources is small: the average cost of benchmark provision amounts to 0.18% of the first-period resources of the poorest quintile (Section 6.4).

Own-benefit. The calibrated baseline adopts the own-benefit extension of Section 5.2: generation B enjoys a benefit $\delta\,\mathbb{E}_j[\xi_j]\,g$ already in $t=1$, entering its first-period budget as a monetary resource alongside the cost $\gamma_j\,\Gamma(g)$. Setting it equal to δ times its expected future benefits $\mathbb{E}_j[\xi_j]$ preserves the benefit principle.

Preferred level and price. The first-period carbon price is the marginal abatement cost at the chosen provision level, $p^* = \Gamma'(g^*)$. The benchmark price is $p^{\mathrm{BM}} = \delta\,\xi + \xi/R$ – the undiscounted aggregate own marginal benefit plus the market-discounted future marginal benefit from Equation (27). Augmenting the three-factor decomposition (19) by the own-benefit term of Section 5.2 and maintaining Assumption 1, that is, $\mathrm{BC}_j = \mathrm{BC}_j^{\mathrm{own}} = \chi_j = 1$, the preferred level and price of quintile j satisfy

$$\Gamma'(g_j^*) = \delta\,\xi \;+\; \frac{\xi}{\widetilde{R}_j}, \tag{29}$$

$$\frac{p_j^*}{p^{\mathrm{BM}}} = \frac{g_j^*}{g^{\mathrm{BM}}} = \varpi + (1-\varpi)\,\frac{R}{\widetilde{R}_j}\,, \qquad \varpi := \frac{\delta}{\delta + 1/R} = \frac{\delta R}{1+\delta R}. \tag{30}$$

Appendix F derives the first line from quintile j's marginal welfare gain of provision. To obtain the second line from the first one, use $\Gamma'(g_j^*) = p_j^*$ and divide both sides of the equation by $p^{\mathrm{BM}} = \delta\,\xi + \xi/R$. Relative to the benchmark, the preferred price is a convex combination of the own-benefit ratio, which equals one because bequest constraints do not affect it, and the discount-rate factor $R/\widetilde{R}_j$; the weight ϖ on the former is generation B's share of the present value of the aggregate marginal benefit. The deviation of p_j^* from p^{BM} is equal to the deviation of the preferred emission abatement g_j^* from its benchmark counterpart because costs are assumed to be quadratic, implying linear marginal cost. At $\delta = 0$, $\varpi = 0$ and the discount-rate factor $R/\widetilde{R}_j$ fully explains the shortfall.

Appendix J describes the calibration in detail and reports the quintile-level earnings and bequest figures as well as the intergenerational transition matrix; Table 1 shows the resulting parameter values. We solve the model numerically using Python. Generation B's first-period saving is found by minimizing its first-order condition over a grid of 1,000 points spanning its first-period resources, and the preferred and realized provision levels over a grid in g with 100 equidistant points between 0 and the benchmark level g^{BM}, extended above g^{BM} at the same spacing within the feasible domain $[0, \bar{g}]$ (Section 2.1).

Table 1: Calibrated parameter values. Panel A lists the parameters set from data, from the literature, or by assumption; Panel B the values derived from them. All monetary values are in 2022 US dollars.

Symbol	Description	Value	Source / definition
Panel A: calibrated and assigned			
n	Length of one period (years)	30	Assumption
η	CRRA parameter	1	Assumption
$R_y - 1$	Real interest rate, yearly	2.84%	World Bank (US), 20-year average starting 2000 (World Bank, 2025)
$G_y - 1$	GDP growth rate, yearly	2.08%	World Bank (US), 20-year average starting 2000 (World Bank, 2025)
a	Dynastic altruism	0.38	Calibrated to a 30% lifetime transfer-receipt share (Wolff and Gittleman, 2014)
ε_c	Income elasticity of the policy cost	0.35	Pottier (2022)
ε_b	Income elasticity of climate damages	0.70	Gilli et al. (2024)
ϖ	Own-benefit weight, generation B's share of the benefit's present value	0.2410	US age structure 30–59, NCHS 2023 life tables (Arias et al., 2025), Census 2025 (U.S. Census Bureau, 2026)
s_{US}	US share of the global social cost of carbon (SCC)	0.12	Mean of four integrated assessment models in Nordhaus (2017)
SCC^{glob}	Global SCC ($/tCO$_2$)	140	United States Environmental Protection Agency (2023), 2.5% discount rate, emission year 2022
SCC^{dom}	Domestic SCC = benchmark price p^{BM} ($/tCO$_2$)	16.8	$s_{\text{US}} \cdot \text{SCC}^{\text{glob}} = 0.12 \times 140$
κ	Scale parameter of the cost function $\Gamma(g) = \kappa g^2$ ($/tCO$_2^2$)	0.0174	Calibrated to match the EMF 32 emission reduction share from Barron et al. (2018)
Panel B: derived			
R	Period gross interest rate	2.32	$(R_y)^n$
G	Period gross growth factor	1.86	$(G_y)^n$
β	Discount factor	0.80	G/R (balanced growth)
ϕ	Consumption share of generation C	0.39	$(1 - \beta a)/(1 + \beta)$
δ	Own-benefit intensity	0.14	$\varpi/[(1 - \varpi)R]$
ξ	Marginal benefit of g ($/tCO$_2$)	29.6	$\text{SCC}^{\text{dom}} \cdot R/(1 + \delta R)$

6.2 Political Process

The politically-revealed discount rate $\widetilde{R}_{\text{pol}}$, the realized level of climate policy g^* and the carbon price p^* depend on how the political process aggregates the preferences of the five income quintiles. We consider four scenarios: One-Person-One-Vote, Median-Voter, One-Dollar-One-Vote, and Utilitarian. All but the Utilitarian one aggregate the quintiles'

preferred prices to a weighted average

$$p^* = \sum_{j=1}^{5} \nu_j \, p_j^*, \qquad \nu_j \geq 0, \quad \textstyle\sum_j \nu_j = 1, \tag{31}$$

where ν_j is set directly and represents the influence quintile j carries over the outcome. Because $p_j^* = \Gamma'(g_j^*) = \delta\,\xi + \xi/\widetilde{R}_j$ by Equation (29), these same weights continue to determine the politically-revealed rate $\widetilde{R}_{\text{pol}}$:

$$p^* = \sum_{j=1}^{5} \nu_j \left(\delta\,\xi + \frac{\xi}{\widetilde{R}_j} \right) = \delta\,\xi + \xi \underbrace{\sum_{j=1}^{5} \frac{\nu_j}{\widetilde{R}_j}}_{1/\widetilde{R}_{\text{pol}}},$$

where each $\widetilde{R}_j$ is evaluated at quintile j's preferred level g_j^*.

Equal weights $\nu_j = 1/5$ for all j give the *One-Person-One-Vote* scenario, a proxy for a representative democracy. The realized price is the unweighted average of the preferred prices p_j^*, $j \in \{1, \ldots, 5\}$. Placing all influence on the quintile with the median preferred price, $\nu_{\text{med}} = 1$ and $\nu_j = 0$ otherwise, gives the *Median-Voter* scenario. Choosing weights that are proportional to first-period resources

$$\nu_j = Y_{B_j,1} / \sum_k Y_{B_k,1}, \qquad Y_{B_j,1} := w_{B_j,1} + b_{A_j,1},$$

gives the *One-Dollar-One-Vote* scenario, which puts more weight on the higher income quintiles, capturing a higher influence of the rich through lobbying.

Finally, the *Utilitarian* scenario fixes equal political power weights $\omega_j = 1/5$ in the government's objective $W = \sum_j \omega_j \, U_{B_j}^*$ instead of the weights ν_j and lets the realized level solve the first-order condition (50). The government then effectively maximizes a utilitarian welfare function over generation B dynasties where cost and benefits in consumption equivalents are weighted by the marginal utility of the household receiving them.

We report the figures from the One-Person-One-Vote scenario as our main results. There are two reasons for this. First, it is one of the three scenarios in which the politically-revealed rate is, as in Section 3, an aggregate to which every quintile's implicit discount rate contributes, whereas in the Median-Voter scenario it is the rate of a single quintile. Second, among these three scenarios, it is the middle result. The Median-Voter scenario is the standard representation for majoritarian voting systems like the US one. However, the modeled polity is not the whole US electorate but only generation B, aged 30–59, whose median has no counterpart in US elections. Moreover, the two results are very similar to each other: the premium over the market rate is 1.54 percentage points per year under One-Person-One-Vote and 1.35 under the Median Voter, against a market rate of 2.84% per year (Table 3).

6.3 Results

We now present the results for the quintile-level implicit discount rates and the corresponding carbon price for different distributions of political power. Moreover, we explore

how public debt can be used to relax bequest constraints and lead to higher levels of emission abatement along the lines of Section 4.

Quintile level. Table 2 displays the annualized implicit discount rate $\widetilde{r}_{j,y} = \widetilde{R}_j^{1/n} - 1$, the premium over the yearly market rate $r_y := R_y - 1 = 2.84\%$, the preferred price in \$/tCO$_2$ as well as in percent below its benchmark $p^{\text{BM}} = 16.8$ \$/tCO$_2$ (equal to the domestic SCC), and the probability that the bequest constraint binds for the respective parent household. Because the table reports yearly rates, the relationship between the preferred price p_j^* and the implicit discount rate displayed in the table follows through Equation (30), with $R/\widetilde{R}_j = \big((1+r_y)/(1+\widetilde{r}_{j,y})\big)^n$.

The implicit discount rate $\widetilde{r}_{j,y}$ is monotonically decreasing in income. While the highest income quintile only mildly departs from the market rate (its bequest constraint binds if its children end up in Q5, too, which happens with a probability of more than one third), the lowest income quintile has a bequest-constraint premium of 3.53 percentage points, making its rate more than twice the market rate (its bequest constraint is binding in all future states of the world). Interestingly, Q4's implicit discount rate is lower than Q3's despite the fact that Q4's bequest constraint binds with higher probability. This is explained by two facts: first, for both Q3 and Q4, the cut-off earnings of their children that makes their constraint bind is between future earnings quintile Q2 and Q3. In other words, Q3 and Q4 parents only leave a positive bequest to children with earnings in Q1 or Q2. Because children of Q4 parents have a more than 8 percentage points higher probability of ending up in earnings quintile Q3–Q5, their bequest constraint binds with higher probability. Second, the implicit discount rate does not only reflect whether bequest constraints bind but also how strongly they bind, that is, how large the expected Lagrange multiplier μ_{B_j} in Equation (17) is. The fact that bequest constraints bind less strongly for parents in Q4 overcompensates the fact that they face binding constraints with a higher probability, resulting in a lower implicit discount rate, compared to Q3.

The pattern observed for the implicit discount rate is mirrored in the preferred prices: binding bequest constraints lead to households from Q1 preferring a carbon price almost 50% below the benchmark price. For Q4, the preferred price is still 20% below the benchmark.

Table 2: Implicit discount rate per year, its premium over the market rate, preferred carbon price, its shortfall from the benchmark price, and probability that the bequest constraint binds, by income quintile under Assumption 1, evaluated at $g = g^{\mathrm{BM}}$. Rates are compounded annually, $\widetilde{r}_{j,y} = \widetilde{R}_j^{1/n} - 1$; the market rate is 2.84% per year and the benchmark price is $p^{\mathrm{BM}} = 16.8$ \$/tCO$_2$. pp: percentage points.

	Income quintile				
	1	2	3	4	5
$\widetilde{r}_{j,y}$ (% per year)	6.38	5.10	4.19	3.93	3.18
$\widetilde{r}_{j,y} - r_y$ (pp per year)	3.53	2.26	1.35	1.08	0.33
p_j^* (\$/tCO$_2$)	8.7	10.7	12.7	13.4	15.6
% below p^{BM}	48.3	36.3	24.5	20.5	7.0
Probability that the constraint binds	1.00	0.80	0.61	0.70	0.36

Q1 is a case in point for the "equivalence and breakdown" result of Proposition 2. Because its bequest constraint is always binding, its private behavior – saving, consumption and bequest – is the same as that of an intergenerationally egoistic agent with $a = 0$ and the same resources. Their preferred carbon prices differ, however. The egoistic agent prefers a carbon price of $\varpi = 0.24$ times the benchmark (the limit of Equation (30) with $\widetilde{R}_j \to \infty$), because of the benefits accruing during its own lifetime. Q1, in contrast, prefers a carbon price that is 52% of the benchmark price, more than twice the level of the egoist. The bequest constraint shuts down Q1's private transfer to its child, but leaves its altruistic valuation of the child's consumption intact. The equivalence between the two agents thus breaks down in the political sphere.

Overall, the effect of high implicit discount rates, driven by binding bequest constraints, has a sizable impact on preferred carbon prices *despite* households being dynastically altruistic. Through the political process, this translates into realized carbon prices that fall short of the benchmark level.

Aggregate level. Table 3 shows the following variables for the four polity scenarios described in Section 6.2: the annualized politically-revealed rate $\widetilde{r}_{\mathrm{pol},y}$, its premium over the market rate $\widetilde{r}_{\mathrm{pol},y} - r_y$, which approximates the annualized bequest-constraint premium of the augmented Ramsey rule in Proposition 3, $\Pi/n = \ln\big[(1+\widetilde{r}_{\mathrm{pol},y})/(1+r_y)\big]$, the realized carbon price p^* and its shortfall compared to the benchmark price p^{BM}.

Table 3: Politically-revealed discount rate per year, bequest-constraint premium, realized carbon price, and its shortfall from the benchmark price, by scenario under Assumption 1. Rates are compounded annually, $\widetilde{r}_{\text{pol},y} = \widetilde{R}_{\text{pol}}^{1/n} - 1$; the market rate is 2.84% per year and the benchmark price is $p^{\text{BM}} = 16.8$ \$/tCO$_2$. pp: percentage points.

	One-Person-One-Vote	Median Voter	Utilitarian	One-Dollar-One-Vote
$\widetilde{r}_{\text{pol},y}$ (% per year)	4.38	4.19	5.13	3.60
$\widetilde{r}_{\text{pol},y} - r_y$ (pp per year)	1.54	1.35	2.28	0.75
p^* (\$/tCO$_2$)	12.2	12.7	10.7	14.3
% below p^{BM}	27.3	24.5	36.6	14.9

In the One-Person-One-Vote scenario the realized price is the average preferred price of the households. This does not hold for the politically-revealed rate, because $1/\widetilde{R}_{\text{pol}} = \sum_j (1/5)/\widetilde{R}_j$ is the harmonic mean of the implicit discount rates. The politically-revealed rate is 4.38% per year against a market rate of 2.84%. The premium of 1.54 percentage points is thus more than half the market rate, and the realized carbon price falls short of the benchmark price by more than one quarter.

In our calibration, Q3 is the median voter. Its implicit discount rate is slightly below and, consequently, its preferred carbon price above the number from the One-Person-One-Vote scenario.

The Utilitarian scenario shows that the premium is largest under the aggregation a utilitarian planner would enact. This is explained by the larger weight such a planner attributes to the lowest income quintiles. Finally, the One-Dollar-One-Vote scenario gives the lowest politically-revealed rate and the highest realized carbon price because it gives the highest weight to Q5, the household whose bequest constraint binds less severely.

A shortfall of roughly 27% below the benchmark level begs for a remedy. In Appendix L we show that the public debt scheme described in Section 4, where debt-financed transfers alleviate bequest constraints, would necessitate such large debt volumes that they are practically infeasible. These volumes are partial-equilibrium figures: they abstract from the effect that debt of this size would have on the interest rate of an economy such as the United States (see Section 7). Freeing all households from their bequest constraints in all states of the world – necessary to attain efficient provision in the main scenario – would require almost 10 trillion USD of deficit *per year*, more than one third of 2022 US GDP. Note that a part of the deficit-financed transfers would be saved and left as bequest for the time of redemption by those households freed from their bequest constraint. Still, the volume of the deficit involved is prohibitively high. For comparison, the total cost of benchmark emission abatement $\Gamma(g^{\text{BM}})$, scaled to the US economy, amounts to 107 billion USD over the 30 years of the period, roughly 3.6 billion USD per year and three orders of magnitude smaller. At the upper-anchor SCC we use as a robustness check, 10.2 times our baseline figure, this cost rises by a factor of about 104 (see Section 6.4), to roughly 370 billion USD per year. If the higher SCC raises the necessary debt volume by much less than the cost of abatement, freeing half of the households from the constraint,

which at our baseline calibration requires only one tenth of the volume needed to free all households and closes more than half of the gap between realized and benchmark carbon price (Appendix L), might be a policy option, after all. Durable reforms of the income tax could also affect implicit discount rates; exploring them is beyond the scope of this article.

6.4 Robustness

We perform robustness checks on the following five calibration inputs: generation B's dynastic altruism a, its first-period resources, the own-benefit intensity δ, generation C's consumption share ϕ, as well as the global SCC. Table 4 reports implicit discount rates at the quintile level as well as the One-Person-One-Vote scenario's outcome for each check next to our main results; Appendix M reports them in detail.

Table 4: Implicit discount rate per year $\widetilde{r}_{j,y}$ by income quintile, evaluated at $g = g^{\mathrm{BM}}$, and politically-revealed rate per year $\widetilde{r}_{\mathrm{pol},y}$ and realized carbon price p^* in the One-Person-One-Vote scenario, for the main calibration and each robustness check, under Assumption 1. Rates are in % per year, compounded annually, and prices in \$/tCO$_2$. The market rate is 2.84% per year; the benchmark price is $p^{\mathrm{BM}} = 16.8$ \$/tCO$_2$, except in the global SCC check, which uses the SCC of Bilal and Känzig (2026).

	$\widetilde{r}_{j,y}$ by income quintile					One-Person-One-Vote	
Robustness check	1	2	3	4	5	$\widetilde{r}_{\mathrm{pol},y}$	p^*
Main calibration	6.38	5.10	4.19	3.93	3.18	4.38	12.2
Dynastic altruism a							
low	7.86	6.01	5.17	4.76	3.54	5.19	10.5
high	5.24	4.34	3.62	3.47	2.87	3.81	13.7
First-period resources	5.78	5.61	4.79	4.48	3.31	4.67	11.6
Own-benefit intensity δ	6.37	5.10	4.19	3.92	3.18	4.38	13.5
Consumption share ϕ	7.67	5.91	5.06	4.66	3.50	5.09	10.7
Global SCC	7.29	5.41	4.42	4.11	3.21	4.54	121.3

Dynastic altruism a. In our baseline model, we calibrate $a = 0.38$ to match the share of US households receiving a bequest over their lifetime of 30%, reported by Wolff and Gittleman (2014) (see Appendix J). As we discuss in Section 7, there are good reasons to believe that this might lead to a being either over- or underestimated.

Because the model population of children consists of 25 types, by the parent's quintile and the child's earnings state, the share of households receiving a bequest is a step function of dynastic altruism a. For the robustness check, we use $a = 0.28$ and $a = 0.47$, the lowest

and the highest value on the two neighboring steps of that function, which give bequest shares of 26.6% and 34.8%, against 30.6% in the baseline (Appendix J).

The results of the robustness check are in line with expectations: a lower value of dynastic altruism leads to bequest constraints binding more often and more severely, higher implicit discount rates and lower realized carbon prices through the polity; the opposite is the case for the higher value of a. The lower (higher) value for altruism changes the politically-revealed rate in the main scenario by $+0.81$ (-0.57) percentage points per year, raising the shortfall of the realized carbon price from the benchmark by 10.0 (lowering it by 8.7) percentage points. Even in the high-altruism calibration, the shortfall below the benchmark price is more than 18% and thus quantitatively relevant.

First-period resources. In this robustness check, we deviate from our baseline specification and use income instead of earnings from the same data source and identify it with $w_{B_j,1}$, leading to higher first-period resources throughout (see Table 5 in Appendix J). We do this for two reasons: first, the intergenerational mobility matrix from Jäntti (2006) is a parent-income to children-earnings transition table. Second, our baseline measure for earnings excludes transfers, including Social Security, which are particularly relevant for low-income households. In our model, they have the highest implicit discount rates, caused by their low first-period resources, and contribute strongly to the shortfall.

Because simply substituting income for earnings in the calibration of $w_{B_j,1}$ leads to a bequest share of 42.8% in the model, a sizable excess over the calibration target for a, we additionally recalibrate dynastic altruism in this step, bringing it down from 0.38 to 0.30 with a corresponding bequest share of 26.6% (Appendix J). The consequences of these two movements have opposing signs: while higher first-period resources ease bequest constraints, lower intergenerational altruism makes them bind more frequently and more strictly.

Combined, these two changes lead to a net decrease in Q1's implicit discount rate. In the lowest quintile, mean yearly income exceeds the mean yearly earnings of the lowest earnings quintile by 84%, against at most 25% in the other quintiles. For Q2–Q5, the simultaneous reduction in a overcompensates the increase in first-period resources. For all of them, the implicit discount rates are higher than in the baseline. In this specification, implicit discount rates are still monotonically decreasing in income, but the range is compressed and Q1 much closer to Q2 than in the baseline. Through the polity, the politically-revealed rate in the main scenario rises by $+0.29$ percentage points per year, and the shortfall of the realized carbon price from the benchmark rises by 3.9 percentage points compared to the baseline earnings specification, taking it from 27.3% to 31.2% below the benchmark price. Thus, calibrating first-period resources based on income *increases* the aggregate shortfall, once the level of altruism is adjusted to reflect observed bequest shares.

The own-benefit intensity δ. In our baseline calibration, the own-benefit intensity δ is calibrated to reflect the own-benefits of generation B, i.e., we restrict our computations to the share of lifetime benefits accruing to people aged 30–59 in $t = 1$. In this robustness

check, we investigate the effect of calibrating δ to include the benefits that all current voters (aged 18 and above) will experience over their lifetime. The share of own-benefits in total benefits ϖ increases from 0.2410 to 0.4543. This more than doubles δ's value, taking it from 0.137 to 0.359.

A higher share of own-benefits means that the distortion stemming from the binding bequest constraints acts less strongly on the preferred carbon price. The effects on the implicit discount rates are near nil and the politically-revealed rate does not move; the small changes stem from the higher first-period resources due to the higher own-benefits and the child's lower resources due to the lower future benefits. In the main scenario, the shortfall of the realized price falls from 27.3% to 19.6% of the benchmark price, that is, by 7.7 percentage points. Still, the shortfall of almost 20% below the benchmark remains sizable.

Generation C's consumption share ϕ. In the two-period model, the consumption share ϕ of generation C emulates the saving and bequest decisions of a multi-period model (Section 6.1). In our baseline specification, we set $\phi = (1 - \beta a)/(1 + \beta) = 0.39$ (Section 6.1). In this robustness check, we set $\phi = 1/(1 + \beta) = 0.56$, the share that an altruist would choose whose bequest constraint always binds, for instance because the earnings of its child are large (Appendix K). It is also the share of an egoist ($a = 0$). The effect is an increase in consumption by generation C, which lowers its marginal utility and thus generation B's willingness to forgo consumption for its child, raising the implicit discount rates. In line with expectations, the politically-revealed rate in the main scenario rises by 0.71 percentage points per year, and the shortfall in the realized carbon price by 8.9 percentage points. With regard to generation C's consumption share, our baseline calibration is thus conservative.

The global SCC. Finally, we recompute our results for the global SCC figure from Bilal and Känzig (2026), an upper anchor from the literature, which implies a domestic SCC of 172 \$/tCO_2. It is 10.2 times the figure used in our baseline. For quadratic abatement cost, this means that the average cost per household at the benchmark roughly increases by a factor of 104.[14] The average cost per household of the benchmark policy, 816 USD at our baseline calibration (see Appendix J), corresponds to 0.18% of Q1's first-period resources; at the higher SCC, it rises to about 85,000 USD, or 18% of these resources. Benefits $\xi\, g^{\mathrm{BM}}$ rise by the same factor, because both ξ and g^{BM} are proportional to p^{BM}.

Consequently, the implicit discount rates rise, most strongly so for Q1, those households for which benefits and costs make up the largest share in household resources. Nevertheless, in the main scenario the politically-revealed rate rises by only 0.16 percentage points per year and the shortfall by 2.2 percentage points – relatively mild given the more than tenfold increase in the SCC. In absolute terms, the shortfall scales with the benchmark price.

[14] To see this, note that the relation between benchmark abatement and carbon price is given by $\Gamma'(g^{\mathrm{BM}}) = p^{\mathrm{BM}}$ and thus $g^{\mathrm{BM}} = p^{\mathrm{BM}}/(2\kappa)$. Because household-specific cost of abatement is quadratic in g^{BM}, it is quadratic in $p^{\mathrm{BM}} = s_{\mathrm{US}}\, \mathrm{SCC}^{\mathrm{glob}}$ as well.

In summary, our baseline results are not affected qualitatively: the shortfall of the realized carbon price remains sizable in all checks; its size depends on these inputs in predictable ways.

7 Discussion

We now discuss four features of the model and how they influence the results. First, we turn to Assumption 1: the benefit principle and the absence of the insurance channel. Second, we discuss the assumption of positive dynastic altruism the model relies on, third, the assumption of an exogenous market rate, and fourth, the assumption of exogenous transition probabilities.

Income-dependent incidence of benefits and costs. In Section 3.2, we derived that the level of public good provision g_j^* preferred by household B_j deviates from the benchmark level due to three factors: a discount-rate factor, a benefit-cost factor, and an insurance factor. For the rest of the analysis, we imposed Assumption 1 to focus on the discount-rate factor only. When relaxing the assumption, all results on the household-level implicit discount rates, including how they are affected by transfers, are unchanged. However, when transfers and public debt affect marginal utilities of generation C, they affect the insurance factor, too, and results on preferred levels of g are affected. For instance, an intragenerational transfer to a parent whose bequest constraint binds only in the child's favorable states raises the child's consumption in the unfavorable states through the parent's bequest and thereby moves χ_j toward one, reducing its distortive effect. Public debt, by contrast, can move the insurance factor away from one: for a household constrained in every state, the debt service lowers the child's consumption by the same amount in every state, which raises marginal utility most in the child's unfavorable states.[15] Most importantly, public debt alone is in general insufficient to

[15]To understand the two results, note that, using $u' \equiv u'(c_{C_j,2})$

$$\chi_j = 1 + \frac{\mathrm{Cov}_j(\xi_j, u'(c_{C_j,2}))}{\mathbb{E}_j[\xi_j]\,\mathbb{E}_j[u'(c_{C_j,2})]} = \frac{\mathbb{E}_j[\xi_j u']}{\mathbb{E}_j[\xi_j]\mathbb{E}_j[u']} = \frac{P_{jL}\xi_j^L x + P_{jH}\xi_j^H}{\mathbb{E}_j[\xi_j](P_{jL}x + P_{jH})},$$

where $x := u'(c_{C_j,2}^L)/u'(c_{C_j,2}^H)$. Using the quotient rule, we obtain $\partial\chi_j/\partial x \propto P_{jL}P_{jH}(\xi_j^L - \xi_j^H)$. This term is negative if $\mathrm{Cov}_j(\xi_j, u'(c_{C_j,2})) < 0$ as in the climate policy application: since $u'(c_{C_j,2}^H) < u'(c_{C_j,2}^L)$, the covariance $\mathrm{Cov}_j(\xi_j, u'(c_{C_j,2})) = P_{jL}P_{jH}(\xi_j^H - \xi_j^L)\big(u'(c_{C_j,2}^H) - u'(c_{C_j,2}^L)\big)$ is negative only if $\xi_j^H > \xi_j^L$.

The opposite holds for $\mathrm{Cov}_j(\xi_j, u'(c_{C_j,2})) > 0$: in that case $\partial\chi_j/\partial x \propto P_{jL}P_{jH}(\xi_j^L - \xi_j^H) > 0$. Finally, for any $\eta > 0$ it holds, for the intragenerational transfer, which raises the parent's bequest in the unfavorable state, that

$$x = \left(\frac{c_{C_j,2}^H}{c_{C_j,2}^L}\right)^\eta = \left(\frac{w_{C,2}^H + \xi_j^H g}{w_{C,2}^L + \xi_j^L g + b_{B_j,2}^L}\right)^\eta \quad \Longrightarrow \quad \frac{\partial x}{\partial T_1} < 0, \qquad \text{since } \frac{\partial b_{B_j,2}^L}{\partial T_1} > 0,$$

and, because $c_{C_j,2}^H > c_{C_j,2}^L$, that

$$x = \left(\frac{w_{C,2}^H + \xi_j^H g - RT_1}{w_{C,2}^L + \xi_j^L g - RT_1}\right)^\eta \quad \Longrightarrow \quad \frac{\partial x}{\partial T_1} > 0,$$

attain the benchmark. The instruments of Appendix B suffice: dynasty- and state-specific transfers in $t = 2$, committed to in the first period, insure the idiosyncratic risk, and dynasty-specific transfers in $t = 1$ separate the distributional conflict from the provision of the public good.

In Appendix N, we relax Assumption 1 for our calibrated model and compute the three factors and the preferred carbon price on the quintile level. Using the quintile average as a proxy for the One-Person-One-Vote scenario, the realized-price shortfall grows from 27% in the baseline to 45%. Assumption 1 thus makes the baseline shortfall conservative, as we anticipated for the insurance channel in Section 3.2. The discount-rate factor $R/\widetilde{R}_j$ is virtually unchanged, compared to our baseline results. The insurance factor is monotonically increasing in income and strongly contributes to preferred levels being inefficiently low. On average, it is almost as low as the discount-rate factor. While own-benefits net of cost clearly favor the higher income quintiles, net future benefits mildly favor the two lowest. This is due to the regression to the mean implied by the intergenerational transition matrix of Jäntti (2006): the income elasticity of the expected future benefit falls to $\varepsilon_b^B = 0.30$, slightly below the cost elasticity $\varepsilon_c = 0.35$.

Our calibration reproduces the pattern documented in the literature on heterogeneities relevant in the context of environmental policy reviewed by Drupp et al. (2025): climate-policy benefits are distributed progressively and the cost regressively, as implied by income elasticities of damages and of the cost below one ($\varepsilon_b = 0.70$, $\varepsilon_c = 0.35$). To the best of our knowledge, neither the income-dependent implicit discount rates, nor the idiosyncratic insurance factor, nor the distribution of future benefits mediated through altruism and intergenerational income and earnings mobility has been studied in this literature. In our calibration, the first two depress the preferred carbon price about equally, and the third reverses the sign of the net incidence of future benefits relative to that of own-benefits. If this result survives in richer models of climate policy incidence, it might be worth highlighting, next to the emphasis on the regressive incidence of cost in climate policy communication, that future benefits net of cost, as perceived by parents, mildly favor the two lowest income quintiles.

Dynastic altruism. Our model relies on positive dynastic altruism. Referring to the infinitely-lived agent implied by the dynastic altruism of Barro (1974), Kotlikoff et al. (2021, p. 5) state that "[...] such altruism begs the question of why appropriate climate policy is not already in place". Inter alia, they invoke the failure of Ricardian equivalence in empirical observations as evidence against dynastic altruism (Kotlikoff et al., 2021, p. 5, fn. 8): when resources differ across generations, there is no evidence for private transfers adjusting to neutralize this (Altonji et al., 1992).

At the same time, altruism toward future generations at large is observed as present, behaviorally relevant, and linked to support for climate policy by Agneman et al. (2024).

for the case of debt redemption: a transfer T_1 to generation B redeemed by a tax RT_1 on generation C in $t = 2$. Jointly, this implies that, first, a marginal intragenerational transfer moves χ_j toward one; and second, public debt moves χ_j away from one, so that for $\mathrm{Cov}_j(\xi_j, u'(c_{C_j,2})) < 0$ it lowers χ_j and thus, for a given implicit discount rate, the preferred level of g.

Closer to our own framework, Boar (2021) shows that parents accumulate precautionary savings against their children's income risk.

Our model offers an avenue to reconcile the departure from Ricardian equivalence in private savings and inefficiently low provision of long-lived public goods with positive dynastic altruism, thus abandoning the strong assumption of intergenerational egoism in canonical OLG models. A constrained parent *welcomes* a reallocation across generations via transfers, as the bequest constraint prevents it from acting itself. Indeed, a household constrained in every state is indistinguishable from an egoistic agent in the private sphere (Proposition 2), and constrained households in general do not neutralize intergenerational transfers: public debt relaxes the bequest constraint of the constrained household B_L and lowers its implicit discount rate (Lemma 1). The evidence on missing Ricardian equivalence, read as a rejection of dynastic altruism, is therefore consistent with a world in which bequest constraints bind.

Our mechanism requires no strong form of altruism: any positive degree suffices. In fact, the wedge becomes larger, the less pronounced altruism is, since lower altruism makes the bequest constraint bind more often. Its magnitude is sensitive to the value of a, as the robustness check in Section 6.4 shows. There is one reason why our calibration might understate altruism, and another why it might overstate it. On the one hand, because altruism a is calibrated to observable wealth transfers, the parameter might underestimate dynastic altruism, as it does not take into account the (time) cost incurred by parents for the children's upbringing and probably only parts of the monetary expenses for education. On the other hand, if other, non-altruistic motives drive intergenerational wealth transfers (Kopczuk, 2013), the parameter choice might overestimate dynastic altruism.

Our model also abstracts from altruism beyond the dynasty. For the application to climate policy, this omission may matter: altruism toward future generations at large is linked to support for climate policy (Agneman et al., 2024), and cross-dynastic altruism implies that society is more patient than the market rate suggests (Nesje, 2024). Including cross-dynastic altruism and non-altruistic transfer motives in the model is beyond the scope of this article.

Endogenous interest rate. Our analytical model assumes a small open economy with an exogenous market rate R, whereas the calibrated model is calibrated to the United States, a large economy. The central results carry over. Households take the market rate as given in a closed economy as well, so binding bequest constraints raise their implicit discount rates, and with them the politically-revealed rate, above whatever market rate prevails (Propositions 1 and 3). Computing these rates at the observed market rate is therefore valid, and so is the realized carbon price, as long as the government also takes the market rate as given when choosing it. The policy involved is small: the average cost of benchmark provision amounts to 0.18% of the first-period resources of the poorest quintile, so its effect on savings and the interest rate is likely limited. Less clear are the effects of transfers and public debt. In a closed economy, they would change savings and bequest decisions and thereby the interest rate, which in turn feeds back into household resources and implicit discount rates. We therefore read the debt volumes of Section 6

as partial-equilibrium orders of magnitude, and leave a general-equilibrium analysis of transfers and public debt in the US context to future work.

Exogenous mobility. The transition probabilities P_{ji} are exogenous and thus policy-invariant: the transfers and debt of Sections 3 and 4 leave them unchanged. However, children's wages depend on their human capital, and – under bequest constraints – parental resources influence the investment in it, as in Loury (1981) and Becker and Tomes (1986). Thus, a transfer to a parent might increase the child's probability of a favorable realization of the productivity process. By Proposition 1(c), higher upward mobility raises the implicit discount rate of a constrained parent, because its bequest constraint binds more often and more deeply. This effect would counteract the rate-decreasing effect of transfers described in Lemma 1, so that our results overstate the effect of transfers on implicit discount rates and preferred levels. For realized provision, the net effect is ambiguous, because higher mobility also shifts political weight toward the unconstrained dynasty (Section 3.3). For an unconstrained parent, a change in the transition probabilities leaves its implicit discount rate at R, as long as its bequest constraint does not bind as a consequence. Endogenizing intergenerational earnings transitions by adding human capital investment to the model is beyond the scope of this article.

8 Conclusion

In this article, we present a model of collective choice over the provision of long-term public investment in which short-termism does not originate in government present bias, principal-agent problems, or other political distortions. Instead, bequest constraints combined with upward intergenerational income mobility raise constrained households' implicit discount rates above the market rate, and responsive governments underinvest relative to the market-discounted efficiency benchmark. In the baseline calibration and the main scenario, the politically-revealed rate is 4.38% per year against a market interest rate of 2.84% and the realized carbon price falls 27.3% short of the benchmark. In addition, our model reconciles positive dynastic altruism with a failure of Ricardian equivalence and inefficiently low public investment.

The microfoundations of the model have the following policy implications. Transfers from unconstrained to constrained households raise provision, as long as they carry positive political weight. Using public debt to relax the constraint is possible, yet normatively questionable and, in our calibration, practically infeasible. Instead, a golden rule that finances the entire cost of provision by public debt, with the debt repaid along a benefit principle in the future, gives efficient provision, whatever the households' discount rates and political weights, and makes the deciding generation better off; the children of constrained households gain only if the initial shortfall was large enough.

We identify the following avenues for future research. First, while there is empirical evidence on the effect of poverty on discount rates mediated through liquidity constraints in general (Haushofer and Fehr, 2014), we are not aware of any quantification of the effect of income on political support for long-run policies *mediated* through bequest con-

straints. Given the size of the distortion our model implies, such a quantification would be highly valuable. Second, our stylized two-period model could be embedded into a dynamic general-equilibrium model with endogenous interest rate to settle the effects of transfers and public debt in this context discussed in Section 7. Third, augmenting the model's dynasty linkages with non-altruistic bequest motives would improve its calibration, adding human capital investment and other intergenerational transfers would endogenize intergenerational mobility, and extending the model to cross-dynastic altruism would broaden its relevance for climate policy. Fourth, a more granular calibration at the top of the income and earnings distribution would make it possible to quantify the potential of intragenerational transfers; at the current calibration, all model households are bequest-constrained in some states of the world. Fifth, combining within-life borrowing constraints, as in Caplin and Leahy (2023), with collective choice would extend the analysis to medium-horizon public goods. Finally, the quantification of the idiosyncratic insurance factor discussed in Section 7 suggests that its effect is sizable and its study promising.

Use of AI

The authors used AI tools (Claude, Anthropic) in preparing this article. In a supportive capacity, AI was used for language-related improvements, including grammar, spelling, and style; for writing the code used to calibrate and solve the model; for restructuring mathematical proofs to enhance readability; and for improving the figures displayed.

AI was moreover used generatively for two results: the saving-response lemma and its proof in Appendix A, and the monotonicity lemma and its proof in Appendix D. The authors have verified them for correctness and take full responsibility for them, as for the entire content of this article.

References

Agneman, Gustav, Sofia Henriks, Hanna Bäck, and Emma Renström (2024). "Intergenerational altruism and climate policy preferences". In: *PNAS nexus* 3.4, pp. 1–11.

Aiyagari, S. R. (1994). "Uninsured Idiosyncratic Risk and Aggregate Saving". In: *Quarterly Journal of Economics* 109.3, pp. 659–684.

Aladangady, Aditya, Jesse Bricker, Andrew C. Chang, Sarena Goodman, Jacob Krimmel, Kevin B. Moore, Sarah Reber, Alice Henriques Volz, and Richard A. Windle (2023). *Changes in U.S. Family Finances from 2019 to 2022: Evidence from the Survey of Consumer Finances*. Washington DC. URL: `https://www.federalreserve.gov/publications/files/scf23.pdf` (visited on 07/10/2025).

Altig, David and Steven J. Davis (1993). "Borrowing constraints and two-sided altruism with an application to social security". In: *Journal of Economic Dynamics and Control* 17.3, pp. 467–494.

Altonji, Joseph G., Fumio Hayashi, and Laurence J. Kotlikoff (1992). "Is the Extended Family Altruistically Linked? Direct Tests Using Micro Data". In: *The American Economic Review* 82.5, pp. 1177–1198. URL: `http://www.jstor.org/stable/2117473`.

Arias, Elizabeth, Jiaquan Xu, and Kenneth D. Kochanek (2025). *United States Life Tables, 2023*. Hyattsville, MD. URL: `https://www.cdc.gov/nchs/data/nvsr/nvsr74/nvsr74-06.pdf` (visited on 07/17/2026).

Atkinson, Anthony B. and Joseph E. Stiglitz (2015). *Lectures on Public Economics: Updated Edition*. Princeton University Press.

Bakış, Ozan, Barış Kaymak, and Markus Poschke (2015). "Transitional dynamics and the optimal progressivity of income redistribution". In: *Review of Economic Dynamics* 18.3, pp. 679–693.

Barro, Robert J. (1974). "Are Government Bonds Net Wealth?" In: *Journal of Political Economy* 82.6, pp. 1095–1117.

Barron, Alexander R., Allen A. Fawcett, Marc A. C. Hafstead, James R. McFarland, and Adele C. Morris (2018). "Policy Insights from the EMF 32 Study on U.S. Carbon Tax Scenarios". In: *Climate Change Economics* 9.1.

Bassetto, Marco and Thomas J. Sargent (2006). "Politics and Efficiency of Separating Capital and Ordinary Government Budgets". In: *Quarterly Journal of Economics* 121.4, pp. 1167–1210.

Becker, Gary S. and Nigel Tomes (1986). "Human Capital and the Rise and Fall of Families". In: *Journal of Labor Economics* 4.3, Part 2, S1–S39.

Bergmann, Tobias and Nikolaj Moretti (2026). "Trading budget deficits for public investment: Optimal deficit rules for present-biased governments". In: *European Journal of Political Economy* 93, p. 102852.

Bergquist, Magnus, Andreas Nilsson, Niklas Harring, and Sverker C. Jagers (2022). "Meta-analyses of fifteen determinants of public opinion about climate change taxes and laws". In: *Nature Climate Change* 12.3, pp. 235–240.

Bilal, Adrien and Diego R. Känzig (2026). "The Macroeconomic Impact of Climate Change: Global Versus Local Temperature". In: *Quarterly Journal of Economics* 141.2, pp. 889–944.

Boar, Corina (2021). "Dynastic Precautionary Savings". In: *The Review of Economic Studies* 88.6, pp. 2735–2765.

Board of Governors of the Federal Reserve System (2023). *Survey of Consumer Finances 2022: Summary Extract Public Data (file SCFP2022)*. Dataset. URL: `https://www.federalreserve.gov/econres/scfindex.htm` (visited on 07/10/2025).

Boly, Mohamed, Jean-Louis Combes, Maxime Menuet, Alexandru Minea, Pascale Combes Motel, and Patrick Villieu (2022). "Can public debt mitigate environmental debt? Theory and empirical evidence". In: *Energy Economics* 111, 105895.

Bovenberg, A. Lans and Ben J. Heijdra (1998). "Environmental tax policy and intergenerational distribution". In: *Journal of Public Economics* 67.1, pp. 1–24.

Burgess, David F. and Richard O. Zerbe (2013). "The most appropriate discount rate". In: *Journal of Benefit-Cost Analysis* 4.03, pp. 391–400.

Caplin, Andrew and John Leahy (2004). "The social discount rate". In: *Journal of Political Economy* 112.6, pp. 1257–1268.

— (2023). "Missing Participants, Missing Markets, and the Social Discount Rate: Borrowing Constraints, Intergenerational Transfers, Altruism, and the Desire for Legacy". In: *Annual Review of Financial Economics* 15.1, pp. 165–184.

Carlsson, F., M. Kataria, A. Krupnick, E. Lampi, A. Lofgren, P. Qin, S. Chung, and T. Sterner (2012). "Paying for Mitigation: A Multiple Country Study". In: *Land Economics* 88.2, pp. 326–340.

Cherbonnier, Frédéric and Christian Gollier (2023). "Fixing Our Public Discounting Systems". In: *Annual Review of Financial Economics* 15.1, pp. 147–164.

Chetty, Raj, Nathaniel Hendren, Patrick Kline, and Emmanuel Saez (2014). "Where is the land of Opportunity? The Geography of Intergenerational Mobility in the United States". In: *Quarterly Journal of Economics* 129.4, pp. 1553–1623.

Cukierman, Alex and Allan H. Meltzer (1989). "A political theory of government debt and deficits in a neo-Ricardian framework". In: *The American Economic Review*, pp. 713–732.

Deaton, Angus (1991). "Saving and Liquidity Constraints". In: *Econometrica* 59.5, pp. 1221–1248.

Diederich, Johannes and Timo Goeschl (2014). "Willingness to Pay for Voluntary Climate Action and Its Determinants: Field-Experimental Evidence". In: *Environmental and Resource Economics* 57.3, pp. 405–429.

Dietz, Simon, Christian Gollier, and Louise Kessler (2018). "The climate beta". In: *Journal of Environmental Economics and Management* 87, pp. 258–274.

Drazen, Allan (1978). "Government Debt, Human Capital, and Bequests in a Life-Cycle Model". In: *Journal of Political Economy* 86.3, pp. 505–516.

Drupp, Moritz A., Mark C. Freeman, Ben Groom, and Frikk Nesje (2018). "Discounting Disentangled". In: *American Economic Journal: Economic Policy* 10.4, pp. 109–134.

Drupp, Moritz A., Ulrike Kornek, Jasper N. Meya, and Lutz Sager (2025). "The Economics of Inequality and the Environment". In: *Journal of Economic Literature* 63.3, pp. 840–874.

Edenhofer, Ottmar, Ulrich Eydam, Maik Heinemann, Matthias Kalkuhl, and Nikolaj Moretti (2025a). *A Green-Golden Rule for Climate Policy*. Available at SSRN. URL: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=5119380 (visited on 05/20/2025).

— (2025b). "Rechtfertigt Klimapolitik eine Erhöhung der Verschuldung? Plädoyer für eine grün-goldene Regel". In: *Perspektiven der Wirtschaftspolitik* 26.2, pp. 220–233.

Franks, Max, David Klenert, Anselm Schultes, Kai Lessmann, and Ottmar Edenhofer (2018). "Is capital back? The role of land ownership and savings behavior". In: *International Tax and Public Finance* 25.5, pp. 1252–1276.

Galí, Jordi, J. David López-Salido, and Javier Vallés (2007). "Understanding the Effects of Government Spending on Consumption". In: *Journal of the European Economic Association* 5.1, pp. 227–270.

Gecan, Ron (2021). *How Carbon Dioxide Emissions Would Respond to a Tax or Allowance Price: An Update*. CBO Working Paper. Congressional Budget Office. URL: https://www.cbo.gov/publication/57580 (visited on 09/12/2026).

Gilli, Martino, Matteo Calcaterra, Johannes Emmerling, and Francesco Granella (2024). "Climate change impacts on the within-country income distributions". In: *Journal of Environmental Economics and Management* 127, p. 103012.

Gollier, Christian (2024). "The cost-efficiency carbon pricing puzzle". In: *Journal of Environmental Economics and Management* 128, p. 103062.

Gollier, Christian and Richard Zeckhauser (2005). "Aggregation of Heterogeneous Time Preferences". In: *Journal of Political Economy* 113.4, pp. 878–896.

Gonzalez-Eiras, Martín and Dirk Niepelt (2008). "The future of social security". In: *Journal of Monetary Economics* 55.2, pp. 197–218.

Goussebaïle, Arnaud (2024). "Democratic climate policies with overlapping generations". In: *Environmental and Resource Economics* 87.5, pp. 1249–1273.

Groom, Ben, Moritz A. Drupp, Mark C. Freeman, and Frikk Nesje (2022). "The Future, Now: A Review of Social Discounting". In: *Annual Review of Resource Economics* 14.1, pp. 467–491.

Haushofer, Johannes and Ernst Fehr (2014). "On the psychology of poverty". In: *Science* 344.6186, pp. 862–867.

Heal, Geoffrey M. and Antony Millner (2014). "Agreeing to disagree on climate policy". In: *Proceedings of the National Academy of Sciences of the United States of America* 111.10, pp. 3695–3698.

Hendricks, Lutz (2007). "Retirement Wealth and Lifetime Earnings". In: *International Economic Review* 48.2, pp. 421–456.

Huggett, Mark (1993). "The risk-free rate in heterogeneous-agent incomplete-insurance economies". In: *Journal of Economic Dynamics and Control* 17.5-6, pp. 953–969.

Jackson, Matthew O. and Leeat Yariv (2015). "Collective Dynamic Choice: The Necessity of Time Inconsistency". In: *American Economic Journal: Microeconomics* 7.4, pp. 150–178.

Jäntti, Markus (2006). *American exceptionalism in a new light: a comparison of intergenerational earnings mobility in the Nordic countries, the United Kingdom and the United States*. IZA Discussion Paper 1938. IZA - Institute of Labor Economics.

Karp, Larry and Armon Rezai (2014). "The Political Economy of Environmental Taxation with Overlapping Generations". In: *International Economic Review* 55.3, pp. 711–733.

Kopczuk, Wojciech (2013). "Taxation of Intergenerational Transfers and Wealth". In: *Handbook of Public Economics*. Vol. 5. Elsevier, pp. 329–390.

Kotlikoff, Laurence J., Felix Kubler, Andrey Polbin, Jeffrey Sachs, and Simon Scheidegger (2021). "Making Carbon Taxation a Generational Win win". In: *International Economic Review* 62.1, pp. 3–46.

Löschel, Andreas, Bodo Sturm, and Carsten Vogt (2013). "The demand for climate protection—Empirical evidence from Germany". In: *Economics Letters* 118.3, pp. 415–418.

Loury, Glenn C. (1981). "Intergenerational Transfers and the Distribution of Earnings". In: *Econometrica* 49.4, p. 843.

Mankiw, N. Gregory (2000). "The Savers–Spenders Theory of Fiscal Policy". In: *The American Economic Review* 90.2, pp. 120–125.

Marglin, Stephen A. (1963). "The Social Rate of Discount and The Optimal Rate of Investment". In: *Quarterly Journal of Economics* 77.1, p. 95.

Milesi-Ferretti, Gian Maria (2004). "Good, bad or ugly? On the effects of fiscal rules with creative accounting". In: *Journal of Public Economics* 88.1-2, pp. 377–394.

Millner, Antony and Geoffrey M. Heal (2023). "Choosing the Future: Markets, Ethics, and Rapprochement in Social Discounting". In: *Journal of Economic Literature* 61.3, pp. 1037–1087.

Nardi, Mariacristina de and Fang Yang (2014). "Bequests and heterogeneity in retirement wealth". In: *European Economic Review* 72, pp. 182–196.

Nesje, Frikk (2024). "Cross-dynastic intergenerational altruism". In: *Journal of Environmental Economics and Management* 128, p. 103059.

Nordhaus, William D. (2007). "A Review of the Stern Review on the Economics of Climate Change". In: *Journal of Economic Literature* 45.3, pp. 686–702.

— (2017). "Revisiting the social cost of carbon". In: *Proceedings of the National Academy of Sciences of the United States of America* 114.7, pp. 1518–1523.

O'Donnell, Owen et al. (2007). "The Incidence of Public Spending on Healthcare: Comparative Evidence from Asia". In: *The World Bank Economic Review* 21.1, pp. 93–123.

Paulley, Neil, Richard Balcombe, Roger Mackett, Helena Titheridge, John Preston, Mark Wardman, Jeremy Shires, and Peter White (2006). "The demand for public transport: The effects of fares, quality of service, income and car ownership". In: *Transport Policy* 13.4, pp. 295–306.

Peletier, Ben D., Robert A. J. Dur, and Otto H. Swank (1999). "Voting on the Budget Deficit: Comment". In: *The American Economic Review* 89.5, pp. 1377–1381.

Pottier, Antonin (2022). "Expenditure elasticity and income elasticity of GHG emissions: A survey of literature on household carbon footprint". In: *Ecological Economics* 192, 107251.

Ricke, Katharine, Laurent Drouet, Ken Caldeira, and Massimo Tavoni (2018). "Country-level social cost of carbon". In: *Nature Climate Change* 8.10, pp. 895–900.

Ricke, Katharine L. and Ken Caldeira (2014). "Maximum warming occurs about one decade after a carbon dioxide emission". In: *Environmental Research Letters* 9.12, 124002.

Sachs, Jeffrey D. (2014). "Climate change and intergenerational well-being". In: *The Oxford handbook of the macroeconomics of global warming*, pp. 248–259.

Schleich, Joachim, Xavier Gassmann, Corinne Faure, and Thomas Meissner (2016). "Making the implicit explicit: A look inside the implicit discount rate". In: *Energy Policy* 97, pp. 321–331.

Stern, Nicholas (2008). "The Economics of Climate Change". In: *American Economic Review* 98.2, pp. 1–37.

U.S. Census Bureau (2024). *Historical Households Tables, Table HH-1: Households by Type: 1940 to Present (Current Population Survey, Annual Social and Economic Supplements)*. Dataset. URL: https://www.census.gov/data/tables/time-series/demo/families/households.html (visited on 09/12/2026).

— (2026). *Annual Estimates of the Resident Population by Single Year of Age and Sex for the United States: April 1, 2020 to July 1, 2025 (Vintage 2025, file NC-EST2025-AGESEX-RES)*. Dataset. URL: https://www2.census.gov/programs-surveys/popest/datasets/2020-2025/national/asrh/nc-est2025-agesex-res.csv (visited on 07/17/2026).

U.S. Energy Information Administration (2023). *Coal generation decreased in 2022, but overall U.S. emissions increased (Today in Energy)*. URL: https://www.eia.gov/todayinenergy/detail.php?id=61022 (visited on 09/12/2026).

Uhlig, Harald (1996). "A law of large numbers for large economies". In: *Economic Theory* 8.1, pp. 41–50.

United States Environmental Protection Agency (2010). *Guidelines for Preparing Economic Analyses*. EPA 240-R-10-001. URL: https://19january2021snapshot.epa.gov/sites/static/files/2017-09/documents/ee-0568-06.pdf (visited on 06/14/2026).

— (2023). *Report on the Social Cost of Greenhouse Gases: Estimates Incorporating Recent Scientific Advances*. Report. Washington DC: Environmental Protection Agency. URL: https://www.epa.gov/system/files/documents/2023-12/epa_scghg_2023_report_final.pdf (visited on 01/29/2025).

Vogt-Schilb, Adrien, Guy Meunier, and Stéphane Hallegatte (2018). "When starting with the most expensive option makes sense: Optimal timing, cost and sectoral allocation of abatement investment". In: *Journal of Environmental Economics and Management* 88, pp. 210–233.

Wada, Kenichi, Keigo Akimoto, Fuminori Sano, Junichiro Oda, and Takashi Homma (2012). "Energy efficiency opportunities in the residential sector and their feasibility". In: *Energy* 48.1, pp. 5–10.

Wolff, Edward N. and Maury Gittleman (2014). "Inheritances and the distribution of wealth or whatever happened to the great inheritance boom?" In: *The Journal of Economic Inequality* 12.4, pp. 439–468.

Woodford, Michael (1986). "Stationary sunspot equilibria in a finance constrained economy". In: *Journal of Economic Theory* 40.1, pp. 128–137.

— (1990). "Public debt as private liquidity". In: *The American Economic Review* 80.2, pp. 382–388.

World Bank (2025). *World Development Indicators*. Dataset. Washington DC. URL: `https://databank.worldbank.org/source/world-development-indicators` (visited on 01/2025).

Yared, Pierre (2019). "Rising Government Debt: Causes and Solutions for a Decades-Old Trend". In: *The Journal of Economic Perspectives* 33.2, pp. 115–140.

Zeldes, Stephen P. (1989). "Consumption and Liquidity Constraints: An Empirical Investigation". In: *Journal of Political Economy* 97.2, pp. 305–346.

A Household B's Problem

This appendix collects the facts about household B_j's problem that the proofs and derivations of the following appendices draw on: the net endowments through which policy enters the problem, the bequest condition and its shadow value, the second-stage policies, the Euler equation, which holds despite the kink that the bequest constraint introduces in second-period choices, and the responses of saving to the net endowments (Lemma A.1). It also shows that the parent's second-period marginal utility is lower when its child is the high-productivity type.

Using a superscript, we index household B_j's second period by the type $i \in \{L, H\}$ of its child, which occurs with probability P_{ji} (with $P_{jL} + P_{jH} = 1$), and denote by $m_j := R\, s_{B_j,1}$ its second-period resources.

Net Endowments

Policy reaches household B_j and its child only through two net endowments, B_j's resources in $t = 1$ and its child's endowment in state i in $t = 2$,

$$e_{B_j,1} := w_{B_j,1} + b_{A_j,1} - \gamma_j\, \Gamma(g) + \delta\, \xi\, \sigma_j\, g + T_{j,1}, \qquad e^i_{C_j,2} := w^i_{C,2} + \xi^i_j\, g + T^i_{j,2}. \tag{32}$$

Here, $\gamma_j\, \Gamma(g)$ is the dynasty's share of the cost of provision (Section 2.2) and $\xi^i_j\, g$ the child's benefit (Equation (8)). The term $\delta\, \xi\, \sigma_j\, g$ is the own-benefit, where $\sigma_j \geq 0$ with $\sum_j \sigma_j = 1$ is dynasty j's share of the aggregate own-benefit; it is present only in Section 5.2, where $\sigma_j = \xi_j/\xi$, and in the calibrated model of Section 6; elsewhere we set $\delta = 0$ and it drops out. The transfers $T_{j,1}$ to B_j and $T^i_{j,2}$ to its child in state i are zero unless stated otherwise. The two schemes of Lemma 1 are special cases: the intragenerational transfer sets $T_{L,1} = T_1$ and $T_{H,1} = -T_1$, the intergenerational transfer $T_{j,1} = T_1$ and $T^i_{j,2} = T_2 = -R\, T_1$ for both dynasties. In terms of the net endowments, the budget constraints (6) and (8), extended by the own-benefit and the transfers, read $c_{B_j,1} + s_{B_j,1} = e_{B_j,1}$ and $c^i_{C_j,2} = e^i_{C_j,2} + b^i_{B_j,2}$. The bequest $b_{A_j,1}$ received from generation A is taken as given throughout.

The Two-Stage Problem

Household B_j chooses its saving to maximize dynastic utility (2), with its first-period budget constraint (6) in net-endowment form substituted in,

$$\max_{s_{B_j,1}} \; u\big(e_{B_j,1} - s_{B_j,1}\big) + \beta \sum_{i \in \{L,H\}} P_{ji}\, V_2\big(R\, s_{B_j,1},\, e^i_{C_j,2}\big),$$

where V_2 is the value of second-period resources m when the child's endowment is e, with the budget constraints of parent and child, (7) and (8) in net-endowment form, substituted in,

$$V_2(m, e) := \max_{b \geq 0} \; u(m - b) + a\, u(e + b).$$

Second Stage

Denote the optimal policies by $c^*_{B_j,2}(m,e)$ and $b^*_{B_j,2}(m,e)$, with the child consuming $c^*_{C_j,2} = e + b^*_{B_j,2}$. The bequest first-order condition is Equation (11) state by state, $u'(c^i_{B_j,2}) = a\,u'(c^i_{C_j,2}) + \mu^i_{B_j}$ with $\mu^i_{B_j} \geq 0$ and $\mu^i_{B_j}\, b^i_{B_j,2} = 0$, so the shadow value of the bequest constraint is

$$\mu^i_{B_j} = u'(c^i_{B_j,2}) - a\,u'(c^i_{C_j,2}) = \begin{cases} 0 & \text{if } b^i_{B_j,2} > 0, \\ u'(m_j) - a\,u'(e^i_{C_j,2}) \geq 0 & \text{if } b^i_{B_j,2} = 0. \end{cases} \tag{33}$$

For later reference, we also state the bequest condition in expectation over the child's type,

$$\mathbb{E}_j\big[u'(c_{B_j,2})\big] = a\,\mathbb{E}_j\big[u'(c_{C_j,2})\big] + \mathbb{E}_j\big[\mu_{B_j}\big]. \tag{34}$$

Two regimes arise. When the constraint is slack, the parent equates $u'(c_{B_j,2}) = a\,u'(c_{C_j,2})$, and an extra unit of resources is split between its own consumption and the bequest. Under CRRA, $u'(c) = c^{-\eta}$, this sharing rule reads $c_{C_j,2} = a^{1/\eta}\,c_{B_j,2}$. Combining it with the budget identities $c_{B_j,2} + b_{B_j,2} = m$ and $c_{C_j,2} = e + b_{B_j,2}$ gives the linear policies

$$c^*_{B_j,2} = \frac{m+e}{1+a^{1/\eta}}, \qquad c^*_{C_j,2} = \frac{a^{1/\eta}\,(m+e)}{1+a^{1/\eta}}, \qquad b^*_{B_j,2} = \frac{a^{1/\eta}\,m - e}{1+a^{1/\eta}}, \tag{35}$$

valid whenever $e \leq a^{1/\eta}\,m$, that is, whenever they imply a non-negative bequest. When instead $e > a^{1/\eta}\,m$, the constraint binds: the parent sets $b^*_{B_j,2} = 0$ and consumes m, and the child consumes its endowment e. Equivalently, the constraint binds in state i if and only if $u'(m_j) > a\,u'(e^i_{C_j,2})$: at a zero bequest, the parent values a unit of its own consumption more than the altruistic value of that unit to its child. At the threshold $e = a^{1/\eta}\,m$, the slack policies (35) give $c^*_{B_j,2} = m$, $c^*_{C_j,2} = e$ and $b^*_{B_j,2} = 0$, which are the binding policies, so the policies are continuous in (m,e). They are kinked at the threshold, since their derivatives jump there:

$$\frac{\partial c^*_{B_j,2}}{\partial m} = \frac{\partial c^*_{B_j,2}}{\partial e} = \frac{1}{1+a^{1/\eta}} \;\; \text{(slack)}, \qquad \frac{\partial c^*_{B_j,2}}{\partial m} = 1, \;\; \frac{\partial c^*_{B_j,2}}{\partial e} = 0 \;\; \text{(binding)}. \tag{36}$$

In particular, the parent's marginal propensity to consume out of second-period resources is strictly positive in both regimes.

First Stage: The Euler Equation Survives the Kink

At the optimal policies, $V_2(m,e) = u(c^*_{B_j,2}) + a\,u(c^*_{C_j,2})$. Differentiating the first-stage objective with respect to saving, with $c_{B_j,1} = e_{B_j,1} - s_{B_j,1}$, gives the first-order condition

$$-\,u'(c_{B_j,1}) + \beta \sum_{i\in\{L,H\}} P_{ji}\left[u'(c^i_{B_j,2})\,\frac{\partial c^i_{B_j,2}}{\partial s_{B_j,1}} + a\,u'(c^i_{C_j,2})\,\frac{\partial c^i_{C_j,2}}{\partial s_{B_j,1}}\right] = 0.$$

The bracket equals $R\,u'(c^i_{B_j,2})$ in both regimes. In the slack regime, the budget identities give $c^i_{B_j,2} + c^i_{C_j,2} = R\,s_{B_j,1} + e^i_{C_j,2}$, so the two derivatives sum to R; combined with

$u'(c^i_{B_j,2}) = a\,u'(c^i_{C_j,2})$, the bracket equals $R\,u'(c^i_{B_j,2})$. In the binding regime, $c^i_{B_j,2} = R\,s_{B_j,1}$ and $c^i_{C_j,2} = e^i_{C_j,2}$, so the two derivatives are R and 0, and the bracket again equals $R\,u'(c^i_{B_j,2})$. For the same reason, the left-hand derivative (from the binding regime) is $R\,u'(c^i_{B_j,2})$ at the threshold $e = a^{1/\eta}\,m$ itself. There, the right-hand derivative (from the slack regime) equals $R\,u'(c^i_{B_j,2})$, because $\mu^i_{B_j} = 0$ at the threshold, so that $u'(c^i_{B_j,2}) = a\,u'(c^i_{C_j,2})$ holds there as well. They coincide, so the objective is differentiable at the threshold too. Either way, the first-order condition reduces to

$$u'(c_{B_j,1}) = \beta R\,\mathbb{E}_j\big[u'(c_{B_j,2})\big], \tag{37}$$

which is the Euler equation (13) of the main text, valid whether or not the constraint binds in either state. The Inada condition makes the solution interior, $0 < s_{B_j,1} < e_{B_j,1}$.

The same computation with respect to the child's endowment gives its marginal value to the parent, again in both regimes and at the threshold,

$$\frac{\partial V_2(m,e)}{\partial e} = a\,u'\big(c^*_{C_j,2}(m,e)\big)\,: \tag{38}$$

in the slack regime, the derivatives of the two consumptions $c_{B_j,2}$ and $c_{C_j,2}$ with respect to e sum to one, and in the binding regime they are 0 and 1.

Saving Responses

The following lemma states how household B_j's saving, and with it its first-period consumption and second-period resources, responds to the two net endowments; the proofs of the following appendices draw on it.

Lemma A.1 (Saving responses)**.** *Let $e_{B_j,1} > 0$ and $e^i_{C_j,2} > 0$ for $i \in \{L, H\}$. For given net endowments $e_{B_j,1}$, $e^L_{C_j,2}$ and $e^H_{C_j,2}$, the Euler equation* (37) *has a unique solution $s_{B_j,1}$, which is continuous in the endowments. Wherever the set of binding states does not change,*

(a) $\frac{\partial s_{B_j,1}}{\partial e_{B_j,1}} \in (0,1)$*, so that both $c_{B_j,1}$ and m_j rise with $e_{B_j,1}$;*

(b) if the constraint binds in state i, then $s_{B_j,1}$, $c_{B_j,1}$ and m_j do not depend on $e^i_{C_j,2}$;

(c) if the constraint is slack in state i, then $\partial s_{B_j,1}/\partial e^i_{C_j,2} < 0$, so that $c_{B_j,1}$ rises and m_j falls with $e^i_{C_j,2}$.

Proof. Write the Euler equation as $F_j(s) = 0$, with

$$F_j(s) := u'(e_{B_j,1} - s) - \beta R \sum_{i\in\{L,H\}} P_{ji}\,u'\big(c^*_{B_j,2}(R\,s,\, e^i_{C_j,2})\big).$$

Differentiating, with $\partial m_j/\partial s = R$,

$$\frac{\partial F_j}{\partial s} = -u''(c_{B_j,1}) - \beta R^2 \sum_{i\in\{L,H\}} P_{ji}\,u''(c^i_{B_j,2})\,\frac{\partial c^*_{B_j,2}}{\partial m} > 0,$$

since $u'' < 0$ and the marginal propensities (36) are strictly positive in both regimes. The function F_j is continuous because the policies are, it tends to $+\infty$ as $s \to e_{B_j,1}$ because $c_{B_j,1} \to 0$ and $u'(c_{B_j,1}) \to \infty$, and it tends to $-\infty$ as $s \to 0$ because $c^i_{B_j,2} \leq m_j \to 0$ and the marginal utility in the second summand diverges. The root therefore exists, is unique, and is continuous in the endowments. The implicit function theorem gives the three responses.

(a) First-period endowment. Since $\partial F_j / \partial e_{B_j,1} = u''(c_{B_j,1}) < 0$,

$$\frac{\partial s_{B_j,1}}{\partial e_{B_j,1}} = \frac{-\,u''(c_{B_j,1})}{\partial F_j / \partial s} \in (0,1),$$

where the upper bound is strict because $\partial F_j / \partial s$ exceeds $-u''(c_{B_j,1})$ by its strictly positive second summand. Consequently

$$\frac{\partial c_{B_j,1}}{\partial e_{B_j,1}} = 1 - \frac{\partial s_{B_j,1}}{\partial e_{B_j,1}} \in (0,1), \qquad \frac{\partial m_j}{\partial e_{B_j,1}} = R\,\frac{\partial s_{B_j,1}}{\partial e_{B_j,1}} > 0.$$

(b) Child's endowment in a binding state. If the constraint binds in state i, then $c^i_{B_j,2} = m_j$ does not depend on $e^i_{C_j,2}$, and $e^i_{C_j,2}$ enters no other state; hence

$$\frac{\partial F_j}{\partial e^i_{C_j,2}} = 0 \qquad \Longrightarrow \qquad s_{B_j,1},\ c_{B_j,1},\ m_j \text{ unchanged.}$$

(c) Child's endowment in a slack state. If the constraint is slack in state i, then by Equation (36), at fixed s,

$$\frac{\partial F_j}{\partial e^i_{C_j,2}} = -\,\beta R\, P_{ji}\, \frac{u''(c^i_{B_j,2})}{1 + a^{1/\eta}} > 0$$

$$\Longrightarrow \qquad \frac{\partial s_{B_j,1}}{\partial e^i_{C_j,2}} = -\frac{\partial F_j / \partial e^i_{C_j,2}}{\partial F_j / \partial s_{B_j,1}} < 0, \qquad \frac{\partial c_{B_j,1}}{\partial e^i_{C_j,2}} > 0, \qquad \frac{\partial m_j}{\partial e^i_{C_j,2}} < 0.$$

□

Finally, compare the parent's second-period marginal utility across its child's types. Suppose the child's net endowment is higher in state H, $e^H_{C_j,2} > e^L_{C_j,2}$, as it is when $w^H_{C,2} > w^L_{C,2}$ and benefits ξ^i_j and transfers $T^i_{j,2}$ do not fall with the child's type. The bequest $b^*_{B_j,2}(m,e)$ is non-increasing in e and strictly decreasing where it is positive, since $\partial b^*_{B_j,2}/\partial e = -1/(1+a^{1/\eta})$ in the slack regime (Equation (35)) and $b^*_{B_j,2} = 0$ in the binding regime, which obtains for $e > a^{1/\eta}\, m$. The parent's consumption $c^*_{B_j,2} = m - b^*_{B_j,2}$ is therefore non-decreasing in e, and strictly increasing where the bequest is positive. Hence

$$u'\big(c^H_{B_j,2}\big) \leq u'\big(c^L_{B_j,2}\big), \tag{39}$$

with strict inequality whenever B_j leaves a positive bequest in state L. Marginal utility is thus lower in the state in which the child is richer, which is also the state in which the constraint binds first.

B The Efficiency Benchmark

This appendix establishes the two properties of the benchmark level g^{BM} stated in Section 2.2. First, every first-best Pareto-efficient allocation features $g = g^{\mathrm{BM}}$. Second, a government that has lump-sum transfers and public debt at its disposal chooses g^{BM}, whatever the weights ω_j. Because these results hold more generally for the own-benefit formulation of Section 5.2, we show them for the more general version. The baseline model follows for the own-benefit parameter $\delta = 0$.

Net Present Value of Provision

By the law of large numbers, the realized aggregate benefit of a level g in the second period is $\xi\, g$ (Equation (10)), and the aggregate own-benefit in the first period is $\sum_j \delta\, \xi\, \sigma_j\, g = \delta\, \xi\, g$, with $\delta \geq 0$ (Equation (32)). Since the economy can borrow and lend at rate R, the net present value of provision is

$$N(g) := \delta\, \xi\, g + \frac{\xi\, g}{R} - \Gamma(g).$$

Γ is strictly convex with $\Gamma'(0) = 0$ and unbounded Γ', so N is strictly concave and has a unique maximizer, characterized by $N'(g) = 0$. For $\delta = 0$, this is condition (15), and for $\delta > 0$ it is the benchmark $\Gamma'(g^{\mathrm{BM}}) = \xi/R + \delta\, \xi$ of Section 5.2: g^{BM} maximizes N.

First-Best Pareto Efficiency

An allocation consists of a level g and a consumption level for every household. It is feasible in the first-best sense (irrespective of bequest constraints and of the instruments available to the government) if it satisfies the economy's intertemporal resource constraint,

$$\sum_j \Big[c_{A_j,1} + c_{B_j,1} + \frac{1}{R} \sum_i P_{ji} \big(c^i_{B_j,2} + c^i_{C_j,2} \big) \Big] = \bar{Y} + N(g), \tag{40}$$

where

$$\bar{Y} := \sum_j \Big[Y_{A_j,1} + w_{B_j,1} + \frac{1}{R} \sum_i P_{ji}\, w^i_{C,2} \Big]$$

is the present value of all endowments. The level g enters the constraint only through $N(g)$.

Consider a feasible allocation with $g \neq g^{\mathrm{BM}}$. Replacing g by g^{BM} raises the right-hand side of Equation (40) by $N(g^{\mathrm{BM}}) - N(g) > 0$. Distribute this surplus such that every consumption level rises. Each household's utility is increasing in its own consumption and, for $a \geq 0$, non-decreasing in its child's utility (Equations (1)–(4)), so every household is strictly better off. Hence an allocation with $g \neq g^{\mathrm{BM}}$ is Pareto-dominated, and every first-best Pareto-efficient allocation features $g = g^{\mathrm{BM}}$.

The Government with Lump-Sum Transfers and Public Debt

Suppose that, in addition to the taxes $\gamma_j\,\Gamma(g)$, the government can pay a lump-sum transfer $T_{j,1}$ to household B_j in $t=1$ and a lump-sum transfer $T^i_{j,2}$ to household C_j of type i in $t=2$, where negative values are taxes. It commits to the second-period transfers in $t=1$ and can issue public debt at rate R. The budget constraints (6) and (8), extended by the own-benefit and the transfers, become

$$\begin{aligned} c_{B_j,1} + s_{B_j,1} &= w_{B_j,1} + b_{A_j,1} - \gamma_j\,\Gamma(g) + \delta\,\xi\,\sigma_j\,g + T_{j,1},\\ c^i_{C_j,2} &= w^i_{C,2} + b^i_{B_j,2} + \xi^i_j\,g + T^i_{j,2}, \end{aligned}$$

and the government's intertemporal budget constraint is

$$\sum_j T_{j,1} + \frac{1}{R}\sum_j\sum_i P_{ji}\,T^i_{j,2} = 0. \tag{41}$$

Households choose saving and bequests as in Section 2.1, subject to the bequest constraint (9), and the government maximizes W from Equation (14) over g and the transfers. We take the bequest $b_{A_j,1}$ as given, and let $a>0$ and $\omega_j>0$.[16]

Since households choose saving and bequests optimally, the envelope theorem applies (Appendix A), and a marginal change of the policy affects the indirect utility of household B_j only directly:

$$\begin{aligned} \frac{\partial U^*_{B_j}}{\partial T_{j,1}} &= u'(c_{B_j,1}),\\ \frac{\partial U^*_{B_j}}{\partial T^i_{j,2}} &= \beta\,a\,P_{ji}\,u'(c^i_{C_j,2}),\\ \frac{\partial U^*_{B_j}}{\partial g} &= (\delta\,\xi\,\sigma_j - \gamma_j\,\Gamma'(g))\,u'(c_{B_j,1}) + \beta\,a\sum_i P_{ji}\,u'(c^i_{C_j,2})\,\xi^i_j. \end{aligned}$$

With λ the multiplier on the government's budget constraint (41), the first-order conditions for the transfers are

$$\omega_j\,u'(c_{B_j,1}) = \lambda, \tag{42}$$

$$\omega_j\,\beta\,a\,u'(c^i_{C_j,2}) = \frac{\lambda}{R}, \tag{43}$$

and the first-order condition for g is

$$\sum_j \omega_j\Big[(\delta\,\xi\,\sigma_j - \gamma_j\,\Gamma'(g))\,u'(c_{B_j,1}) + \beta\,a\sum_i P_{ji}\,u'(c^i_{C_j,2})\,\xi^i_j\Big] = 0.$$

[16] The restriction ensures an interior optimum. If a dynasty carries no weight, $\omega_j=0$, the government taxes its members to the limit and passes the proceeds on to the other dynasty; if $a=0$, it does the same with generation C in favor of generation B. In either case, the entire net present value $N(g)$ accrues to households that carry weight, so W is still maximized at $g=g^{\mathrm{BM}}$.

Substituting Equations (42) and (43) and using $\sum_j \sigma_j = 1$, $\sum_j \gamma_j = 1$ and the definition of the aggregate marginal benefit in Equation (10) gives

$$\sum_j \Big[\lambda\left(\delta\,\xi\,\sigma_j - \gamma_j\,\Gamma'(g)\right) + \frac{\lambda}{R}\overbrace{\sum_i P_{ji}\,\xi_j^i}^{\mathbb{E}_j[\xi_j]}\Big] = 0$$

$$\implies \quad \lambda\Big[\delta\,\xi - \Gamma'(g) + \frac{\xi}{R}\Big] = 0.$$

Since $\lambda = \omega_j\,u'(c_{B_j,1}) > 0$ by Equation (42), this is the condition $N'(g) = 0$ that characterizes g^{BM}. At an optimum, the government therefore chooses $g = g^{\mathrm{BM}}$, whatever the weights ω_j.

In Section 7, we argue that the instruments used by the government suffice to neutralize the discount-rate, benefit-cost, and insurance factors of the decomposition (19). To see this, note that conditions (42) and (43) also imply $u'(c_{B_j,1}) = \beta R\,a\,u'(c^i_{C_j,2})$ in every state i. The child's consumption is thus insured against its productivity draw, and the implicit discount rate defined in Equation (16) equals the market rate, $\widetilde{R}_j = R$. In terms of the decomposition (19), the discount-rate factor is thus equal to one because public debt and the first-period transfers leave no bequest constraint binding. Additionally, the first-period transfers allow the government to redistribute between the dynasties, so that the heterogeneous benefit-cost factors, for $\delta > 0$ also those of the own-benefit, do not affect the level of provision. Moreover, the insurance factor of every dynasty is equal to one because the second-period transfers can condition on the child's type and therefore insure the household against the child's productivity risk.

C Proof of Proposition 1

Part (a). Substituting the bequest condition in expectation (34) into the Euler equation (13) yields

$$u'(c_{B_j,1}) = \beta R\,\mathbb{E}_j[u'(c_{B_j,2})] = \beta R\left(a\,\mathbb{E}_j[u'(c_{C_j,2})] + \mathbb{E}_j[\mu_{B_j}]\right).$$

Plugging this into the definition of the implicit discount rate from Equation (16) gives

$$\widetilde{R}_j = \beta R\frac{a\,\mathbb{E}_j[u'(c_{C_j,2})] + \mathbb{E}_j[\mu_{B_j}]}{\beta\,a\,\mathbb{E}_j[u'(c_{C_j,2})]} = R\left(1 + \frac{\mathbb{E}_j[\mu_{B_j}]}{a\,\mathbb{E}_j[u'(c_{C_j,2})]}\right).$$

Since $\mu^i_{B_j} \geq 0$, with $\mu^i_{B_j} > 0$ exactly when the constraint binds in state i (Equation (33)), $\mathbb{E}_j[\mu_{B_j}] = 0$ if the constraint is slack in every state occurring with positive probability, and $\mathbb{E}_j[\mu_{B_j}] > 0$ if it binds with positive probability. The inequality from the proposition (its strict case as well as the equality) follows.

For Parts (b) and (c), we rewrite the implicit discount rate. Since $a\,\mathbb{E}_j[u'(c_{C_j,2})] = \mathbb{E}_j[u'(c_{B_j,2})] - \mathbb{E}_j[\mu_{B_j}]$ by Equation (34), and $\mathbb{E}_j[u'(c_{B_j,2})] = u'(c_{B_j,1})/(\beta R)$ by the Euler equation (13),

$$\widetilde{R}_j = \frac{R}{1 - X_j}, \qquad X_j := \frac{\beta R\,\mathbb{E}_j[\mu_{B_j}]}{u'(c_{B_j,1})} = \frac{\mathbb{E}_j[\mu_{B_j}]}{\mathbb{E}_j[u'(c_{B_j,2})]}. \tag{44}$$

The term X_j is the share of the parent's expected second-period marginal utility that is accounted for by the bequest constraint. Since $a > 0$ and $u' > 0$, Equation (34) gives $\mathbb{E}_j[u'(c_{B_j,2})] > \mathbb{E}_j[\mu_{B_j}] \geq 0$, so $X_j \in [0, 1)$, and $\widetilde{R}_j$ is strictly increasing in X_j.

Parts (b) and (c). We prove both parts for a generic constrained dynasty, denoted L for concreteness; the argument uses only that its bequest constraint binds with positive probability. As in Appendix A, $m_L := R\, s_{B_L,1}$ denotes B_L's second-period resources, and we let the child's net endowment be higher in state H, $e^H_{C_L,2} > e^L_{C_L,2}$. Since the constraint binds in state i if and only if $e^i_{C_L,2} > a^{1/\eta}\, m_L$ (Appendix A), it can bind in state L only if it also binds in state H. By Equation (44), $\widetilde{R}_L$ is strictly increasing in X_L. For the comparative statics with respect to a and P_{LH}, it therefore suffices to sign two objects: the expected shadow value $\mathbb{E}_L[\mu_{B_L}]$ (the numerator of X_L) and the first-period marginal utility $u'(c_{B_L,1})$ (the denominator of X_L). We sign them in each binding configuration and then connect the two.

Configuration (A): one state binds. Suppose B_L's constraint binds in the high-productivity (rich-child) state H, while B_L leaves a positive bequest in state L, so $\mu^H_{B_L} > 0$ and $\mu^L_{B_L} = 0$, with $c^H_{C_L,2} = e^H_{C_L,2}$ fixed at the corner $b^H_{B_L,2} = 0$. Appendix A shows that B_L's saving obeys the standard Euler equation (13) despite the kink in its bequest policy, and that its second-period marginal utility is lower in the state where the constraint binds, $u'(c^H_{B_L,2}) < u'(c^L_{B_L,2})$, strictly so because $b^L_{B_L,2} > 0$ (Equation (39)).

Altruism. Hold saving $s_{B_L,1}$ fixed and raise a. In the binding state nothing moves: $b^H_{B_L,2} = 0$ stays and $c^H_{B_L,2} = m_L$, so $u'(c^H_{B_L,2})$ is unchanged. In the slack state the parent re-optimizes $u'(c^L_{B_L,2}) = a\, u'(c^L_{C_L,2})$; a higher weight a on the child raises the bequest $b^L_{B_L,2}$ and lowers $c^L_{B_L,2}$, so $u'(c^L_{B_L,2})$ rises. Hence, at the old saving, $\mathbb{E}_L[u'(c_{B_L,2})]$ rises (slack term up, binding term fixed), and the Euler equation (13) is violated with its right-hand side exceeding its left. Since the left-hand side rises with saving and the right-hand side falls with it (Equation (36)), B_L saves more, restoring Equation (13) at

$$s_{B_L,1} \uparrow, \qquad c_{B_L,1} \downarrow, \qquad u'(c_{B_L,1}) \uparrow,$$

thus signing the denominator of X_L. Meanwhile $\mathbb{E}_L[\mu_{B_L}] = P_{LH}\, \mu^H_{B_L}$ with $\mu^H_{B_L} = u'(m_L) - a\, u'(c^H_{C_L,2})$ (Equation (33)) falls: directly, since $\partial \mu^H_{B_L}/\partial a = -\,u'(c^H_{C_L,2}) < 0$, and further because the induced rise in $s_{B_L,1}$ raises $c^H_{B_L,2} = m_L$ and lowers $u'(m_L)$. Both objects move X_L down, so $\partial \widetilde{R}_L/\partial a < 0$.

Upward mobility. Raising P_{LH}, and hence lowering $P_{LL} = 1 - P_{LH}$, leaves the per-state second-stage policies unchanged but moves two objects. Evaluated at the old level of saving, $\mathbb{E}_L[u'(c_{B_L,2})]$ falls, since more probability mass is placed on the lower-marginal-utility state H, and the Euler equation (13) is violated with its left-hand side exceeding its right. Since the left-hand side rises with saving and the right-hand side falls with it (Equation (36)), B_L lowers saving and raises first-period consumption,

$$s_{B_L,1} \downarrow, \qquad c_{B_L,1} \uparrow, \qquad \text{hence} \qquad u'(c_{B_L,1}) \downarrow,$$

signing the denominator of X_L. Since $\mu^L_{B_L} = 0$, $\mathbb{E}_L[\mu_{B_L}] = P_{LH}\, \mu^H_{B_L}$ rises: directly through the larger weight P_{LH}, and further because the induced fall in $s_{B_L,1}$ lowers $c^H_{B_L,2} = m_L$ and so raises $\mu^H_{B_L}$ (Equation (33)). Both objects move X_L up, so $\partial \widetilde{R}_L/\partial P_{LH} > 0$.

Configuration (B): both states bind. Now suppose B_L's constraint binds in both states ($\mu^L_{B_L}, \mu^H_{B_L} > 0$). Second-period consumption is then deterministic, $c^i_{B_L,2} = m_L$, so $\mathbb{E}_L[u'(c_{B_L,2})] = u'(m_L)$ is independent of a and P_{LH}, and the Euler equation (13) leaves $s_{B_L,1}$ – and hence $u'(c_{B_L,1})$ – invariant: the result rests on the numerator of X_L alone.

Altruism. Each $\mu^i_{B_L} = u'(m_L) - a\,u'(e^i_{C_L,2})$ (Equation (33)) falls directly in a, so $\mathbb{E}_L[\mu_{B_L}] \downarrow$ and $\partial \widetilde{R}_L/\partial a < 0$.

Upward mobility. Since $c^H_{C_L,2} = e^H_{C_L,2} > e^L_{C_L,2} = c^L_{C_L,2}$ gives the rich-child state the lower $a\,u'(c_{C_L,2})$, we have $\mu^H_{B_L} > \mu^L_{B_L}$ (Equation (33)); shifting weight to H raises $\mathbb{E}_L[\mu_{B_L}]$, so $\partial \widetilde{R}_L/\partial P_{LH} > 0$.

Configuration (C): connecting the two configurations. Configurations (A) and (B) connect continuously. As a rises, $\mu^L_{B_L}$ falls and, at a critical value of a, attains zero – L's low state passing from the both-binding configuration (B) to the one-binding configuration (A). At this switch, state L sits at the threshold of Appendix A, $e^L_{C_L,2} = a^{1/\eta}\,m_L$, where $b^L_{B_L,2} = 0$ and $\mu^L_{B_L} = 0$. Because policies, and hence $\widetilde{R}_L$, are continuous in a across this switch (see below) and $\partial \widetilde{R}_L/\partial a < 0$ on each side, $\widetilde{R}_L$ is strictly decreasing in a throughout, including across the switch. The second-stage policies are continuous in a because, at the switch, the slack policies (35), which depend continuously on a, give $c^L_{B_L,2} = m_L$, $c^L_{C_L,2} = e^L_{C_L,2}$ and $b^L_{B_L,2} = 0$, which are the binding policies (Appendix A). Saving is continuous in a because the Euler equation holds at the switch as well (Appendix A), so that saving is the root of the function F_L in the proof of Lemma A.1. This function is strictly increasing in saving, so that it crosses zero exactly once. It is also continuous in a, since the second-stage policies are. A small change in a therefore moves the crossing, and with it saving, only a little. The same continuity argument covers the binding-region change in the upward-mobility case, where a state begins to bind as P_{LH} rises.

Finally, a dynasty whose bequest constraint is slack in every state has $\mathbb{E}_j[\mu_{B_j}] = 0$ (Equation (33)), hence $X_j = 0$ and $\widetilde{R}_j = R$ (Equation (44)), for any $a > 0$ and any mobility probability at which it remains unconstrained. □

D The Monotonicity Lemma and Its Proof

For a fixed dynasty j, the provision level g enters household B_j's two-stage saving-bequest problem (Appendix A) only through the two net endowments $e_{B_j,1}$ and $e^i_{C_j,2}$ of Equation (32), holding the received bequest $b_{A_j,1}$ fixed, as throughout. With $\delta = 0$ and without transfers, the first is

$$e_{B_j,1}(g) = w_{B_j,1} + b_{A_j,1} - \gamma_j\,\Gamma(g), \qquad \frac{\partial e_{B_j,1}}{\partial g} = -\gamma_j\,\Gamma'(g) \le 0,$$

which falls in g because the dynasty bears the cost share $\gamma_j \in (0,1)$. The second is the child's net endowment in state i,

$$e^i_{C_j,2}(g) = w^i_{C,2} + \xi^i_j\,g, \qquad \frac{\partial e^i_{C_j,2}}{\partial g} = \xi^i_j \ge 0,$$

which rises in g through the marginal benefit. On the domain $[0, \bar{g}]$ of g (Section 2.1), $e_{B_j,1}(g) > 0$ and $e^i_{C_j,2}(g) \geq w^i_{C,2} > 0$, so Lemma A.1 applies at every g. Say that dynasty j is *constrained at* g if its bequest constraint binds with positive probability at that level – equivalently, $\widetilde{R}_j(g) > R$ (Proposition 1(a)).

Lemma D.1 (Monotonicity of the implicit rate in provision)**.** *Let $a > 0$ and let the benefits satisfy $\xi^i_j \geq 0$ with $\mathbb{E}_j[\xi_j] > 0$. Then the implicit discount rate $\widetilde{R}_j(g)$ of every dynasty is continuous and non-decreasing on $[0, \bar{g}]$. Moreover there is a threshold $\hat{g}_j \in [0, \bar{g}]$ such that dynasty j is unconstrained at every $g < \hat{g}_j$ and constrained at every $g > \hat{g}_j$, and*

$$\widetilde{R}_j(g) = R \;\; \textit{for } g < \hat{g}_j, \qquad \widetilde{R}_j \;\textit{strictly increasing on } [\hat{g}_j, \bar{g}].$$

Equivalently, the marginal valuation of provision, $\xi/\widetilde{R}_j(g)$, is non-increasing: constant at ξ/R below the threshold, strictly decreasing above it.

Proof. As in Appendix A, the two second-period states $i \in \{L, H\}$ occur with probabilities $P_{ji} \in (0, 1)$, and $m_j := R\, s_{B_j,1}$ denotes B_j's second-period resources.

Step 1: reduced form, representation and plan of the proof. Because household B_j's problem depends on g only through $e_{B_j,1}(g)$ and $\big(e^L_{C_j,2}(g), e^H_{C_j,2}(g)\big)$, the implicit rate is a reduced-form function $\widetilde{R}_j(e_{B_j,1}, e^L_{C_j,2}, e^H_{C_j,2})$, and on any open interval of g on which the set of binding states does not change, the chain rule gives

$$\frac{\mathrm{d}\widetilde{R}_j}{\mathrm{d}g} = -\,\gamma_j\,\Gamma'(g)\,\frac{\partial \widetilde{R}_j}{\partial e_{B_j,1}} + \sum_{i \in \{L,H\}} \xi^i_j\,\frac{\partial \widetilde{R}_j}{\partial e^i_{C_j,2}}. \tag{45}$$

By Equation (44) in the proof of Proposition 1, $\widetilde{R}_j = R/(1 - X_j)$ with $X_j \in [0, 1)$, so $\widetilde{R}_j$ is strictly increasing in X_j, and it suffices to sign the responses of X_j. Step 2 signs $\partial \widetilde{R}_j / \partial e_{B_j,1} \leq 0$, and Step 3 signs $\partial \widetilde{R}_j / \partial e^i_{C_j,2} \geq 0$; both draw on the saving responses of Lemma A.1. Step 4 assembles Equation (45), shows that $\widetilde{R}_j$ is continuous in g and that the binding pattern changes monotonically in g, and concludes.

Step 2 (Claim A): the response of the rate to first-period resources. We show

$$\frac{\partial \widetilde{R}_j}{\partial e_{B_j,1}} < 0 \;\text{ if some state binds}, \qquad \frac{\partial \widetilde{R}_j}{\partial e_{B_j,1}} = 0 \;\text{ if no state binds}.$$

There are three binding patterns.

No state binds. Slackness is an open condition: the inequality $e^i_{C_j,2} < a^{1/\eta}\, m_j$ is strict, and $m_j = R\, s_{B_j,1}$ is continuous in the net endowments (Lemma A.1), so all states remain slack in a neighborhood, where $\mathbb{E}_j[\mu_{B_j}] \equiv 0$ (Equation (33)): $X_j \equiv 0$ and $\widetilde{R}_j \equiv R$ is invariant.

Both states bind. Then $c^i_{B_j,2} = m_j$ in both states, so by Equations (33) and (44)

$$X_j = \frac{u'(m_j) - a\,\mathbb{E}_j[u'(e_{C_j,2})]}{u'(m_j)} = 1 - \frac{a\,\mathbb{E}_j[u'(e_{C_j,2})]}{u'(m_j)}.$$

The endowments $e^i_{C_j,2}$ are fixed and $e_{B_j,1}$ enters only through m_j, with $\partial m_j/\partial e_{B_j,1} > 0$ by Lemma A.1(a); a higher m_j strictly lowers $u'(m_j)$, strictly raises the ratio, and strictly lowers X_j.

Exactly one state binds. Without loss of generality, let the constraint bind in state H and be slack in state L (nothing below uses the ranking of the child's net endowments in the two states). Then

$$\mathbb{E}_j[\mu_{B_j}] = P_{jH}\,\mu^H_{B_j}, \qquad \mu^H_{B_j} = u'(m_j) - a\,u'(e^H_{C_j,2}) > 0,$$

and, with the slack-state policy (35),

$$\mathbb{E}_j[u'(c_{B_j,2})] = P_{jL}\,u'(c^L_{B_j,2}) + P_{jH}\,u'(m_j), \qquad c^L_{B_j,2} = \frac{m_j + e^L_{C_j,2}}{1 + a^{1/\eta}}.$$

Since $e^L_{C_j,2} > 0$, this policy implies the budget bound, used below,

$$m_j = (1 + a^{1/\eta})\,c^L_{B_j,2} - e^L_{C_j,2} \;\le\; (1 + a^{1/\eta})\,c^L_{B_j,2}. \tag{46}$$

By Equation (44), $X_j = P_{jH}\,\mu^H_{B_j}/\mathbb{E}_j[u'(c_{B_j,2})]$. At fixed $e^L_{C_j,2}$ and $e^H_{C_j,2}$, every object in this expression depends on $e_{B_j,1}$ only through m_j, and $\partial m_j/\partial e_{B_j,1} > 0$ by Lemma A.1(a); so it suffices to show $\mathrm{d}X_j/\mathrm{d}m_j < 0$. By the quotient rule,

$$\operatorname{sign}\frac{\mathrm{d}X_j}{\mathrm{d}m_j} = \operatorname{sign}\left(\frac{\mathrm{d}\mu^H_{B_j}}{\mathrm{d}m_j}\,\mathbb{E}_j[u'(c_{B_j,2})] - \mu^H_{B_j}\,\frac{\mathrm{d}\,\mathbb{E}_j[u'(c_{B_j,2})]}{\mathrm{d}m_j}\right),$$

$$\frac{\mathrm{d}\mu^H_{B_j}}{\mathrm{d}m_j} = u''(m_j), \qquad \frac{\mathrm{d}\,\mathbb{E}_j[u'(c_{B_j,2})]}{\mathrm{d}m_j} = \frac{P_{jL}\,u''(c^L_{B_j,2})}{1 + a^{1/\eta}} + P_{jH}\,u''(m_j).$$

Expanding and grouping by probability weights,

$$\begin{aligned}&\frac{\mathrm{d}\mu^H_{B_j}}{\mathrm{d}m_j}\,\mathbb{E}_j[u'(c_{B_j,2})] - \mu^H_{B_j}\,\frac{\mathrm{d}\,\mathbb{E}_j[u'(c_{B_j,2})]}{\mathrm{d}m_j}\\ &\qquad = P_{jH}\,u''(m_j)\left[u'(m_j) - \mu^H_{B_j}\right] + P_{jL}\left[u''(m_j)\,u'(c^L_{B_j,2}) - \mu^H_{B_j}\,\frac{u''(c^L_{B_j,2})}{1 + a^{1/\eta}}\right].\end{aligned}$$

The first group is strictly negative, since $u'(m_j) - \mu^H_{B_j} = a\,u'(e^H_{C_j,2}) > 0$ and $u''(m_j) < 0$. The second group contains the tension that makes this claim non-trivial: its first term is negative but its second term is positive (as $u'' < 0$), reflecting the fact that a higher m_j lowers the shadow value $\mu^H_{B_j}$ (numerator of X_j) but also lowers the expected marginal utility $\mathbb{E}_j[u'(c_{B_j,2})]$ (denominator of X_j). To resolve the tension, bound the positive term. First, since $a\,u'(e^H_{C_j,2}) > 0$,

$$\mu^H_{B_j}\,\frac{-\,u''(c^L_{B_j,2})}{1 + a^{1/\eta}} \;<\; u'(m_j)\,\frac{-\,u''(c^L_{B_j,2})}{1 + a^{1/\eta}}.$$

Second, under CRRA, $-u''(c) = \eta\,c^{-\eta-1}$, so

$$\frac{u'(m_j)\left(-u''(c^L_{B_j,2})\right)/(1 + a^{1/\eta})}{u'(c^L_{B_j,2})\left(-u''(m_j)\right)} = \frac{m_j^{-\eta}\,\eta\,(c^L_{B_j,2})^{-\eta-1}}{(1 + a^{1/\eta})\,(c^L_{B_j,2})^{-\eta}\,\eta\,m_j^{-\eta-1}} = \frac{m_j}{(1 + a^{1/\eta})\,c^L_{B_j,2}} \;\le\; 1,$$

by the budget bound (46). Chaining the two inequalities above,

$$\mu^H_{B_j}\,\frac{-\,u''(c^L_{B_j,2})}{1+a^{1/\eta}}\;<\;u'(c^L_{B_j,2})\,\big(-u''(m_j)\big),$$

which says exactly that the second group is strictly negative. Hence $\mathrm{d}X_j/\mathrm{d}m_j<0$, and with $\partial m_j/\partial e_{B_j,1}>0$,

$$\frac{\partial \widetilde{R}_j}{\partial e_{B_j,1}}<0.$$

Step 3 (Claim B): the response of the rate to the child's net endowments. We show that $\partial\widetilde{R}_j/\partial e^i_{C_j,2}=0$ for every state if no state binds, while, as soon as some state binds – i.e., the dynasty is constrained – $\partial\widetilde{R}_j/\partial e^i_{C_j,2}>0$ for every state $i\in\{L,H\}$. Three cases. Fix a state i. Either it binds, whatever the other state does (i); or it is slack while the other state binds (ii); or no state binds (iii); in a constrained dynasty, a slack state falls under (ii).

(i) State i binds. By Lemma A.1(b), $s_{B_j,1}$, m_j and $c_{B_j,1}$ are unchanged, and so is

$$\mathbb{E}_j\big[u'(c_{B_j,2})\big]=P_{ji}\,u'(m_j)+P_{jk}\,u'\big(c^*_{B_j,2}(m_j,\,e^k_{C_j,2})\big),$$

where k denotes the other state: state i contributes $u'(m_j)$, and the other state's consumption $c^*_{B_j,2}(m_j,e^k_{C_j,2})$ depends only on m_j and its own endowment $e^k_{C_j,2}$, neither of which moves. The multiplier (Equation (33)) rises strictly,

$$\frac{\partial\mu^i_{B_j}}{\partial e^i_{C_j,2}}=-\,a\,u''(e^i_{C_j,2})>0\qquad\Longrightarrow\qquad\frac{\partial X_j}{\partial e^i_{C_j,2}}=\frac{P_{ji}\,\big(-a\,u''(e^i_{C_j,2})\big)}{\mathbb{E}_j[u'(c_{B_j,2})]}>0.$$

(ii) State i slack, the other state k binds. By Lemma A.1(c), saving falls strictly, so m_j falls and $c_{B_j,1}$ rises. The binding state's multiplier (Equation (33))

$$\mu^k_{B_j}=u'(m_j)-a\,u'(e^k_{C_j,2})$$

rises strictly as $u'(m_j)$ rises, so $\mathbb{E}_j[\mu_{B_j}]$ rises; and $u'(c_{B_j,1})$ falls. In the first expression of Equation (44) the numerator rises and the denominator falls: X_j rises strictly. Here, unlike in Step 2, the numerator and the denominator of X_j move it in the same direction, so no quantitative comparison is needed.

(iii) No state binds. As in Step 2, slackness is an open condition, so $\mathbb{E}_j[\mu_{B_j}]\equiv 0$ in a neighborhood: $X_j\equiv 0$ and $\widetilde{R}_j\equiv R$.

Step 4: assembly. Steps 2 and 3 sign the partial derivatives of $\widetilde{R}_j$ within a binding pattern, that is, on any interval of g on which the set of binding states does not change. To conclude that $\widetilde{R}_j$ is non-decreasing on all of $[0,\bar{g}]$, three things are needed: the sign of $\mathrm{d}\widetilde{R}_j/\mathrm{d}g$ within a pattern (4a); that $\widetilde{R}_j$ does not jump where the pattern changes (4b); and that the pattern changes at only finitely many points, so that these intervals cover $[0,\bar{g}]$ up to those points (4c). (4d) combines them.

(4a) Within a binding pattern. Substitute Steps 2 and 3 into Equation (45), reproduced for the reader:

$$\frac{\mathrm{d}\widetilde{R}_j}{\mathrm{d}g}=-\,\gamma_j\,\Gamma'(g)\,\frac{\partial\widetilde{R}_j}{\partial e_{B_j,1}}+\sum_{i\in\{L,H\}}\xi^i_j\,\frac{\partial\widetilde{R}_j}{\partial e^i_{C_j,2}}.$$

On an interval of g where no state binds, both terms vanish and $\widetilde{R}_j \equiv R$. On an interval where the dynasty is constrained, the first summand is the product of $-\gamma_j \Gamma'(g) \leq 0$ and $\partial \widetilde{R}_j / \partial e_{B_j,1} < 0$, hence non-negative, and strictly positive for $g > 0$. The second summand is strictly positive for $g \geq 0$, because Step 3 makes every partial derivative strictly positive and the assumption $\mathbb{E}_j[\xi_j] > 0$ ensures $\xi_j^i > 0$ in at least one state. Hence $\mathrm{d}\widetilde{R}_j / \mathrm{d}g > 0$ on the interior of every constrained interval.

(4b) Continuity. The net endowments are continuous in g, the Euler root is continuous in the net endowments (Lemma A.1), and the second-stage policies are continuous in $(m_j, e^i_{C_j,2})$ (Appendix A); hence $c_{B_j,1}$, $\mathbb{E}_j[u'(c_{C_j,2})]$ and therefore $\widetilde{R}_j(g)$ (Equation (16)) are continuous in g, also where the binding pattern changes.

(4c) The binding pattern changes monotonically in g. At fixed saving, the function F_j from the proof of Lemma A.1 (the Euler equation rearranged as $F_j(s_{B_j,1}) = 0$) is non-decreasing in g: the first-period endowment $e_{B_j,1}(g)$ does not rise, so $u'\big(e_{B_j,1}(g) - s_{B_j,1}\big)$ does not fall, and the parent's consumption $c^*_{B_j,2}(m_j, e)$ is non-decreasing in the child's endowment (Equation (36), with the policies continuous at the threshold), so $u'(c^i_{B_j,2})$ does not rise as $e^i_{C_j,2}(g)$ rises. Since F_j is strictly increasing in saving, its root $s_{B_j,1}(g)$ is non-increasing in g. So $m_j(g) = R\, s_{B_j,1}(g)$ is non-increasing while every $e^i_{C_j,2}(g)$ is non-decreasing, and the binding criterion of Appendix A, $e^i_{C_j,2} > a^{1/\eta}\, m_j$, once satisfied at some g remains satisfied at every higher g: each state binds beyond a state-specific threshold. The g-axis therefore splits into at most three consecutive intervals – no state binds, one binds, both bind (some possibly empty) – so the dynasty is unconstrained below some $\hat{g}_j \in [0, \bar{g}]$ and constrained above it. This is the threshold $\hat{g}_j$ of the statement.

(4d) Conclusion. Combining: $\widetilde{R}_j$ is continuous throughout and equals R on $[0, \hat{g}_j)$, hence also at $\hat{g}_j$ when $\hat{g}_j > 0$; it has a strictly positive derivative on the interior of each constrained subinterval, so it is strictly increasing on $[\hat{g}_j, \bar{g}]$ and non-decreasing on $[0, \bar{g}]$. The statement for the marginal valuation $\xi / \widetilde{R}_j(g)$ follows immediately. □

E Proof of Lemma 1

We use the reduced form of Lemma D.1's proof (Appendix D, Step 1): dynasty j's implicit rate is a function $\widetilde{R}_j(e_{B_j,1}, e^L_{C_j,2}, e^H_{C_j,2})$ of the net endowments of Equation (32), with the signs of the partial derivatives established there in Steps 2 and 3. These signs hold within a binding pattern, and for a marginal transfer, the set of binding states does not change.

(a) Intragenerational transfer. A marginal transfer $T_1 > 0$ from B_H to B_L in $t = 1$ ($T_{L,1} = T_1$ and $T_{H,1} = -T_1$ in Equation (32)) changes first-period net endowments only:

$$\frac{\partial e_{B_L,1}}{\partial T_1} = 1, \qquad \frac{\partial e_{B_H,1}}{\partial T_1} = -1, \qquad \frac{\partial e^i_{C_j,2}}{\partial T_1} = 0 \quad \text{for all } j, i.$$

Dynasty L is constrained, so Step 2 applies with a binding state present; since the transfer moves $\widetilde{R}_L$ only through its argument $e_{B_L,1}$,

$$\frac{\mathrm{d}\widetilde{R}_L}{\mathrm{d}T_1} = \frac{\partial \widetilde{R}_L}{\partial e_{B_L,1}} \frac{\partial e_{B_L,1}}{\partial T_1} = \frac{\partial \widetilde{R}_L}{\partial e_{B_L,1}} < 0.$$

By assumption, dynasty H is at an interior bequest optimum in every state, so a marginal loss of resources leaves it in the no-binding pattern (Appendix D, Step 2), where $X_H \equiv 0$ by Equation (44): $\widetilde{R}_H = R$ is unchanged.

(b) Intergenerational transfer. Per household the scheme pays $T_1 > 0$ in $t = 1$ and taxes the child $R\,T_1$ in $t = 2$ in every state ($T_{j,1} = T_1$ and $T^i_{j,2} = -R\,T_1$ in Equation (32)):

$$\frac{\partial e_{B_j,1}}{\partial T_1} = 1, \qquad \frac{\partial e^i_{C_j,2}}{\partial T_1} = -R \quad \text{for } i = L, H.$$

For the constrained dynasty L, Steps 2 and 3 give

$$\frac{\mathrm{d}\widetilde{R}_L}{\mathrm{d}T_1} = \underbrace{\frac{\partial \widetilde{R}_L}{\partial e_{B_L,1}}}_{<0} - R \sum_{i\in\{L,H\}} \underbrace{\frac{\partial \widetilde{R}_L}{\partial e^i_{C_L,2}}}_{>0} \; < \; 0 :$$

the first-period receipt and the second-period tax on the child reinforce each other, as stated in the main text. For the unconstrained dynasty H, we derive the Ricardian response by guess-and-verify. Guess that B_H raises its saving by exactly the transfer, $\partial s_{B_H,1}/\partial T_1 = 1$. Then first-period consumption $c_{B_H,1} = e_{B_H,1} - s_{B_H,1}$ is unchanged, while $m_H = R\,s_{B_H,1}$ rises at rate R and every $e^i_{C_H,2}$ falls at rate R, so $m_H + e^i_{C_H,2}$ – the only argument of the slack-state consumption policies (35) – is unchanged in both states: all second-period consumptions of parent and child are unchanged, and the bequest rises by exactly the tax the child must pay,

$$\frac{\partial b^i_{B_H,2}}{\partial T_1} = \frac{a^{1/\eta}\,R + R}{1 + a^{1/\eta}} = R > 0,$$

so the bequest stays positive and the slack-state policies continue to apply. Since no consumption changes, the Euler equation continues to hold at this candidate, which by uniqueness of the Euler root (Lemma A.1) is therefore the optimal response. With all marginal utilities unchanged, $\widetilde{R}_H = R$ is unchanged.

□

F Derivation of the Preferred Level g^*_j

We derive the first-order condition (18) and the decomposition (19) for the more general own-benefit formulation of Section 5.2, which also gives Equations (27) and (29); the baseline follows for $\delta = 0$. We start from household B_j's problem in the reduced form of Appendix A, with the transfers set to zero, $T_{j,1} = T^i_{j,2} = 0$. The level g then enters the problem only through the two net endowments (32), with

$$\frac{\partial e_{B_j,1}}{\partial g} = \delta\,\xi\,\sigma_j - \gamma_j\,\Gamma'(g), \qquad \frac{\partial e^i_{C_j,2}}{\partial g} = \xi^i_j.$$

The preferred level g^*_j is defined by $\partial U^*_{B_j}/\partial g = 0$. Since saving $s_{B_j,1}$ is optimized, the envelope theorem gives

$$\frac{\partial U^*_{B_j}}{\partial g} = \big(\delta\,\xi\,\sigma_j - \gamma_j\,\Gamma'(g)\big)\,u'(c_{B_j,1}) + \beta \sum_{i\in\{L,H\}} P_{ji}\,\frac{\partial V_2\big(R\,s_{B_j,1},\, e^i_{C_j,2}\big)}{\partial e}\,\xi^i_j.$$

The first term is the marginal own-benefit net of the marginal cost, both accruing in $t = 1$, the second the altruistic value of the child's benefit. By Equation (38), the marginal value of the child's endowment is $\partial V_2/\partial e = a\,u'(c^i_{C_j,2})$, in both regimes and at the threshold, so B_j's marginal welfare gain of provision is

$$\frac{\partial U^*_{B_j}}{\partial g} = \big(\delta\,\xi\,\sigma_j - \gamma_j\,\Gamma'(g)\big)\,u'(c_{B_j,1}) + \beta\,a\,\mathbb{E}_j\big[u'(c_{C_j,2})\,\xi_j\big]\,. \tag{47}$$

Setting it to zero at g^*_j yields the first-order condition in expectation form, which for $\delta = 0$ is Equation (18).

Write the expectation of the product as level plus covariance,

$$\begin{aligned}\mathbb{E}_j[u'(c_{C_j,2})\,\xi_j] &= \mathbb{E}_j[\xi_j]\,\mathbb{E}_j[u'(c_{C_j,2})] + \mathrm{Cov}_j(\xi_j, u'(c_{C_j,2})) \\ &= \mathbb{E}_j[\xi_j]\,\mathbb{E}_j[u'(c_{C_j,2})]\left(1 + \frac{\mathrm{Cov}_j(\xi_j, u'(c_{C_j,2}))}{\mathbb{E}_j[\xi_j]\,\mathbb{E}_j[u'(c_{C_j,2})]}\right).\end{aligned} \tag{48}$$

The bracket is the insurance factor χ_j of Equation (19). Divide the first-order condition by $\gamma_j\,u'(c_{B_j,1})$ and use $\beta a\,\mathbb{E}_j[u'(c_{C_j,2})]/u'(c_{B_j,1}) = 1/\widetilde{R}_j$ from Equation (16) to obtain

$$\Gamma'(g^*_j) = \delta\,\xi\,\frac{\sigma_j}{\gamma_j} + \frac{\mathbb{E}_j[\xi_j]}{\gamma_j}\,\frac{1}{\widetilde{R}_j}\left(1 + \frac{\mathrm{Cov}_j\big(\xi_j, u'(c_{C_j,2})\big)}{\mathbb{E}_j[\xi_j]\,\mathbb{E}_j[u'(c_{C_j,2})]}\right).$$

Multiplying and dividing the second term by $\xi = \sum_k \mathbb{E}_k[\xi_k]$ and by R produces the decomposition

$$\Gamma'(g^*_j) = \delta\,\xi\,\mathrm{BC}^{\mathrm{own}}_j + \frac{\xi}{R}\,\frac{R}{\widetilde{R}_j}\,\mathrm{BC}_j\,\chi_j, \qquad \mathrm{BC}^{\mathrm{own}}_j := \frac{\sigma_j}{\gamma_j}, \tag{49}$$

with the benefit-cost factor $\mathrm{BC}_j = (\mathbb{E}_j[\xi_j]/\xi)/\gamma_j$; for $\delta = 0$, it is the decomposition (19). Under Assumption 1, $\mathrm{BC}_j = \chi_j = 1$, and with the own-benefit share $\sigma_j = \mathbb{E}_j[\xi_j]/\xi$ of Sections 5.2 and 6, $\mathrm{BC}^{\mathrm{own}}_j = 1$ as well; Equation (49) then reduces to $\Gamma'(g^*_j) = \delta\,\xi + \xi/\widetilde{R}_j$, which is Equations (27) and (29).

G Derivation of the Politically-Revealed Discount Rate

We derive the government's first-order condition for the more general own-benefit formulation of Section 5.2; the baseline condition (20) follows for $\delta = 0$. The government chooses g to maximize $W = \sum_j \omega_j\,U^*_{B_j}(g)$. Household B_j's marginal welfare gain of provision is Equation (47) of Appendix F, which holds at every g. Writing its expectations term as level plus covariance (see Equation (48)),

$$\frac{\partial U^*_{B_j}}{\partial g} = \big(\delta\,\xi\,\sigma_j - \gamma_j\,\Gamma'(g)\big)\,u'(c_{B_j,1}) + \beta a\,\mathbb{E}_j[\xi_j]\,\mathbb{E}_j[u'(c_{C_j,2})] + \beta a\;\mathrm{Cov}_j\big(\xi_j, u'(c_{C_j,2})\big)\,.$$

Invoking the maintained Assumption 1 – $\mathrm{Cov}_j = 0$ (state-independent benefits, $\xi^i_j \equiv \xi_j$, so $\mathbb{E}_j[\xi_j] = \xi_j$) and the benefit principle $\gamma_j = \mathbb{E}_j[\xi_j]/\xi = \xi_j/\xi$ – with the own-benefit share

$\sigma_j = \xi_j/\xi = \gamma_j$ of Sections 5.2 and 6, and using $\widetilde{R}_j = u'(c_{B_j,1})/(\beta a\, \mathbb{E}_j[u'(c_{C_j,2})])$ from Equation (16),

$$\frac{\partial U^*_{B_j}}{\partial g} = u'(c_{B_j,1}) \left[\delta\, \xi\, \sigma_j - \gamma_j\, \Gamma'(g) + \frac{\xi_j}{\widetilde{R}_j}\right] = \frac{u'(c_{B_j,1})\, \xi_j}{\xi} \left[\delta\, \xi - \Gamma'(g) + \frac{\xi}{\widetilde{R}_j}\right].$$

The government's first-order condition $\sum_j \omega_j\, \partial U^*_{B_j}/\partial g = 0$ then reads

$$\Gamma'(g^*) \sum_j \omega_j\, \xi_j\, u'(c_{B_j,1}) = \sum_j \omega_j\, \xi_j\, u'(c_{B_j,1}) \left(\delta\, \xi + \frac{\xi}{\widetilde{R}_j}\right),$$

where $c_{B_j,1}$ and $\widetilde{R}_j$ are evaluated at g^*. Dividing both sides by $\sum_k \omega_k\, \xi_k\, u'(c_{B_k,1})$ gives

$$\Gamma'(g^*) = \delta\, \xi + \frac{\xi}{\widetilde{R}_{\text{pol}}}, \qquad \frac{1}{\widetilde{R}_{\text{pol}}} = \sum_j \frac{\nu_j}{\widetilde{R}_j}, \tag{50}$$

with the weights ν_j of Equation (21), which are non-negative and sum to one. For $\delta = 0$, this is Equation (20).

With two dynasties, L and H, $\nu_H = 1 - \nu_L$, and the politically-revealed rate can be written as a function of the single weight ν_L,

$$D := \frac{1}{\widetilde{R}_{\text{pol}}} = \frac{\nu_L}{\widetilde{R}_L} + \frac{\nu_H}{\widetilde{R}_H} = \frac{1}{\widetilde{R}_H} + \nu_L \left(\frac{1}{\widetilde{R}_L} - \frac{1}{\widetilde{R}_H}\right). \tag{51}$$

By Equation (50), $g^* = (\Gamma')^{-1}(\delta\, \xi + \xi\, D)$. Since Γ' is strictly increasing, g^* is increasing in D for every $\delta \geq 0$, provided the effect of g on D is negligible (both $\widetilde{R}_j$ and ν_j depend on g). Equation (51) separates two channels. Through the *rate* channel, a lower $\widetilde{R}_L$ raises D whenever $\nu_L > 0$. Through the *weight* channel, a lower ν_L raises D whenever $\widetilde{R}_L > \widetilde{R}_H$, since the coefficient $1/\widetilde{R}_L - 1/\widetilde{R}_H$ is then negative.

H Derivation of Realized Provision under Upward Mobility

We maintain $\widetilde{R}_H = R < \widetilde{R}_L$: dynasty H is unconstrained, while dynasty L's bequest constraint binds with positive probability. We treat $\widetilde{R}_j$ and ν_j as independent of g, so that g^* is increasing in D (Equation (51), Appendix G). By Proposition 1(c), a rise in P_{LH} raises $\widetilde{R}_L$, which lowers D since $\nu_L > 0$ – the rate channel. Its effect on the weight ν_L depends on the binding configuration of Appendix C; since the constraint can bind in state L only if it binds in state H, there are two. If B_L's constraint binds in state H only (configuration (A)), the rise in P_{LH} lowers B_L's saving and raises $c_{B_L,1}$ (Appendix C), so $u'(c_{B_L,1})$ falls. Since P_{LH} does not enter B_H's problem, $u'(c_{B_H,1})$ is unchanged, and ν_L falls by Equation (21), raising D – the weight channel. The two channels have opposite signs, so the net effect on D, and hence on g^*, cannot be signed without further information. If the constraint binds in both states (configuration (B)), B_L's saving, and hence $u'(c_{B_L,1})$, does not depend on P_{LH} (Appendix C). Then ν_L is unchanged, only the rate channel operates, and the rise in P_{LH} lowers D and hence g^*.

I Proof of Proposition 4

We treat $\widetilde{R}_j$ and ν_j as independent of g, so that g^* is increasing in D (Equation (51), Appendix G). By Lemma 1, each scheme lowers $\widetilde{R}_L$ while leaving $\widetilde{R}_H = R$ unchanged, which raises D since $\nu_L > 0$ – the rate channel. Next, we analyze the weight channel of the two schemes.

(a) Intragenerational transfer. The transfer raises B_L's first-period net endowment and lowers B_H's ($T_{L,1} = T_1$ and $T_{H,1} = -T_1$ in Equation (32)), so by Lemma A.1(a) $c_{B_L,1}$ rises and $c_{B_H,1}$ falls. Hence $u'(c_{B_L,1})$ falls and $u'(c_{B_H,1})$ rises, so ν_L falls by Equation (21). Both the rate channel and the weight channel raise D, hence g^*.

(b) Intergenerational transfer. In a Ricardian way, B_H raises its saving by exactly T_1, leaving $c_{B_H,1}$ unchanged (Appendix E). For B_L, the scheme raises $e_{B_L,1}$ by T_1 and lowers $e^i_{C_L,2}$ by RT_1 in both states (Equation (32)); for a marginal transfer, the set of binding states does not change. If the constraint binds in both states, $s_{B_L,1}$ does not depend on $e^i_{C_L,2}$, and $c_{B_L,1}$ rises with $e_{B_L,1}$ (Lemma A.1(a), (b)). If it binds in state H only (by Appendix C, the only other case), consider the hypothetical saving $s_{B_L,1} + T_1$. At this saving, $c_{B_L,1}$ is unchanged, and so is $m_L + e^L_{C_L,2}$, hence B_L's consumption in the slack state L (Equation (35)); its consumption in the binding state H, $c^H_{B_L,2} = m_L$, rises by RT_1. The right-hand side of the Euler equation (37) thus falls below its left-hand side. Since the left-hand side rises with saving and the right-hand side falls with it (Equation (36)), B_L saves less than $s_{B_L,1} + T_1$, and $c_{B_L,1}$ rises. In both cases, $u'(c_{B_L,1})$ falls while $u'(c_{B_H,1})$ is unchanged, so again ν_L falls by Equation (21). Both channels raise D, hence g^*. □

J Calibration

This appendix describes the calibration of the model to the United States. It reports the parameters set from data, from the literature, or by assumption, together with the quintile-level inputs (Table 5) and the intergenerational earnings transition matrix (Table 6).

We assume one time period to represent 30 years, a standard value for two-period OLG models that tend to identify one time period with either 30 years (Gonzalez-Eiras and Niepelt, 2008; Franks et al., 2018) or 35 years (Karp and Rezai, 2014; Goussebaïle, 2024). Utility is assumed to be logarithmic, i.e., $\eta = 1$ and $u(c) = \ln c$ to ease the computation of the future consumption share ϕ (Appendix K). For the discount factor β, we assume $\beta = G/R$, where R is the gross real interest rate and G the gross growth factor of GDP over one period, which we use to project future earnings from current earnings. Given log utility, this is the balanced-growth condition $\beta R = G$, which neutralizes the pure life-cycle saving motive: absent wage risk, the household's own consumption would grow at the economy-wide rate $G - 1$, leaving altruism to shape the bequest. We take both the yearly real interest rate R_y and the yearly GDP growth rate G_y from the World Bank's World Development Indicators (series FR.INR.RINR and NY.GDP.MKTP.KD.ZG from World Bank, 2025) and compute 20-year averages starting in 2000.

Earnings and bequest. To calibrate the earnings of generation B, we use the Survey of Consumer Finances for the year 2022 (Aladangady et al., 2023). We base ourselves on the summary extract public data provided by the Federal Reserve (Board of Governors of the Federal Reserve System, 2023), which contains the summary variables underlying that report. Because generation B is the working generation, we restrict the sample to households whose reference person is aged 30–59, the 30 years of one model period. Earnings are wages and salaries plus business and farm income. We sort the households of this sample into earnings quintiles and compute average yearly earnings for each quintile. The present value of earnings $w_{B_j,1}$ is the yearly figure aggregated over the 30-year period, growing at the GDP growth rate and discounted at the real interest rate.

In addition to its earnings, generation B receives a bequest $b_{A_j,1}$ from generation A, which we take from the literature. For its level, we follow Hendricks (2007), who reports that households inherit on average 2.4 years of mean after-tax household earnings over their lifetime. For its distribution across the quintiles, we use the shares of lifetime inheritances received by the quintiles of lifetime earnings reported by Nardi and Yang (2014, Table 7): 13.9, 6.0, 22.2, 16.6 and 41.3% from the bottom to the top quintile.[17] Total available resources of generation B in the first period are the sum of the two, $Y_{B_j,1} = w_{B_j,1} + b_{A_j,1}$. Table 5 reports the quintile-level figures. As a robustness check, we replace earnings by total income from the same survey, with households sorted into income quintiles (Table 11).

Since the benefit of climate policy accrues to generation C and scales with its *income*, we also need the earnings of generation C. To account for the passing by of 30 years between $t = 1$ and $t = 2$, we assume that earnings grow homogeneously with the GDP growth rate: the earnings of generation C in earnings state i are the earnings of quintile i of generation B, multiplied by the growth factor G. The child's income base then adds to these the bequest the child inherits from its parent (evaluated at $g = 0$, see Equation (28)). We take the intergenerational transition probabilities from Jäntti (2006), reported in Table 6.[18]

[17] Mean yearly earnings of all households in the Survey of Consumer Finances are 101.9 thousand USD in 2022. Dividing by the ratio of pre-tax to after-tax earnings of 1.3 reported by Hendricks (2007) and multiplying by 2.4 gives 188.1 thousand USD. Hendricks (2007) values inheritances at age 52 and measures them against detrended earnings, that is, against mean earnings of the year in which they are valued. We assume that this ratio also holds for generation B, which reaches age 52 only 22 years after the start of the period. With earnings growing at the rate G_y, the mean bequest received at age 52 is $188.1 \times G_y^{22} = 296.2$ thousand USD, and its present value at age 30 is $296.2/R_y^{22} = 159.9$ thousand USD.

[18] We use Jäntti (2006), who report transition matrices for the child's *earnings*, rather than the more recent, more granular, and more widely cited Chetty et al. (2014), who report income(-rank) mobility, because the former is the exogenous driver of the child's income in our model. The matrix of Jäntti (2006) differs from our calibration in three respects: parents are sorted into quintiles of family income from all sources rather than of earnings, the sons' earnings are wages and salaries without business income, and the unit of observation is the individual son rather than the household.

Table 5: Quintile-level calibration inputs, in thousands of 2022 US dollars. Earnings are averages by earnings quintile of households aged 30–59 from the Survey of Consumer Finances 2022 (Board of Governors of the Federal Reserve System, 2023). Earnings are wages and salaries plus business and farm income. The present values aggregate the yearly figure over the $n = 30$ years of a period, growing at G_y and discounted at R_y (a factor of 27.00). The bequest is constructed from Hendricks (2007) and Nardi and Yang (2014) and valued at the start of the period. Generation C's yearly earnings are those of generation B projected forward by one period. The first four rows are indexed by generation B's earnings quintile j, the next two by generation C's earnings state i, and the last three, used in the robustness check of Table 11, by generation B's income quintile; there, income is total income and first-period resources are its present value plus the bequest.

	Quintile				
Quantity	1	2	3	4	5
Yearly earnings, generation B	13.0	49.1	81.5	129.1	398.5
Present value of earnings, $w_{B_j,1}$	351.7	1,325.5	2,201.0	3,486.5	10,759.6
Bequest, $b_{A_j,1}$	111.1	48.0	177.4	132.7	330.1
First-period resources, $Y_{B_j,1}$	462.8	1,373.5	2,378.4	3,619.1	11,089.8
Yearly earnings, generation C	24.2	91.2	151.4	239.8	740.0
Present value of earnings, $w^i_{C,2}$	653.2	2,461.8	4,087.6	6,475.0	19,982.7
Robustness check: income quintiles					
Yearly income, generation B	23.9	55.0	88.7	137.0	496.7
Present value of income	645.9	1,485.2	2,395.6	3,699.7	13,412.5
First-period resources	757.0	1,533.1	2,573.0	3,832.4	13,742.6

Table 6: Intergenerational transition matrix for the United States, from Jäntti (2006). Entry P_{ji} is the probability that the child of a parent in family-income quintile j ends up in earnings quintile i. Rows sum to one up to rounding in the source.

	Child's earnings quintile i				
Parent's quintile j	1	2	3	4	5
1	0.400	0.254	0.165	0.108	0.074
2	0.205	0.262	0.208	0.186	0.139
3	0.181	0.204	0.250	0.202	0.162
4	0.138	0.164	0.206	0.238	0.255
5	0.098	0.117	0.166	0.259	0.360

Dynastic altruism. We calibrate the dynastic altruism parameter a to match the empirically observed figure of 30% of US households receiving an intergenerational wealth

transfer over their lifetime (Wolff and Gittleman, 2014). To do so, we compute the share of model households receiving a positive bequest holding fixed $g = 0$ over a grid of a-values. The share is a step function (we have $5 \times 5 = 25$ types of children-households differing along the parent-type/own-type dimension) and all $a \in [0.3714, 0.3895]$ minimize the distance to the calibration target (30.6% of model households receive a bequest). We set $a = 0.38$ as the rounded central value of that interval. Note that for this value, all of the quintiles face a positive probability of being bequest-constrained. Including households whose bequest constraint never binds would need to further split up the top quintile. For the robustness check in Section 6.4, we use the two neighboring steps: the share is 26.6% for all $a \in [0.2770, 0.3714]$ and 34.8% for all $a \in [0.3895, 0.4723]$. We take the outermost values rounded to two decimals, $a = 0.28$ and $a = 0.47$ (Tables 9 and 10). In the robustness check with total income in place of earnings, $a = 0.38$ gives a share of 42.8%, and the step closest to the target is 26.6%, for all $a \in [0.2648, 0.3386]$. We set $a = 0.30$, the rounded central value of that interval (Table 11).

Cost of climate policy and domestic SCC. Concerning emission abatement, we assume the cost to be quadratic in ambition g, $\Gamma(g) = \kappa\, g^2$, a common simplification in stylized analyses of abatement (e.g., Vogt-Schilb et al., 2018; Gollier, 2024). In the climate policy interpretation of our model, the present value of the marginal benefits – the undiscounted own-benefit plus the discounted future benefit, $\delta\,\xi + \xi/R$ – corresponds to the *domestic social cost of carbon*, i.e., the discounted sum of the marginal damages, near-term and distant alike, that an additional ton of CO_2 inflicts *on the United States*. It is the price a generation-B household would set if it valued the full stream of avoided damages – its own and its child's – and faced no bequest constraint.

We base our analysis on this figure to abstract from the well-known failure of any single country to internalize the *global* benefits of emission abatement. Instead, we isolate the residual gap that our bequest, discount and insurance mechanism produces. Note that reciprocity in international climate policy, for instance achieved through international cooperation, would raise the policy-relevant price toward its global counterpart, but it would not close the gap that opens below the domestic benchmark, which is what we study here.

The model's benchmark price is the present value of the marginal benefits. The calibration sets it equal to the domestic SCC, which we build as the product of the global SCC and the share of climate damages accruing to the United States,

$$p^{\mathrm{BM}} = \delta\,\xi + \xi/R, \qquad p^{\mathrm{BM}} = \mathrm{SCC}^{\mathrm{dom}} = s_{\mathrm{US}} \cdot \mathrm{SCC}^{\mathrm{glob}}. \tag{52}$$

The domestic share of global marginal damages s_{US} is obtained from averaging figures from four integrated assessment models compared by Nordhaus (2017). These put it at 10, 17, 7 and 15%, and we take the rounded mean $s_{\mathrm{US}} = 12\%$. Estimating country-level social costs of carbon directly, K. Ricke et al. (2018) independently obtain 11% for the United States.

For the global level $\mathrm{SCC}^{\mathrm{glob}}$, our baseline draws from the 2023 assessment of the US Environmental Protection Agency (EPA), which at a 2.5% discount rate reports 120

$/tCO_2$ for emissions in 2020 and 140 $/tCO_2$ for emissions in 2030, both in 2020 US dollars (United States Environmental Protection Agency, 2023). We choose to deviate from EPA's central rate of 2% and to rely on the upper bound of 2.5% instead because it is the rate that is closest to our calibrated real interest rate of 2.84%. Interpolating linearly to the emission year 2022 gives 124 $/tCO_2$, and deflating to the 2022 base year of the income data with the US consumer price index (2010 = 100; 2020 = 118.7, 2022 = 134.2) (World Bank, 2025) gives SCC^{glob} = 140 $/tCO_2$ and hence p^{BM} = 16.8 $/tCO_2$. The macroeconomic estimate of Bilal and Känzig (2026), roughly 1,200 $/tCO_2$, serves as an upper anchor. The authors do not state a base year for it; we take it to be 2017 US dollars, the base year of the data their model is calibrated on, which gives 1,430 $/tCO_2$ in 2022 US dollars and p^{BM} = 172 $/tCO_2$. Because the SCC pins the total present-value benefit, the implied $\xi = p^{BM} \cdot R/(1+\delta R)$ falls with δ, while p^{BM} itself is independent of δ.

The level of SCC^{glob} does not affect the results we report as ratios as long as the cost and the benefit of the policy are small relative to lifetime income, which is the case for values around our baseline. Both ξ and g^{BM} scale with the benchmark, so the four structural factors, the politically-revealed rate, and every preferred and realized price expressed as a share of p^{BM} then remain virtually unchanged. The figures we quote in $/tCO_2$ move proportionally with the level, and the policy's dollar cost $\Gamma(g^{BM})$ with its square. The robustness check in Section 6.4 reports the results at the upper anchor of Bilal and Känzig (2026), where the cost and the benefits of the benchmark policy are no longer small relative to the resources of the lowest income quintile (Table 14).

Cost of emission abatement. The scale parameter κ of the cost function is calibrated as follows. The long-lived public good under scrutiny g is defined as emission abatement, more precisely as the cumulative emission abatement of the five-household model economy over the 30-year period, measured in tCO_2. We assume the following functional relationship between g and a carbon price p: $g(p) = 5\,\alpha(p)\,E$, where E denotes the no-policy emissions of an average household over the period and $\alpha(p)$ the reduction share induced by a carbon price p. Note that, since the marginal benefit ξ derives from SCC^{dom} in $/tCO_2$ (Equation (52)), the benefit $\xi\, g$ is measured in dollars once g is measured in tons.

With $\Gamma(g) = \kappa\, g^2$, the marginal abatement cost $\Gamma'(g) = 2\kappa g$ is linear in g with slope 2κ, so κ is measured in $/tCO_2^2$. We can invert the marginal abatement cost at an observed price-abatement pair $(p_0,\, g(p_0))$ to obtain $\kappa = p_0/\big(2\, g(p_0)\big)$. The price p_0 lies above SCC^{dom} = 16.8 $/tCO_2$; we use it because it is the lowest carbon price for which the model comparison reports reduction shares.

US energy-related CO_2 emissions amounted to 4,939 million tons in 2022 (U.S. Energy Information Administration, 2023), and the United States counted 131.2 million households (U.S. Census Bureau, 2024), giving 37.6 tCO_2 per household and year. Holding this level constant over the period length of 30 years, we obtain a cumulative emission level per household of E = 1,129 tCO_2 in the absence of policy. We use economy-wide emissions per household rather than a consumption footprint because the reduction shares below refer to an economy-wide carbon price.

We take the reduction share from the EMF 32 model comparison (Barron et al., 2018):

a carbon tax of 25 \$/tCO$_2$ (in 2010 US dollars) introduced in 2020 and rising by 1% per year reduces cumulative 2020–2030 CO$_2$ emissions by 18% relative to the reference scenario on average across eleven models (range 11–30%, their Table 1). The Congressional Budget Office's updated price sensitivities point to the same order of magnitude: a tax starting at 25 \$/tCO$_2$ reduces covered emissions by 8% in its first and 17% in its tenth year (Gecan, 2021).

To account for the fact that the reduction share is an average over the eleven years 2020–2030, we use the decade-average price, 26.3 \$/tCO$_2$ in 2010 US dollars. Next, we deflate it to the 2022 base year of the income data with the US consumer price index (series FP.CPI.TOTL from World Bank, 2025, 2010 = 100, 2022 = 134.2), giving $p_0 = 35.3$ \$/tCO$_2$.

The corresponding emission abatement $g(p_0)$ and resulting κ are given by

$$\begin{aligned} g(p_0) &= 5 \times 0.18 \times 1{,}129 = 1{,}016 \text{ tCO}_2, \\ \kappa &= 35.3/(2 \times 1{,}016) = 0.0174 \text{ \$/tCO}_2^2, \end{aligned}$$

i.e., 1.74×10^{-5} in the model's unit of thousand USD. At $\text{SCC}^{\text{dom}} = 16.8$ \$/tCO$_2$ the benchmark abatement is $g^{\text{BM}} = 485$ tCO$_2$, that is 97 tCO$_2$ or 8.6% of baseline emissions per household, at a cost of $\Gamma(g^{\text{BM}}) = 4{,}080$ USD for the five-household economy, or 816 USD of monetized cost of behavioral adjustment per household in present value. The model range of Barron et al. (2018) maps into $\kappa \in [0.0104, 0.0284]$ \$/tCO$_2^2$ and $\Gamma(g^{\text{BM}})$ between 498 and 1,360 USD per household. At the calibrated value, the cost and benefit items the policy adds to the household budgets remain small relative to lifetime resources.

Own-benefit intensity. To calibrate the own-benefit intensity δ (measured against the future benefits), we adopt the demographic approach of Edenhofer et al. (2025b) and apply it to the US age structure. In doing so, we assume that an increase in g, that is, a reduction in emissions, starts generating benefits right from the first year. This seems like an acceptable assumption to us, given our period length of 30 years and a time difference between the emission of one ton of CO$_2$ and the *maximum* warming caused by it of 10 years (K. L. Ricke and Caldeira, 2014). Based on this, we can follow the reasoning of the authors above: an increase in g yields a benefit flow of f per person-year that depreciates at rate δ^{dep}.[19] Each cohort captures the flow over its remaining life expectancy, while the normalization is the present value of the flow accruing to a representative household that lives forever and carries a mass equal to the entire population,

$$\text{NPV}_x := \int_0^{\text{LE}_x} f\, e^{-\delta^{\text{dep}} t}\, R_y^{-t}\, \mathrm{d}t, \qquad \text{NPV}^{\text{rep}} := \int_0^{\infty} N\, f\, e^{-\delta^{\text{dep}} t}\, R_y^{-t}\, \mathrm{d}t,$$

where x indexes single years of age in $t = 1$, LE_x is the remaining life expectancy of the cohort aged x, N_x its size, and $N = \sum_x N_x$ the total population, which we hold constant over time. Benefits are discounted at the model's yearly market rate, $R_y^{-t} = e^{-t \ln R_y}$.

[19] The level of the flow is immaterial, since only the share captured by those alive today matters.

The share captured by generation B, the working-age population aged 30–59 in $t = 1$, is then given by

$$\varpi := \frac{\sum_{x=30}^{59} N_x \, \mathrm{NPV}_x}{\mathrm{NPV}^{\mathrm{rep}}} \overset{\delta^{\mathrm{dep}}=0}{=} \frac{\sum_{x=30}^{59} N_x \left(1 - R_y^{-\mathrm{LE}_x}\right)}{\sum_x N_x},$$

where the flow f and the force of interest $\ln R_y$ cancel from the ratio.

For $\delta^{\mathrm{dep}} = 0$ (the atmospheric decay rate of CO_2 is approximately nil), the yearly market rate $R_y - 1 = 2.84\%$, and data for life expectancy and cohort sizes taken from the 2023 US life tables from the National Center for Health Statistics (NCHS) (Arias et al., 2025) and the 2025 Census population estimates (U.S. Census Bureau, 2026), respectively, we obtain $\varpi = 0.2410$.

In the model, the present value of the marginal benefit of provision is the benchmark price, $p^{\mathrm{BM}} = \delta\,\xi + \xi/R$ (52), of which the own-benefit part is $\delta\,\xi$. Equating generation B's share, $\varpi\, p^{\mathrm{BM}} = \delta\,\xi$, we obtain

$$\varpi = \frac{\delta\, R}{1 + \delta\, R} \iff \delta = \frac{\varpi}{R(1 - \varpi)} = 0.137.$$

Note that, by focusing on the 30–59 age band, the model assigns own-benefits to generation B only, disregarding direct benefits for generation A and for adults younger than 30, who belong to generation C. Extending the band to the full electorate aged 18 and above, which reassigns the capture of both groups to B, raises the share to $\varpi = 0.4543$ and the intensity to $\delta = 0.359$. We report results for the 30–59 age band for consistency with our focus on generation B and use the values for the full electorate as a robustness check (Section 6.4 and Table 12).

Income elasticities. We calibrate the income elasticity of the benefit and the income elasticity of the cost of climate policy. For the benefit, we use the income elasticity of climate *damages*, which Gilli et al. (2024) estimate at 0.76 without and 0.64 with adaptation. We take the midpoint $\varepsilon_b = 0.70$, applied to generation C's income.[20] The fact that damages are distributed regressively means that the benefits of avoiding these are progressive.

For the cost, we assume that the carbon-price burden on a household is proportional to its CO_2 emissions and use the respective income elasticity for the United States from Pottier (2022), who reports that several studies find CO_2 emissions rise less than proportionally with total income, with most estimates between 0.3 and 0.4. We choose $\varepsilon_c = 0.35$. Both elasticities lie below unity, so while the benefits of climate policy are distributed progressively, its cost is regressive.

[20] We apply the elasticity to generation C's model income evaluated at $g = 0$. Thus, we exclude the policy benefit itself from the base, keeping the benefit predetermined with respect to the policy it prices, while the state-contingent inherited bequest keeps that income base strictly positive in every state.

K Derivation of the Consumption Share ϕ

Generation C allocates its disposable resources $m = Y^i_{C_j,2}$ between working-life consumption c^y, retirement consumption c^o, and a bequest $b' \geq 0$ to a child it values with the same altruism a and discount β as generation B. The earnings of C's child are stochastic, too; we consider two polar cases, zero earnings and earnings that are large relative to C's resources in every state. The consumption share of C resulting from zero earnings gives our baseline parameter. As shown in Section 6.4, it is the conservative choice; the consumption share for large earnings is the robustness check in the same section.

Assuming the own endowment of C's child, and of all later descendants, to be zero, C's problem is the stationary recursion

$$J(m) = \max_{c^y,\, c^o,\, b' \geq 0} \left[\ln c^y + \beta \ln c^o + \beta a\, J(b') \right] \qquad \text{s.t.} \quad c^y + \frac{c^o}{R} + \frac{b'}{R} = m.$$

We solve it by guess-and-verify. Conjecture $J(m) = \zeta_0 + \zeta_1 \ln m$ for constants ζ_0, ζ_1. With interior bequests the first-order conditions in c^y, c^o, and b' read, with budget multiplier λ,

$$\frac{1}{c^y} = \lambda, \qquad \frac{\beta}{c^o} = \frac{\lambda}{R}, \qquad \frac{\beta a \zeta_1}{b'} = \frac{\lambda}{R},$$

so that $c^o = \beta R\, c^y$ and $b' = \beta a \zeta_1 R\, c^y$. Substituting into the budget constraint,

$$c^y \left(1 + \beta + \beta a \zeta_1\right) = m \qquad \Longrightarrow \qquad \phi := \frac{c^y}{m} = \frac{1}{1 + \beta + \beta a \zeta_1}.$$

We now have $c^y = \phi m$, $c^o = \beta R \phi m$, and $b' = \beta a R \zeta_1 \phi m$. Plugging this into the value function, isolating $\ln m$, and equating its coefficient with ζ_1 from our initial guess gives $\zeta_1 = 1 + \beta + \beta a \zeta_1$, i.e.,

$$\zeta_1 = \frac{1 + \beta}{1 - \beta a}.$$

Hence the working-life consumption share is

$$\phi = \frac{c^y}{m} = \frac{1}{1 + \beta + \beta a \zeta_1} = \frac{1}{\zeta_1} = \frac{1 - \beta a}{1 + \beta},$$

using $1 + \beta + \beta a \zeta_1 = \zeta_1$. We use this interior share as the baseline.

The robustness check in Section 6.4 is performed for $\phi = 1/(1 + \beta)$, C's consumption share in $t = 2$ with a zero bequest, which follows from $c^o = \beta R\, c^y$ and the budget constraint with $b' = 0$. This is the relevant case when the earnings of C's child are large: its marginal utility at a zero bequest is then low enough that C leaves none. This is also the share in the egoistic limit $a = 0$.

L Public Debt to Finance Transfers

In Section 4, we analyze a non-discriminatory lump-sum transfer to all first-period households, paid by public debt redeemed in the second period, to relax the bequest constraints of the households. Because in all but the Median-Voter scenario, the politically-revealed

discount rate is a harmonic mean of the quintile-level rates, only a transfer that frees all households from their bequest constraints ensures efficient climate policy. The size of the needed transfer thus corresponds to the maximal "forbidden bequest" $\hat{b}^i_j$ (see Equation (25)) over all parent-child combinations.

The maximum is attained by the Q1 parent; the forbidden bequests for all parent-child combinations are on display in Table 7. The child of a Q1 parent reaches the top quintile with ex ante probability 0.074 (Table 6). Table 7 shows what is true for all quintiles: $\hat{b}^i_j$ is (weakly) increasing in the child's quintile. Intuitively, the higher the child's earnings, the more the parent household would like to partake in that wealth.

The maximum forbidden bequest Q1 would like to make is the bequest to Q5. It amounts to −10.0 million USD against the 20.0 million USD of Q5's lifetime earnings, more than three times the figure for the bequest to Q4. The needed transfer T_1 in the first period would thus be $T_1 = 10.0/R \approx 4.3$ million USD.

Table 7: Forbidden bequest $-\hat{b}^i_j$ by parent quintile j and child quintile i, evaluated at $g = g^{\mathrm{BM}}$ under Assumption 1. Zero entries mark the parent-child combinations in which the bequest constraint does not bind. The last column is the parent's retirement wealth in the model with the bequest constraint, the last row the child's lifetime earnings. Million 2022 USD per household (second-period values).

	Child's earnings quintile i					Parent's
Parent's quintile j	1	2	3	4	5	retirement wealth
1	−0.3	−1.2	−2.0	−3.2	−10.0	0.5
2	0	−0.8	−1.6	−2.8	−9.6	1.5
3	0	0	−1.0	−2.2	−9.0	2.6
4	0	0	−0.4	−1.6	−8.4	4.0
5	0	0	0	0	−3.7	13.3
Child's lifetime earnings	0.7	2.5	4.1	6.5	20.0	

The pattern in Table 7 follows from a simple rule. With logarithmic utility and generation C consuming the share ϕ of its income, the condition that defines the forbidden bequest, Equation (25), can be solved explicitly,

$$\hat{b}^i_j = \frac{\phi}{a+\phi}\left(w^i_{C,2} + \xi_j\, g^{\mathrm{BM}}\right) \;-\; \frac{a}{a+\phi}\, R\, s_{B_j,1},$$

where $s_{B_j,1}$ is the saving under the unconstrained plan. The term in brackets is the child's lifetime income, which is roughly equal to its lifetime earnings because the benefit of the policy is negligible in comparison. At our calibration both factors are roughly one half: the parent would like to take half of the child's lifetime income and give up half of its own retirement wealth in return. The forbidden bequest therefore rises with the child's quintile and falls with the parent's, and it is similar for the parents in Q1–Q4 whose child reaches Q5, because their retirement wealth is small compared to that child's earnings.

The retirement wealth reported in the table is the one computed with a binding bequest constraint. Absent the constraint, $R\,s_{B_j,1}$ is lower because the parent anticipates the negative bequest. Hence, applying the rule to the earnings and retirement wealth on display in the table's margins slightly understates the resulting forbidden bequest.

A back-of-the-envelope calculation using a figure of 67.8 million households in the age range 30–59 in the United States (own computation from Board of Governors of the Federal Reserve System (2023)) leads to a necessary debt volume of 293 *trillion* USD. Spread over 30 years, the resulting 9.8 trillion USD *per year* is more than one third of US GDP in 2022 (approximately 26 trillion USD (series NY.GDP.MKTP.CD from World Bank, 2025)). This figure is driven up by the Q1–Q5 parent-child pair, which has an ex post population share of $0.2 \times 0.074 = 0.015$, not even 2% of the population. For scale, the cost of the benchmark climate policy itself amounts to $\Gamma(g^{\mathrm{BM}}) \approx 4{,}080$ USD for the five-household model economy,[21] giving a total of 107 billion USD over the 30 years after multiplying by the $131.2/5 = 26.24$ million such economies, computed for all US households (U.S. Census Bureau, 2024) since abatement is economy-wide. This is only a small fraction of the debt volume needed to free all households from their constraints. Note, though, that unlike this resource cost, the transfer is redeemed in the second period.

Table 8: Uniform per-capita debt $T_1 = \hat{b}/R$ (million 2022 USD per household) required to free a given share of households from the bequest constraint. Policy scenario for the premium $\widetilde{r}_{\mathrm{pol},y} - r_y$ and the shortfall below p^{BM}: One-Person-One-Vote. Rates are compounded annually. pp: percentage points.

Share of households freed	31%	50%	75%	90%	100%
Required uniform T_1	0	0.45	1.21	3.63	4.32
$\widetilde{r}_{\mathrm{pol},y} - r_y$ (pp per year)	1.54	0.59	0.18	0.01	0.00
% below p^{BM}	27.3	12.0	3.9	0.2	0.0

Therefore, freeing all households from their constraint is very costly. Thus, we investigate what the effect of a partial relaxation of constraints is on the realized price level and what debt volume is needed. Table 8 displays the results. The main take-away is that freeing half of the households from the constraint already reduces the gap by more than 15 percentage points, thus closing more than half of the gap between realized and benchmark price, while the debt volume needed for this is only one tenth of the one needed to free all households. Freeing 75% of households already needs a deficit almost three times higher but closes 85% of the gap between realized and benchmark price. Note that, in our model, a part of the transfers to first-period households is transmitted to second-period households for repayment. Once a household is freed from the constraint through the

[21] Because

$$\Gamma'(g^{\mathrm{BM}}) = 2\kappa g^{\mathrm{BM}} = \mathrm{SCC}^{\mathrm{dom}} \quad \Longrightarrow \quad \Gamma(g^{\mathrm{BM}}) = \frac{\left(\mathrm{SCC}^{\mathrm{dom}}\right)^2}{4\kappa},$$

$\Gamma(g^{\mathrm{BM}}) \approx 4{,}080$ USD follows once we plug in the values displayed in Table 1.

transfer, it starts acting dynastically and fulfills Ricardian equivalence.

M Robustness Checks

Table 9: Robustness check: dynastic altruism $a = 0.28$, with $\phi = (1 - \beta a)/(1 + \beta) = 0.43$. Implicit discount rate per year, its premium over the market rate, preferred carbon price, its shortfall from the benchmark price, and probability $\mathbb{P}$[binding] that the bequest constraint binds, by income quintile under Assumption 1, evaluated at $g = g^{\mathrm{BM}}$. The One-Person-One-Vote column reports the politically-revealed rate, its premium, the realized carbon price and its shortfall at the realized level g^*, and, as $\mathbb{P}$[binding], the share of households whose bequest constraint binds. The rows "vs. baseline" report the change against the baseline in Tables 2 and 3, computed from the values shown. Rates are compounded annually; the market rate is 2.84% per year and the benchmark price is $p^{\mathrm{BM}} = 16.8$ \$/tCO$_2$. pp: percentage points.

	Income quintile					
	1	2	3	4	5	One-Person-One-Vote
$\widetilde{r}_{j,y}$, $\widetilde{r}_{\mathrm{pol},y}$ (% per year)	7.86	6.01	5.17	4.76	3.54	5.19
$\widetilde{r}_{j,y} - r_y$, $\widetilde{r}_{\mathrm{pol},y} - r_y$ (pp per year)	5.01	3.17	2.33	1.91	0.70	2.34
Rate vs. baseline (pp per year)	+1.48	+0.91	+0.98	+0.83	+0.36	+0.81
p_j^*, p^* (\$/tCO$_2$)	7.1	9.2	10.6	11.4	14.5	10.5
% below p^{BM}	57.7	45.4	37.2	32.2	14.0	37.3
Shortfall vs. baseline (pp)	+9.4	+9.1	+12.7	+11.7	+7.0	+10.0
$\mathbb{P}$[binding]; share constrained	1.00	0.80	0.82	0.70	0.36	0.73

Table 10: As Table 9, for the baseline calibration and dynastic altruism $a = 0.47$, with $\phi = (1 - \beta a)/(1 + \beta) = 0.35$.

	Income quintile					
	1	2	3	4	5	One-Person-One-Vote
$\widetilde{r}_{j,y}$, $\widetilde{r}_{\mathrm{pol},y}$ (% per year)	5.24	4.34	3.62	3.47	2.87	3.81
$\widetilde{r}_{j,y} - r_y$, $\widetilde{r}_{\mathrm{pol},y} - r_y$ (pp per year)	2.40	1.50	0.78	0.63	0.03	0.97
Rate vs. baseline (pp per year)	−1.14	−0.76	−0.57	−0.46	−0.31	−0.57
p_j^*, p^* (\$/tCO$_2$)	10.5	12.3	14.2	14.7	16.7	13.7
% below p^{BM}	37.9	26.7	15.3	12.6	0.6	18.6
Shortfall vs. baseline (pp)	−10.4	−9.6	−9.2	−7.9	−6.4	−8.7
$\mathbb{P}$[binding]; share constrained	1.00	0.80	0.61	0.49	0.36	0.65

Table 11: As Table 9, for total income in place of earnings, households sorted into income quintiles, and dynastic altruism recalibrated to $a = 0.30$, with $\phi = (1-\beta a)/(1+\beta) = 0.42$.

	Income quintile					
	1	2	3	4	5	One-Person-One-Vote
$\widetilde{r}_{j,y}$, $\widetilde{r}_{\mathrm{pol},y}$ (% per year)	5.78	5.61	4.79	4.48	3.31	4.67
$\widetilde{r}_{j,y} - r_y$, $\widetilde{r}_{\mathrm{pol},y} - r_y$ (pp per year)	2.94	2.76	1.94	1.63	0.47	1.83
Rate vs. baseline (pp per year)	−0.60	+0.51	+0.60	+0.55	+0.13	+0.29
p_j^*, p^* (\$/tCO$_2$)	9.5	9.8	11.3	12.0	15.2	11.6
% below p^{BM}	43.3	41.7	32.6	28.6	9.7	31.2
Shortfall vs. baseline (pp)	−5.0	+5.4	+8.1	+8.1	+2.7	+3.9
$\mathbb{P}$[binding]; share constrained	1.00	0.80	0.82	0.70	0.36	0.73

Table 12: As Table 9, for the baseline calibration and the own-benefit weight of the full electorate aged 18 and above, $\varpi = 0.4543$, with $\delta = 0.359$.

	Income quintile					
	1	2	3	4	5	One-Person-One-Vote
$\widetilde{r}_{j,y}$, $\widetilde{r}_{\text{pol},y}$ (% per year)	6.37	5.10	4.19	3.92	3.18	4.38
$\widetilde{r}_{j,y} - r_y$, $\widetilde{r}_{\text{pol},y} - r_y$ (pp per year)	3.53	2.25	1.35	1.08	0.33	1.54
Rate vs. baseline (pp per year)	−0.01	0.00	0.00	−0.01	0.00	0.00
p_j^*, p^* (\$/tCO$_2$)	11.0	12.4	13.9	14.4	16.0	13.5
% below p^{BM}	34.7	26.1	17.6	14.7	5.1	19.6
Shortfall vs. baseline (pp)	−13.6	−10.2	−6.9	−5.8	−1.9	−7.7
$\mathbb{P}$[binding]; share constrained	1.00	0.80	0.61	0.70	0.36	0.69

Table 13: As Table 9, for the baseline calibration and the consumption share of generation C as a parent whose bequest constraint always binds, $\phi = 1/(1+\beta) = 0.56$ (Appendix K).

	Income quintile					
	1	2	3	4	5	One-Person-One-Vote
$\widetilde{r}_{j,y}$, $\widetilde{r}_{\text{pol},y}$ (% per year)	7.67	5.91	5.06	4.66	3.50	5.09
$\widetilde{r}_{j,y} - r_y$, $\widetilde{r}_{\text{pol},y} - r_y$ (pp per year)	4.83	3.07	2.22	1.82	0.66	2.25
Rate vs. baseline (pp per year)	+1.29	+0.81	+0.87	+0.73	+0.32	+0.71
p_j^*, p^* (\$/tCO$_2$)	7.3	9.3	10.8	11.6	14.6	10.7
% below p^{BM}	56.7	44.5	35.9	31.0	13.2	36.2
Shortfall vs. baseline (pp)	+8.4	+8.2	+11.4	+10.5	+6.2	+8.9
$\mathbb{P}$[binding]; share constrained	1.00	0.80	0.82	0.70	0.36	0.73

Table 14: As Table 9, for the baseline calibration and the global SCC of Bilal and Känzig (2026), $\text{SCC}^{\text{glob}} = 1{,}430$ \$/tCO$_2$; the benchmark price is $p^{\text{BM}} = 172$ \$/tCO$_2$, and the shortfall is measured against each economy's own benchmark price.

	Income quintile					
	1	2	3	4	5	One-Person-One-Vote
$\widetilde{r}_{j,y}$, $\widetilde{r}_{\text{pol},y}$ (% per year)	7.29	5.41	4.42	4.11	3.21	4.54
$\widetilde{r}_{j,y} - r_y$, $\widetilde{r}_{\text{pol},y} - r_y$ (pp per year)	4.44	2.57	1.58	1.26	0.37	1.70
Rate vs. baseline (pp per year)	+0.91	+0.31	+0.23	+0.18	+0.03	+0.16
p_j^*, p^* (\$/tCO$_2$)	78.1	103.7	124.0	131.9	158.7	121.3
% below p^{BM}	54.6	39.7	27.9	23.3	7.7	29.5
Shortfall vs. baseline (pp)	+6.3	+3.4	+3.4	+2.8	+0.7	+2.2
$\mathbb{P}$[binding]; share constrained	1.00	0.80	0.82	0.70	0.36	0.73

N Income-Dependent Benefits and Costs

We now relax Assumption 1: the cost and the benefit of climate policy fall on the quintiles in income-specific proportions, calibrated to empirical estimates of the respective income elasticities. Therefore, generally the cost is no longer allocated according to the benefit principle. Moreover, the benefits accruing to generation C scale with its *realized income*. Because the latter is state-dependent, this switches on the insurance factor χ_j. Based on this formulation, we compute the model-projected distribution of dynastic benefits and decompose the carbon prices preferred by the quintiles into four factors: the discount-rate factor, the insurance factor, as well as the own benefit-cost factor and the future benefit-cost factor.

Calibration

We start by describing how the now income-dependent benefits and costs are calibrated.

Future benefit. The benefit in $t = 2$ is the avoided climate damage, which accrues to generation C. It scales with the child's *realized income* through a constant income elasticity ε_b. Generation C's income in state i of dynasty j is its own earnings plus the

bequest it inherits, evaluated in absence of climate policy, $g = 0$,[22]

$$Y^i_{j,0} := w^i_{C,2} + b^i_{j,0}, \qquad \xi^i_j = \xi\, N_b\, (Y^i_{j,0})^{\,\varepsilon_b}, \qquad N_b := \frac{1}{\sum_{k,l} P_{kl}\, (Y^l_{k,0})^{\,\varepsilon_b}}, \tag{53}$$

where $b^i_{j,0}$ is the bequest dynasty j leaves to a child who draws earnings state i, evaluated at $g = 0$, and N_b is a fixed constant. The P-weighted normalization makes the dynasty benefits sum to the aggregate exactly, $\sum_j \mathbb{E}_j[\xi_j] = \sum_{j,i} P_{ji}\, \xi^i_j = \xi$, so the benchmark g^{BM} and the cost-share constraint $\sum_j \gamma_j = 1$ remain mutually consistent. By the law of large numbers of Section 2.1, this sum is not merely an expected value but the realized aggregate benefit: P_{ji} is simultaneously the population share of generation-C households of dynasty j who draw earnings state i.

Cost. The cost of climate policy falls on household B_j in the proportion $\Gamma_j(g) = \gamma_j\, \Gamma(g)$, where $\gamma_j \in (0, 1)$ with $\sum_j \gamma_j = 1$ is the cost *share* of Section 2.2. The cost share is keyed to the parent's first-period resources $Y_{B_j,1} = w_{B_j,1} + b_{A_j,1}$ (Appendix J) through a constant income elasticity ε_c,

$$\gamma_j := N_c\, Y^{\varepsilon_c}_{B_j,1}, \qquad N_c := \frac{1}{\sum_k Y^{\varepsilon_c}_{B_k,1}}, \tag{54}$$

where N_c is a fixed normalization constant; the benefit principle then no longer holds in general, and BC_j deviates from one.

Own-benefit. As in the baseline calibrated model, this extension adopts the own-benefit formulation of Section 5.2: generation B enjoys a benefit $\delta\, \xi\, \sigma_j\, g$ already in $t = 1$, entering its first-period budget as a monetary resource alongside the cost $\gamma_j\, \Gamma(g)$. Section 5.2 motivates the own-benefit by early avoided damages or by co-benefits; the calibration is restricted to the former. Early damages hit those alive when they accrue, so the share is keyed to the *parent's* known first-period income $Y_{B_j,1}$, at the same damage elasticity ε_b as the future benefit,

$$\sigma_j := N_o\, Y^{\varepsilon_b}_{B_j,1}, \qquad N_o := \frac{1}{\sum_k Y^{\varepsilon_b}_{B_k,1}}, \tag{55}$$

where N_o is a fixed normalization constant. It holds that $\sum_j \sigma_j = 1$, so the aggregate own-benefit is exactly $\delta\, \xi\, g$ and, as in Section 5.2, δ measures the aggregate own-benefit relative to the aggregate future benefit $\xi\, g$.

Preferred level and price. The first-period carbon price is the marginal abatement cost at the chosen provision level, $p = \Gamma'(g)$. The benchmark price is $p^{\mathrm{BM}} = \Gamma'(g^{\mathrm{BM}}) = \delta\, \xi + \xi/R$ – the undiscounted aggregate own marginal benefit plus the market-discounted future marginal benefit as in Section 5.2. Substituting the cost share (54), the benefit (53) and the own-benefit share (55) into the four-factor decomposition (49) of Appendix F,

[22] At $g = 0$, the benefit term $\xi\, g$ vanishes, so the income base – subsequently used to compute marginal benefits ξ^i_j – excludes the benefit itself. This prevents circularity.

the preferred level and price of quintile j – the level it would choose deciding alone while paying its own cost – satisfy

$$\Gamma'(g_j^*) = \delta\,\xi\,\mathrm{BC}_j^{\mathrm{own}} \;+\; \frac{\xi}{R}\,\mathrm{BC}_j\,\frac{R}{\widetilde{R}_j}\,\chi_j, \tag{56}$$

$$\frac{p_j^*}{p^{\mathrm{BM}}} = \varpi\,\mathrm{BC}_j^{\mathrm{own}} + (1-\varpi)\,\frac{R}{\widetilde{R}_j}\,\mathrm{BC}_j\,\chi_j, \qquad \varpi := \frac{\delta}{\delta + 1/R} = \frac{\delta R}{1+\delta R}, \tag{57}$$

The second line divides the first by p^{BM}, writing $p_j^* = \Gamma'(g_j^*)$: relative to the benchmark, the preferred price is a convex combination whose weight ϖ is generation B's share of the present value of the aggregate marginal benefit. The future-benefit term carries the three factors of Section 3.2; the own-benefit term stands apart from all three: it accrues within the parent's own first period and with certainty, so neither the dynastic discount rate $\widetilde{R}_j$ nor the insurance factor χ_j influences it, only the own benefit-cost factor $\mathrm{BC}_j^{\mathrm{own}}$. At $\delta = 0$ the weight vanishes and Equation (57) collapses to the three-factor product $(R/\widetilde{R}_j)\,\mathrm{BC}_j\,\chi_j$.

Results

As displayed in Table 1, we use an income elasticity of the cost of carbon pricing of 0.35. Cost increases in income, but less than proportionally, making it a *regressive* policy instrument on the cost side, a known fact for advanced economies (Pottier, 2022). The income elasticity of damages we use of 0.70 means that damages increase less than proportionally with income, making emission abatement *progressive* on the benefit side.

Because $\varepsilon_b > \varepsilon_c$, the own-benefit share rises with income more steeply than the cost share: the ratio σ_j/γ_j increases across the quintiles, so the own-benefit motive favors the richer quintiles.

For the future benefits, the story is different. Because these accrue to the future generation, the future benefits perceived by the parent household are mediated through the earnings-transition matrix and the resulting income (combining earnings and bequest) of the child. The dynasty's future benefit is thus an expectation $\mathbb{E}_j[\xi_j] = \sum_i P_{ji}\,\xi_j^i$ over the child's states. Two features follow that were absent in Section 3.2. First, the child's income base combines a mean-reverting earnings draw – a feature of the empirical intergenerational mobility matrix we use – with an inherited bequest that scales with parental wealth and does *not* mean-revert; the sticky bequest re-inserts a dynastic-wealth gradient. For our calibration, the parent's realized income elasticity $\varepsilon_b^B := \mathrm{d}\ln\mathbb{E}_j[\xi_j]/\mathrm{d}\ln Y_{B_j,1}$ is below the child-level ε_b. In the calibration, we find $\varepsilon_b^B = 0.30$ (against $\varepsilon_b = 0.70$). Our calibrated cost elasticity $\varepsilon_c = 0.35$ lies slightly *above* this. The net incidence therefore tilts to the *pro-poor* side. Since the dynastic benefit rises less steeply with parent income than the cost does, poorer dynasties are net beneficiaries of the benefit-cost split ($\mathrm{BC}_j > 1$) and richer dynasties net contributors ($\mathrm{BC}_j < 1$). The tilt is mild, since the two elasticities are close. Q3 is the exception to an otherwise monotone relationship between income and BC_j, as shown in the BC_j row of Table 15.

Second, because the benefit rises with the child's realized income (elasticity $\varepsilon_b > 0$), it pays off in the child's good, low-marginal-utility states; this negative co-movement makes

$\text{Cov}_j < 0$ and $\chi_j < 1$, most strongly so for the poorest dynasties, whose thin bequests leave the co-movement of benefit and income intact.

Table 15: The four factors of the preferred carbon price as well as its comparison to the benchmark price by income quintile, evaluated at $g = g^{\text{BM}}$.

	Income quintile					
	1	2	3	4	5	Average
$R/\widetilde{R}_j$	0.36	0.52	0.68	0.73	0.91	0.64
BC_j	1.11	1.05	0.95	1.00	0.96	1.02
χ_j	0.49	0.59	0.66	0.69	0.89	0.66
BC_j^{own}	0.47	0.69	0.84	0.97	1.44	0.88
p_j^*/p^{BM}	0.26	0.41	0.53	0.62	0.94	0.55

Table 15 shows the decomposition of the preferred carbon prices of the income quintiles into the four factors of Equation (56): the discount-rate factor $R/\widetilde{R}_j$, the future benefit-cost factor BC_j, the own benefit-cost factor BC_j^{own}, and the insurance factor χ_j. For the sake of comparability, we evaluate Equation (56) at the common level g^{BM}. The difference from switching to each quintile's own optimum g_j^* is immaterial.

The discount-rate factors $R/\widetilde{R}_j$ correspond to the annual implicit discount rates of Table 2 in Section 6, which change by less than 0.01 percentage points when the benefit principle is relaxed and the insurance channel is switched on. Recall that factor and rate are related through $R/\widetilde{R}_j = \big((1+r_y)/(1+\widetilde{r}_{j,y})\big)^n$. At the calibration, relaxing the benefit principle and allowing for the insurance channel to be active does not change the strength of the discount channel.

While the own benefit-cost factor is increasing with income – as anticipated, given that the income elasticity of cost ε_c is smaller than the income elasticity of the benefits ε_b – the future benefit-cost factor is decreasing almost monotonically. It is worth highlighting that, when taking into account the intergenerational income mobility, net future benefits are distributed favorably for the two lower income quintiles Q1 and Q2. On average, the relaxation of the benefit principle is near neutral for the future benefits.

The average deviation from benchmark implied by the insurance factor turns out to be almost as strong as the discount-rate factor's. The insurance factor rises monotonically with income, reflecting the fact that income and thus consumption of Q1's descendants is much more earnings-dependent than the income of Q5's descendants, who can count on a higher bequest in case of low earnings. Because benefits scale with income by construction, they reinforce the insurance function of bequest, mainly available to high-income parents.

Accounting for the four factors, the preferred price is still monotonically increasing in income, though all quintiles prefer a price below the benchmark carbon price. While the preferred prices of parent quintiles Q1–Q4 are below the baseline results in Table 2 – for Q1, the preferred price is halved – Q5 prefers a slightly higher price, driven by the favorable share of own-benefits BC_j^{own}.

The "Average" column of the price row approximates the One-Person-One-Vote realized price, which falls short of the benchmark price by 45%.[23] Compared with the 27% shortfall in the realized carbon price in Section 6, adding the other channels to the model decreases the carbon price by another 18 percentage points.

[23]The averages of the factor rows reproduce it only approximately through the convex combination of Equation (57), because the average price is the average of the products of their quintile-level counterparts. The identification of the "Average" column with the One-Person-One-Vote price is likewise not an identity: that scenario solves the aggregate first-order condition at the common realized level g^*, whereas the column averages the quintiles' preferred prices. The average agrees with the One-Person-One-Vote scenario to the second decimal point.



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