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Cultural Transmission, Property Rights, and Treatment of the Elderly

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Abstract

We study how property rights over land, capital, and output interact with cultural transmission to determine the welfare of the elderly. In our model, respect for the elderly emerges endogenously: adults transmit norms of care to children, which children later reciprocate when they become adults. We compare regimes of insecure rights over produced goods with secure rights over productive resources, showing that both can sustain elderly well-being through distinct channels. By distinguishing between property rights to outputs and to inputs—and further between fixed and created resources—we uncover nonlinear interactions between cultural transmission, property institutions, and production technologies, and a general curvilinear pattern where the elderly are relatively better off compared to the middle-aged in either an insecure property right (i.e., common resources) regime or a high productive property rights regime relative to intermediate cases. Ethnographic evidence illustrates these mechanisms and helps explain cross-societal variation in elderly support. The model also demonstrates how demographic, technological, and policy changes can alter the conditions for elderly well-being across stages of development.

JEL Classification: E21, D15, J14, O15, Z13

Keywords: treatment of the elderly; overlapping generations; property rights; cultural transmission; intergenerational transfers

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1 Introduction

Aging and the elderly have always been part of human existence. Living into old age is common among hunter-gatherers and was likely even common among early Homo sapiens, suggesting that long lifespans may be an evolutionary adaptation to the hunter-gatherer lifestyle (Gurven and Kaplan, 2009; Kaplan and Robson, 2002, 2003). However, the experience of aging varies significantly across societies. In modern economies, the elderly often sustain themselves through personal means and government-provided benefits (United Nations Department of Economic and Social Affairs, 2019). By contrast, in traditional societies, including preliterate ones, the elderly's roles and treatment are diverse. They may be revered for their knowledge, act as cultural custodians, or benefit from specialized or evolving property rights. In some cases, their longevity enables them to accumulate productive assets and experience.

Demographic and technological shifts are reshaping institutions and cultural practices surrounding aging. Increased longevity and declining fertility have dramatically expanded the elderly population worldwide, both in total and relative to younger ages. The global population aged 65 or older is expected to rise from 524 million in 2010 to 1.5 billion by 2050 (World Health Organization, 2011). In 1950, there were three children under five for every person over 65; by 2050, this ratio is projected to reverse (World Health Organization, 2011). These changes influence work, consumption, and savings patterns, particularly for the elderly. Popular works, such as Diamond (2012, Chapter 6), highlight aspects of this transformation, and some governments are responding with targeted policies (United Nations Department of Economic and Social Affairs, 2019).[1]

Across all economic development levels, but especially in less developed economies, the elderly play a key role in preserving and transmitting culture. This raises critical questions: how might demographic and technological changes affecting the elderly influence cultural transmission? (World Health Organization, 2011, p. 5). Notably, much of the anticipated growth in the elderly population will occur in lower income countries, where tradition and culture strongly shape their condition (World Health Organization, 2011; United Nations Department of Economic and Social Affairs, 2019).

We examine how production, property rights, and cultural transmission interact to shape the treatment of the elderly across societies. Our model shows that respect for the elderly can arise endogenously, as parents cultivate norms of care in their children who later reciprocate. A central contribution is to distinguish between property rights over created output and rights over productive inputs such as land or capital, and to study how these rights operate

[1] See https://theweek.com/articles/462230/how-elderly-are-treated-around-world.

under different forms of production. We consider two versions of the model: one in which rights are defined over fixed resources, and another in which they emerge through investment in created resources. In both cases, the interaction of property rights and cultural transmission produces nonlinear patterns in elderly well-being, depending on the capital and land intensity of production. These theoretical insights resonate with the ethnographic record. In particular, Simmons' (1970) classic *The Role of the Aged in Primitive Society* (1970) documented how variation in property rights over land, livestock, tools, or stored goods was tightly linked to the security and status of the elderly, underscoring the importance of institutions in shaping intergenerational support.

The rest of this paper is organized as follows. In Section 2, we discuss relevant models from the literature on the economics of aging, and how they relate to property rights, cultural transmission, and modernization. In Section 3, we consider aspects of the cross-cultural literature on aging and treatment of the elderly. In Section 4, we present our model, which emphasizes property rights, and shows how a 'curvilinear' pattern in cultural concern for the elderly emerges. Section 5 discusses some implications of our results and concludes.

2 Literature

Economic analysis of aging has long focused on the connection between aging, savings behavior, and capital accumulation, central to many dynamic economic models. For example, the life-cycle model of Modigliani (1966) and the overlapping generations (OLG) models of Samuelson (1958) and Diamond (1965) explicitly link these factors. The OLG model has proven particularly useful for studying how aging interacts with family structure, intergenerational transfers, and capital accumulation (Michel et al., 2006). Some models, such as those by Boldrin and Jones (2002) and Nishimura and Zhang (1995), invert the traditional altruism paradigm, exploring child-to-parent altruism, which naturally generates elderly support and investment in children's education and fertility.

Other research emphasizes the strategic role of intergenerational transfers in family cohesion. For example, Cigno (1993) shows that family-based transfers can be self-enforcing under specific economic conditions, such as the availability of capital markets and social support systems (Kaplan and Robson, 2003). Studies like Morand (1999) and Blackburn and Cipriani (2006) further explore the connection between fertility, growth, and elderly support, highlighting transitions from high-fertility, traditional economies to low-fertility, modern ones, with changing patterns of intergenerational transfers.

Models of cultural transmission, such as those by Bisin and Verdier (2000, 2001), offer additional insights into elderly treatment. Olivera (2013) demonstrates how norms of elderly

care can persist despite declining fertility and rising life expectancy. Similarly, Varvarigos (2021) links strong family ties, intergenerational transfers, and traditional means of production to evolving societal norms. Cremer et al. (2013) and Ponthiere (2013) analyze the interaction between social support systems and familial altruism, showing how state-provided care can influence family dynamics and value transmission. Relatedly, the demonstration-effect literature emphasizes a forward-looking motive for elderly support, whereby adults care for their parents in part to induce similar behavior from their children, generating an intergenerational feedback between observed behavior and transmitted norms. (Cox and Stark, 1993, 2005; Stark, 1995; Canta and Pestieau, 2013)

Our approach builds on these foundations but focuses on how cultural transmission interacts with elderly treatment. In contrast to demonstration-effect models, which emphasize transfers as strategic signals to influence children's future behavior, we model elderly care as arising from adults' investments in transmitting preferences and norms that lead children to value and enjoy caring for the elderly, within an environment shaped by property rights and production technologies. Unlike models centered on genetic or altruistic motives, we examine how middle-aged individuals cultivate their children's interest in cultural goods provided by the elderly, creating a direct link between cultural preservation and elderly support. This perspective aligns with Cozzi (1998), where cultural investment serves as a form of wealth storage for future consumption.

Empirical work on altruism toward the elderly supports the complexity of these dynamics. While early studies struggled to disentangle altruistic and self-interested motives (Laferrére, 1999), recent research, such as Klimaviciute et al. (2017), finds evidence of 'moderate altruism' driving intergenerational transfers.

Our model advances this literature by integrating strategic and altruistic aspects of elderly treatment with economic growth, property rights, and production. Unlike most prior research, which uses partial equilibrium approaches, we adopt a general equilibrium framework, as in Acemoglu (2009, Chapter 9). This approach allows us to explore how preferences, technology, different conceptions of property rights, and elderly treatment co-evolve and to develop measures of 'elderly treatment' and 'elderly prestige.' It also connects technological change with the evolving status and treatment of the elderly, providing a comprehensive framework for understanding these dynamics across cultures and economies.

3 The Ethnology of Elderly Treatment

3.1 Cross-cultural research

A foundational study in cross-societal analysis of elderly treatment is Simmons (1970) (originally published in 1945), which surveyed 71 societies, including hunter-gatherers, pastoralists, and subsistence agriculturalists from diverse technological, geographical, and environmental conditions. Simmons aimed to capture a broad cross-section of societies to identify patterns in elderly treatment and how these patterns vary with subsistence strategies and societal complexity.[2]

Simmons's work provides a comprehensive snapshot of elderly treatment across societies before the influence of global modernization and established a framework for subsequent cross-cultural studies. It highlights how the role of the elderly evolves with societal complexity and subsistence strategies. Our summary draws on Simmons' findings, the review by Holmes (1976), and the discussion in Arnhoff et al. (1964).

3.1.1 Food Sharing and Taboos

In societies without well-developed property rights, such as subsistence hunter-gatherer groups, communal food sharing and food taboos provide consumption security for the elderly. As property rights in land and livestock develop, elderly consumption becomes more secure (Simmons, 1970, Ch. 2).

Food sharing is common among hunter-gatherers, motivated by factors such as insurance, exchange, or resource management, though pinpointing a singular reason is difficult.[3] Sharing typically redistributes resources 'vertically' from adults to both the elderly and children, and 'horizontally' among hunters (Lee, 2003). Moreover, hunter-gatherers often lack individual ownership rights over food and land, correlating shared food output with communal access to resources.[4]

Food taboos advantageous to the elderly, described as 'Victual Deference' by Silverman and Maxwell (1978), are widespread among hunter-gatherers in various environments. Simmons noted that these taboos serve as "a social expedient of particular advantage to the aged" and are often manipulated by the elderly for personal benefit (Simmons, 1970, p.

[2]Simmons's methodology resembles the approaches used by G. P. Murdock and collaborators in the Ethnographic Atlas (Murdock, 1969) and the Standard Cross-Cultural Sample (Murdock and White, 1969), as well as data utilized in Pryor (1973). For applications of cross-cultural data in economic modeling, see Baker and Jacobsen (2007b,a); Baker and Miceli (2005).

[3]See Baker and Swope (2021) for an overview of sharing theories among hunter-gatherers, and Kelly (2013, Chapter 6) for an extensive discussion.

[4]However, hunter-gatherers can still be territorial at the group level; see (Baker, 2003).

26). Examples from Simmons include the Inuit, Omaha, Pomo, Iban, and Arunta, where tabooed foods often favored the elderly. Additional examples include the *Ju/'hoansi* of the Kalahari Desert, where elders are believed to have powers enabling them to consume foods considered too dangerous for younger individuals, such as ostrich eggs (Rosenberg, 2009, p. 33). Similarly, among the Chukchee of Siberia, reindeer milk is deemed harmful to the young (McArdle and Yeracaris, 1981; Bogoras, 1904). In the Cook Islands, the Pukapukan people maintained a system of food sharing and taboos that allowed elders to control distribution and reserve nutritious parts, such as belly fats and internal organs, for themselves (Simmons, 1970, p. 10).

3.1.2 Property rights

While nonexclusive food sharing benefits the elderly, Simmons observes that "property rights have been lifesavers for the aged" (Simmons, 1970, p. 36), suggesting that well-defined property rights over assets also benefit them. Simmons distinguishes between these types of rights, emphasizing that while nonexclusive rights over food help sustain the elderly, ownership of assets like land or livestock provides additional advantages.

Simmons documents asset accumulation by the elderly, such as working animals and livestock, in groups like the Navajo (Southwestern North America), Chukchi (Siberia), Yakut (Russian Far East), and Akamba (Kenya). In agricultural societies with land ownership, respect for the elderly often aligns with asset accumulation. As Simmons notes, "Firmly entrenched property rights which enhanced the powers of the aged have also been very common among all cultivators of the soil" (Simmons, 1970, p. 44).

3.1.3 Knowledge and the Elderly

The elderly often secure livelihoods by providing valuable services, including administrative tasks that convey power and prestige. Among less developed societies in Simmons' sample, elders may receive payment for childcare, food processing, technical knowledge, or administrative expertise. Their status improves with the importance of tradition and the degree of specialized knowledge they possess.

Simmons also highlights the provision of cultural goods by the elderly in exchange for compensation. For instance, elderly Navajo were paid for knowledge of magic songs and charms, while Pomo and Lengua medicine men earned fees for performing rites (Simmons, 1970, p. 37-38). Cultural conditioning plays a role in establishing property rights over such intangible assets, as with rights over songs and charms, and in shaping practices like food tabooing or game-sharing rules that benefit the elderly.

Beliefs in the magical powers of the elderly are widespread among subsistence hunters and gatherers, instilling fear and respect. Elders are often thought capable of bringing or curing disease, beliefs actively cultivated across varied contexts, including the Yahgan (Tierra del Fuego), Arunta (Australia), Greenland Inuit, Pomo (California Desert), and Witoto (Northern Peru). Among the Ju/'hoansi, some elders are believed to have healing powers derived from their ability to harness mystical forces without being overwhelmed (Rosenberg, 2009, p. 34).

3.1.4 Inculcation

Attitudes and practices toward the elderly are consciously instilled in the young, often at significant cost to parents. Simmons (1962) emphasizes that such treatment arises from deliberate application of resources and effort, stating, 'Respect for old age has resulted from social discipline' (Simmons, 1970, p. 50). Expanding on this point, Simmons observes:

> ...while human beings can be as indifferent to the dependency needs of their ancestors...they *can also* learn, be taught, inspired, or impelled to respect, succor, and sustain their elders...these patterns of group and filial responsibility are 'passed on' from generation to generation...This learned behavior is called 'culture'." (Simmons, 1962, p. 37)

Cultural conditioning thus enables the elderly to access and control resources they might otherwise lack.

3.2 Elderly Status and Cultural Complexity

Subsequent cross-cultural research on elderly treatment reaches similar conclusions. Press and McKool Jr. (1972, p. 298) summarize Cowgill and Holmes (1971) and their "ostensibly universal generalizations about the status of the aged," that align closely with Simmons (1970). These include the high status of the elderly in contexts where knowledge accumulation is economically important, property rights are accessible, and the elderly can perform meaningful economic tasks. In fact, Press and McKool Jr. (1972, p. 299) note that their independently derived determinants of elderly status coincided with Cowgill's findings.

Although much focus has been on hunter-gatherers and subsistence agricultural or pastoral societies, later research explores how elderly treatment evolves with increasing technological complexity. This involves changes in property rights, social complexity, and production methods. However, defining a consistent trajectory for elderly treatment as societies develop is challenging. Research suggests a nonlinear relationship, with treatment varying

across levels of societal complexity. Terms like 'status' and 'good treatment' are often poorly defined, complicating analysis.[5] For example, comparisons of elderly treatment in hunter-gatherer versus modern industrial societies may hinge on unclear definitions of status and modernity.

A significant characterization is the 'curvilinear hypothesis' (Blumberg and Winch, 1972), as developed by Nimkoff and Middleton (1960).[6] This hypothesis posits a nonlinear relationship between social complexity and family structure: hunter-gatherers and advanced societies tend to have smaller families, while intermediate-level societies feature expansive familial structures. In societies of intermediate complexity, the elderly often hold high status, as documented by Lee (1979). However, this literature often conflates two factors: preferential treatment due to cultural norms and respect derived from accumulated resources. The core question remains: how do asset accumulation and cultural transmission interact?

3.3 Some quantitative evidence

Simmons (1970) provides extensive cross-tabulations of variables to highlight empirical regularities in elderly treatment. This section summarizes his data and presents evidence on the roles, inculcation, and treatment of the elderly across societies. Simmons' data, while valuable, poses challenges for advanced analysis due to its small sample size and missing values. To address this, we constructed indices summarizing key societal features related to the elderly. These indices suggest meaningful relationships among societal characteristics. Appendix A provides a detailed discussion of the data and index construction.

The data includes qualitative traits scaled into indices, summarized in Table 1. The first four indices consider the elderly's role in directly economically productive activities, in social production, in advice and knowledge provision, and the holding of titular roles in the society. The fifth index combines the first three forms of production. The sixth index considers the openness of the society to market-based economic activity. The seventh index measures positive treatment of the elderly, and the eighth index measures the amount of positive inculcation towards the elderly.

We then correlated the six production and openness of economy indices with the two indices for positive treatment of the elderly and positive inculcation towards the elderly. Table 2 presents these correlations. Positive treatment of the elderly is positively correlated with the elderly's contribution to production and with their provision of advice and knowledge, as well as with the combined production index and with their holding of titular duties. Positive inculcation regarding the elderly is also positively correlated with these categories except

[5] Dowd (1981) and Balkwell and Balswick (1981) highlight the issues with vague terminology.

[6] See Lee (1996) for an overview, as well as Lee and Kezis (1981) and Baker and Miceli (2005).

Index	Description
Contribution to direct production	Tasks such as trading, childcare, hunting support, agriculture, household work, and collecting fees for services.
Contribution to social production	Performing marriages, initiation rites, funerals, and roles as priests or shamans.
Knowledge and advice provision	Providing advice and information.
Titular duties	Holding roles as chiefs, elders, and judges.
Combined production	Sum of direct production, social production, and knowledge and advice provision indices.
Openness of economy	Presence of property rights, trading, and currency usage.
Positive treatment	Respect, distinction, and familial support for the elderly.
Positive inculcation	Beliefs portraying the elderly as daimons, heroes, and/or children's friends.

Table 1: Indices constructed from data in Simmons (1970).

for titular duties. Positive treatment and positive inculcation are positively correlated. Interestingly, the open economy index is not correlated with positive treatment and shows some evidence (though not at standard statistical significance) or negative correlation with positive inculcation. We shall consider these patterns in the context of consistency with our formal model later in the paper.

	Positive treatment	Positive inculcation
Contribution to direct production	0.38*	0.24*
Contribution to social production	0.21	0.22
Knowledge and advice provision	0.43*	0.45*
Combined production	0.41*	0.33*
Titular duties	0.36*	0.15
Openness of economy	0.05	-0.16
Positive treatment	-	0.45*

Table 2: Pairwise correlations between indices based on Simmons (1970). * denotes significance at 95%. See Appendix A for variable details.

3.4 Modernization and the Elderly

As globalization and technological change advance, population growth slows, and the global population ages, understanding the interaction between technical change and cultural prac-

tices related to the elderly becomes increasingly critical. While industrialization is often considered detrimental to elderly well-being (Dowd, 1981, e.g.,), the relationship between industrialization and elderly welfare is nuanced. This complexity remains relevant even in modern societies, raising questions about how institutions like social security systems influence care for the elderly. Such questions grow in significance as many regions transition from traditional to modern economies in the coming decades.

For example, Koda and Uruyos (2018) find that public transfers can crowd out private care for the elderly, and that the implications of modernization, including lower fertility and smaller families, tend to reduce familial support. These findings align with theories in Koda and Uruyos (2018) and Cigno (1993). However, Ko and Möring (2021), in their study of pensions in rural China, report that public pensions increase both well-being and intergenerational exchange. Similarly, Kodate and Timonen (2017) describe the complex interplay between public funding, paid healthcare workers, cultural norms, and family care.

The literature suggests that cultural practices, shifting economic structures, and evolving property rights interact with different ways of storing wealth across generations in nuanced and complex ways. These interactions shape how societies balance consumption smoothing with intergenerational support, sometimes reinforcing care for the elderly through cultural norms, asset accumulation, or secure claims to resources. Our model is designed to capture these trade-offs by formalizing the links between cultural transmission, economic structure, and property rights. In doing so, it not only generates predictions consistent with the ethnographic record but also brings sharper definition to otherwise vague concepts in the empirical literature—such as what it means for the elderly to enjoy "status," to possess "prestige," or simply to be "treated well."

4 Theoretical Framework

The model is a standard infinite-horizon overlapping-generations framework, where young, middle-aged, and elderly agents coexist at any given time. Decision-making occurs solely in middle age. In the base model, middle-aged individuals cultivate a preference in the young for giving gifts to the elderly. Upon reaching middle age, these individuals transfer resources to the elderly, deriving 'warm glow utility' as described by Andreoni (1989). This willingness to transfer depends on the degree of appreciation instilled in them during youth by the current middle-aged cohort.[7]

[7]This approach resembles models in which cultural heritage and societal devotion are endogenously determined, such as Cozzi (1998). However, Cozzi's model assumes self-fulfilling beliefs about culture without active cultivation.

Middle-aged and elderly consumption at time t are denoted c_{mt} and c_{et}, with gifts to the elderly represented by g_{mt}. The lifetime utility of a middle-aged agent is given by the log-linear utility function:

$$U_t = (1 - \eta_t) \ln c_{mt} + \eta_t \ln g_{mt} + \beta \ln c_{et+1}, \tag{1}$$

where η_t measures the relative importance of gift-giving in middle-aged utility.

Middle-aged agents receive income y_{mt}, allocated to consumption c_{mt}, savings s_{mt}, gifts g_{mt}, and inculcative investment in the young. Inculcation determines the future demand parameter η_{t+1}, reflecting the young's appreciation for culture when they reach middle age.

Our approach is related to, but distinct from, the framework of Bisin and Verdier (2000, 2001), and bears a closer resemblance to the formulation of Doepke and Zilibotti (2008, 2017), where parents expend resources to shape their children's preferences. In the standard Bisin–Verdier model, vertical transmission generates benefits by producing offspring similar to the parent, with the emphasis on how parental desires to replicate their own preferences interact with the similar forces exerted by other parents.[8]

By contrast, our formulation follows the Doepke–Zilibotti tradition but develops it in a different direction: transmission yields a direct consumption benefit, as children's choices result in transfers to the elderly. This focus motivates us to abstract from non-parental sources of preference formation, such as schools, other institutions, or other broad social influences. Including such influences would introduce competing traits, externalities, and institutional complications that risk obscuring the mechanism we want to isolate, though spillovers from other cultures or external shocks could be incorporated in future extensions. One central reason for employing this approach is that it allows us to naturally compare and contrast culture in its capacity as a savings instrument directly with what one might think of as 'true' savings instruments - things like land and capital.

That having been said, one might interpret our model as one in which the population coordinates on inculcative investments that compete against a baseline or passive cultural state in which the institution is not transmitted, with large-numbers dynamics at work. In this setup, the parameter η represents the fraction of next-generation agents who value the elderly—either by consuming their cultural goods or, in our preferred reading, by deriving warm-glow utility from giving to them. This parallels the way technological factors in our model play the role that institutional change occupies in standard cultural transmission models (see (Bisin and Verdier, 2000, 2001); Bisin and Verdier (2023) is a recent review). Where

[8]One might describe these as 'Simpsonian' models, inspired by Homer Simpson's parenting philosophy: "Kids are the best... You can teach them to hate the things you hate." (*The Simpsons*, season 11, episode 233, 1999).

that literature emphasizes the interaction between culture and institutions, we emphasize the interaction between culture and technology. Indeed, our model focuses on transmission of preferences at the cultural level, and not at the level of the individual family, as we are interested in understanding not how a single person or family's preferences are maintained, but instead how society's cultural practices as a whole are transmitted between generations.

The advantage of this setup is that it directs attention firmly to the interplay between the supply-side characteristics of the economy and the decision to inculcate. As shown below in 4, the inculcative decision can be naturally embedded in a broader choice over how agents save their current wealth. Such a simple comparison is less transparent in the Bisin and Verdier (2000, 2001) framework but emerges directly from our approach.

The cost of inculcation are $d_t(\eta_{t+1})$. Middle-aged consumption is then:

$$c_{mt} = y_{mt} - d_t(\eta_{t+1}) - s_{mt} - g_{mt}. \tag{2}$$

Elderly consumption c_{et} is derived from three sources: returns on previous savings $R_t s_{mt-1}$, earned income y_{et}, and received gifts g_{et}. Income y_{et} may include compensation for productive or advisory roles, government transfers such as social security, or traditional sharing of output in hunter-gatherer societies. Therefore elderly consumption is:

$$c_{et} = R_t s_{mt-1} + y_{et} + g_{et}. \tag{3}$$

This model of intergenerational gift-giving also captures cultural transmission. We will demonstrate that the utility function in (1) aligns with a model where cultural goods of endogenously determined value are exchanged across generations.

4.1 Property rights over natural resources

We begin with a simplified version of the model in which there is no savings ($s_{mt} = 0$ in Equation (3)). Our main purpose in doing this is to firmly focus attention on a world in which property rights are established over a given stock of resources, such as land - in a subsequent section, we focus attention on a situation in which property rights are exerted over accumulated resources, such as capital. Thus, one might view the degree of property ownership as parametric in this section, whereas in section 4.5, property ownership is as a choice.

Substituting middle-aged consumption (2) and elderly consumption (3) into (1) and setting $s_{mt} = 0$, we obtain:

$$U_{mt} = (1 - \eta_t) \ln(y_{mt} - g_{mt} - d_t(\eta_{t+1})) + \eta_t \ln g_{mt} + \beta \ln (y_{et+1} + g_{et+1}) \tag{4}$$

To simplify further, in this section we assume that agents make a simple binary of whether to inculcate children to enjoy giving gifts to the elderly or not; that is, middle-aged agents choose $\eta_t \in \{0, \eta\}$ with $0 < \eta < 1$ at some cost $d_t(\eta)$. Simultaneously, middle-aged agents decide on a gift amount for the current elderly, based on the previous generation's inculcative efforts exerted on them. These assumptions allow us to model the problem as a stationary, infinite-horizon game where each generation sequentially decides on inculcation, anticipating that future generations will follow the same strategy in the future.

We assume that the costs of inculcation are proportional to contemporaneous income. Specifically, when a parent chooses inculcation η costs are $d_t = \delta y_t$. This assumption is motivated by two considerations. First, proportional costs ensure scale invariance of the decision problem, a standard feature of growth and overlapping-generations models in which relative, rather than absolute, costs determine behavior. Second, this formulation is consistent with the way the literature models investments in children as time- and resource-intensive activities whose opportunity costs scale with parental earnings. In this tradition, parental effort is valued at the parent's wage, implying that higher-income parents face higher absolute costs for a given intensity of investment. A recent example of this approach is Caucutt et al. (2025).

Middle-aged utility in an inculcation equilibrium is:

$$U_{mt,\eta} = (1 - \eta) \ln(y_{mt} - g_{mt} - \delta y_{mt}) + \eta \ln g_{mt} + \beta \ln (y_{et+1} + g_{et+1}) \tag{5}$$

In (5) g_{et+1} is the expected next-period gift, given that current youth are to be inculcated. Stability of this equilibrium can be analyzed by considering a deviation where a middle-aged agent opts out of inculcation, leading to no future gifts. In this case, the agent's lifetime utility becomes:

$$U_{mt,0} = (1 - \eta) \ln(y_{mt} - g_{mt}) + \eta \ln g_{mt} + \beta \ln(y_{et+1}) \tag{6}$$

When inculcation and gift-giving are maintained, optimal gifts are derived by differentiating (5) with respect to g_{mt}, yielding:

$$g^*_{mt} = \eta(1 - \delta) y_{mt} \tag{7}$$

Equation (7) indicates that the middle-aged agent gives a gift proportional to disposable income, defined as income remaining after inculcative efforts are exerted. Using this,

equilibrium gifts received, g^*_{et}, can be determined. To account for demographic changes, we assume a constant population growth rate n, such that $N_{t+1} = (1+n)N_t$, where N_t denotes the population size at t. For any amount of gift-giving, this implies $g_{et} = (1+n)g_{mt}$. If the middle-aged agent abandons inculcation, following equation (5) the final gift given is $g'_{mt} = \eta y_{mt}$, and no gift is received during old age in the subsequent period.

4.1.1 Gifts and transfer of cultural goods

Before continuing to analyze inculcative decisions, we digress for a moment to show that the warm glow gift-giving model is equivalent to a model in which cultural goods are transferred between generations. This allows us to relate the importance of gifting in support of the elderly to a more general notion of cultural transmission and its importance in maintaining the elderly. Indeed, it is worth pausing and reiterating how a gift-giving model relates to a model of transmission of culture, and how our model relates to other models of cultural transmission which follow Bisin and Verdier (2000, 2001).

Suppose that instead of enjoying giving gifts, the current middle-aged generation places value on consumption of a cultural good, for which a price p_t must be paid. Let the demand for cultural goods is x^d_t, and suppose that the good is supplied by current elderly, each of whom has one unit of the good to supply. Lifetime utility (1) in these circumstances may be written as:

$$U_t = (1-\eta_t)\ln c_{mt} + \eta_t \ln x^d_t + \beta \ln c_{et+1} \tag{8}$$

Under this alternative specification, utility is not derived from giving gifts to the elderly, but instead derives from consuming the cultural good that the elderly provide. Again assuming that $s_{mt} = 0$, modifying consumption of middle-aged and elderly (2) and (3) accordingly gives (8), and using our assumption that the cost of inculcation $d_t = \delta y_t$ as:

$$U_t = (1-\eta)\ln(y_{mt} - \delta d_t - p_t x_{dt}) + \eta \ln x_{dt} + \beta \ln (y_{et+1} + x_{st+1}p_{t+1}) \tag{9}$$

In specification (9), η now measures the relative importance of cultural consumption to material consumption. Current middle-aged agents spend $p_t x_{mt}$ on cultural goods, which gives them utility $\eta \ln x_{mt}$.

The current middle-aged inculcate an interest in cultural goods in the current young. When cultural goods are more valuable to the young, as reflected in a higher value of η, they

pay more for them, proportionately enriching the elderly.[9] We can now establish that this cultural goods model is observationally equivalent to the warm-glow gift-giving model under our assumptions. This leads us to Proposition 1.

Proposition 1 (Equivalence of gift-giving and cultural exchange)**.** *The models captured by utility functions (1) and (8) are observationally equivalent:*

- ***Gift-giving:*** *Middle-aged agents give gifts to the elderly, and receive 'warm-glow' utility from giving gifts.*
- ***Cultural exchange:*** *Middle-aged agents spend $x_t^d p_t$ on cultural goods supplied by the elderly and earn utility from these goods.*

Proof: The gift-giving model resulted in an equilibrium gift given by current middle-aged agents proportional to current middle-aged disposable income, as in (7). For the cultural goods model, differentiating (9) with respect to x_t^d and solving gives the demand for x_t^d as:

$$x_t^d = \frac{\eta(1-\delta)y_t}{p_t} \tag{10}$$

Each elderly agent has a supply of one unit of cultural goods, so demand equal to supply requires $x_t^s = (1+n)x_t^d$ or $1 = (1+n)x_t^d$. Equating demand from (10) with supply and solving gives $p_t = (1+n)\eta(1-\delta)y_{mt}$. It follows that $p_t x_t^d = \eta(1-\delta)y_{mt}$ are the expenditures of middle-aged agents on cultural goods, while $p_{t+1}x_{t+1}^s = p_{t+1} = (1+n)\eta(1-\delta)y_{mt+1}$ is the amount received by the elderly, identical to the gifts implied by g_{mt}^* in (7) and the resulting gifts received by the elderly, g_{et}^*. □

The equivalence result in Proposition 1 is useful because it allows us to work with the easier-to-solve gift-giving model while preserving the key mechanism through which cultural transmission affects the treatment of the elderly. With this result in hand, it is helpful to revisit how our framework differs from that of Bisin and Verdier (2000, 2001). As in their approach, we assume that investments in inculcation face competing economic constraints. However, whereas in Bisin and Verdier (2000, 2001) inculcative investments compete with population structure, in our model they compete directly with the material side of the economy.

[9] In addition to being similar to models in which parents influence the preferences of their young as in Doepke and Zilibotti (2008, 2017), this interpretation is similar to a model in which firms engage in advertising spending which changes the demand for a good as described in Bagwell (2007), for example.

4.1.2 Inculcation decisions

We can now show that the inculcation decision depends on whether or not elderly income is small relative to middle-aged income. This result and the key income threshold are described in Proposition 2.

Proposition 2 (Relative income and inculcation)**.** *Inculcation occurs when elderly income is sufficiently small relative to middle-aged income, occurring when:*

$$\frac{y_{et+1}}{y_{mt+1}} \leq Y^*$$

where

$$Y^* = \frac{(1+n)\eta(1-\delta)}{\left((1-\delta)^{-\frac{1}{\beta}} - 1\right)}$$

Proof: Substitution of the gift in (7) into (5), and substitution of the terminal gift $g'_{mt} = \eta y_{mt}$ into (6) coupled with the observation that $g_{et+1} = (1+n)g_{mt+1}$ allows writing the difference in utilities along the equilibrium path with inculcation and the utility from discontinuing inculcation, $\Delta U_t = U_{mt,\eta} - U_{mt,0}$ as:

$$\Delta U_t = \ln(y_{mt}(1-\delta)) - \ln y_{mt} + \beta \ln[y_{et+1} + (1+n)\eta(y_{mt+1}(1-\delta))] - \beta \ln(y_{et+1}) \tag{11}$$

ΔU_t in (11) simplifies to:

$$\Delta U_t = \ln\left(1 - \frac{d_t}{y_{mt}}\right) + \beta \ln\left(1 + (1+n)\eta(1-\delta)\frac{y_{mt+1}}{y_{et+1}}\right) \tag{12}$$

Rearranging (12) gives:

$$\Delta U_t \geq 0 \quad \text{if} \quad \frac{y_{et+1}}{y_{mt+1}} \leq \frac{(1+n)\eta(1-\delta)}{\left((1-\delta)^{-\frac{1}{\beta}} - 1\right)} = Y^* \tag{13}$$

□

Proposition 2 defines a critical threshold for the *relative income* earned by the elderly. If relative elderly income falls below the threshold Y^*, inculcation occurs in equilibrium. The threshold increases (making inculcation more likely) if population growth increases ($n \uparrow$); this is because there are more middle-aged agents for each elderly agent, resulting in more gifts received. If the effectiveness of inculcation increases ($\eta \uparrow$), if inculcation becomes cheaper ($\delta \downarrow$), and if old-age consumption becomes more important ($\beta \uparrow$), inculcation becomes more likely. When inequality (13) does not hold, middle-agers do not anticipate the need to

inculcate current youth, as the income they earn when old generates sufficient income for sustenance. Also, the relatively low income of middle-agers does not produce sufficiently large gifts to warrant inculcation.

We now add to the model a measure of the status or prestige of the elderly: the relative consumption of the elderly, $\frac{c_{et}}{c_{mt}}$, which we distinguish from the relative income of the elderly, $\frac{y_{et}}{y_{mt}}$. While the relative consumption of the elderly functions as a direct and convenient measure of elderly well-being, such a distinction is also important to make, because the relative consumption ratio is influenced by one type of property rights (property rights over output), while the relative income ratio is determined by another type of property rights (property rights over inputs such as land).

Using (7) and (13), we write this consumption ratio as follows, accounting for the range of relative incomes for which inculcation and concurrent gift-giving occurs:

$$\begin{aligned} \frac{c_{et}}{c_{mt}} &= \frac{y_{et}}{y_{mt}}, && \frac{y_{et}}{y_{mt}} > Y^* \\ &= \frac{y_{et}}{y_{mt}(1-\eta)(1-\delta)} + \frac{(1+n)\eta}{1-\eta}, && \frac{y_{et}}{y_{mt}} \leq Y^* \end{aligned} \tag{14}$$

Equation (14) suggests that there may not be a direct link between inculcative activity and the relative treatment of the elderly. For example, the elderly may provide services or other productive labor so that y_{et} is large relative to y_{mt}. The elderly will then be well treated, but this could be a result of the nature of production, not of inculcation. The ethnographic record highlights the nature of production and different sorts of property rights as key factors shaping the elderly's economic roles and relative well-being, prompting us to extend the model accordingly.

4.2 Production Technology

In this section we set up the supply side of the economy in a way that allows us to describe a means by which property rights over resources and output interact, and how they influence the treatment of the elderly. Suppose that in each time period, society creates output using labor L_t and a quantity of fixed resources T. We will refer to T as land, but it could represent some other natural resource used to produce output. Output is produced via the constant-returns production function:

$$Y_t = F(L_t, T) \tag{15}$$

Let $A_{it}, i = m, e$ denote the effective labor endowments of middle-aged and elderly agents. Agents supply their labor inelastically, so total labor in (15) is effective labor supplies mul-

tiplied by middle-aged and elderly populations:

$$L_t = N_{mt}A_{mt} + N_{et}A_{et}, \tag{16}$$

The production function (15) is constant-returns so it can be decomposed using Euler's theorem. Using $F_L = \frac{\partial F}{\partial L}$ and $F_T = \frac{\partial F}{\partial T}$, we may write:

$$Y_t = F(L_t, T) = F_L L_t + F_T T \tag{17}$$

The decomposition in (17) gives us a natural way to attribute output to factors of production; $F_L L$ is labor's contribution to total output, while $F_T T$ is the share of total output that can be attributed to fixed inputs. Similarly, the contribution of any agent's labor to output is the marginal product of labor multiplied by the agent's effective labor supply, $F_L l_i$, so output created by the labor of each agent of each respective age is:

$$q^L_{mt} = A_{mt}F_L, \quad q^L_{et} = A_{et}F_L \tag{18}$$

output attributable to the fixed resource is

$$q^T_t = TF_T \tag{19}$$

Property rights define how the output created in (18) and (19) is allocated to agents.

4.3 Property Rights

In Section 3, we discussed Simmons' intriguing remarks on the role of property rights in supporting the elderly. While he describes property rights as 'lifesavers' for the elderly (Simmons, 1970, p. 36), he also notes that weaker property rights can sometimes benefit them, such as when food is shared communally. To clarify, we distinguish between property rights over inputs like land and property rights over output such as game acquired. Simmons appears to blur these distinctions in his ethnographic overview. Strong property rights over productive assets (inputs) likely benefit the elderly as the elderly earn and accumulate ownership rights over the lifespan. Conversely, weak property rights over output, which result perhaps from encouragement of communal sharing of game, may be advantageous to the elderly. This input-output distinction aligns naturally with the Euler decomposition of the production function (17) and allows us to develop a simple way of thinking about the degree to which property rights are delineated.

Suppose that each agent has an ownership share of the fixed resource $\sigma_{it}, i = m, e$ where

$\sum \sigma_{it} = 1$ across the entire population. Since all elderly and middle-aged agents are identical, we may take it to be the case that $\sigma_{et}N_{et} + \sigma_{mt}N_{mt} = 1$. Then, a starting point to describe the output that an agent is responsible for creating is expression (20):

$$q_{it} = q_{it}^L + q_{it}^T = A_{it}F_L + \sigma_{it}F_T T, \quad i = m, e; \quad \sigma_{et}N_{et} + \sigma_{mt}N_{mt} = 1 \tag{20}$$

4.3.1 Property rights over land

The ideas in (20) naturally frame property rights over land (or other assets) in terms of σ. Consider a situation in which ownership of land is not defined at all, as is the case when land is a completely free-access resource. σ_{it} should then be set so as to allow our model to mimic a typical common production model, in which agent i's output depends upon i's relative share of labor, so $q_{it} = q_{it}^L = \frac{l_i}{L}F(L, T)$.[10]

Open-access land rights is then captured by a value of σ_{it}, σ_{it}^0, when land shares mimic labor shares as follows:

$$\sigma_{it}^0 = \frac{A_{it}}{L_t} = \frac{A_{it}}{N_{mt}A_{mt} + N_{et}A_{et}}, \quad i = m, e \tag{21}$$

To confirm that this is in accordance with a typical common property, open access model, note that we can combine agents' output (20) with σ_{it}^0 in (21) to get:

$$q_{it} = A_{it}F_L + \frac{A_{it}}{L_t}F_t T = \frac{A_{it}}{L_t}\left(F_L L_t + F_t T\right) = \frac{A_{it}}{L_t}F(L_t, T) \tag{22}$$

The last part of (22) follows from the assumption that $F(L_t, T)$ is homogeneous of degree one. This pins down one side of a spectrum of possible degrees of ownership rights over land, with σ_{it}^0 in (21) corresponding to a situation in which there are no land property rights.

When property rights are fully defined over land, suppose that a right of first possession or a usufruct right determines ownership. This can be approximated by the elderly controlling assets in a way proportional to past usage (that is, their usage during middle age), so that when asset rights are fully defined, $\sigma_{et} = \frac{A_{mt-1}}{A_{mt-1}N_{mt-1}} = \frac{1}{N_{et}}$. It follows that in this case the middle-aged do not have any property rights, so $\sigma_{mt} = 0$. Fully defined property rights over land are then characterized by values of σ_{it} which we label as $\sigma_{it}^1, where$:

$$\sigma_{et}^1 = \frac{1}{N_{et}}, \quad \sigma_{mt}^1 = 0 \tag{23}$$

[10] This is a slight generalization of the idea that open access resources generate average product as returns for users as in, for example, Gordon (1954). See Baker and Conning (2024) for further discussion.

In (21) and (23), we have described free access and fully defined rights over land using values for σ_{it} as σ_{it}^0 and σ_{it}^1. But a spectrum of intermediate possibilities exists between the two endpoint cases, and we introduce a parameter $\phi_T \in [0, 1]$ to capture the degree of definition of property rights over land (or other fixed assets) as a linear combination of the two polar cases where $\sigma_{it} = \phi_T \sigma_{it}^1 + (1 - \phi_T)\sigma_{it}^0$. This results in values the following values for σ:

$$\sigma_{et} = \phi_T \frac{1}{N_{et}} + (1 - \phi_T)\frac{A_{et}}{L_t} \tag{24}$$

$$\sigma_{mt} = (1 - \phi_T)\frac{A_{mt}}{L_t} \tag{25}$$

When $\phi_T = 0$ in (24) and (25) there are no ownership rights in land, while when $\phi_T = 1$ property rights are completely defined, and we can use larger, intermediate values of ϕ_T to indicate a greater degree of asset ownership in the economy.

4.3.2 Property rights over output

We model imperfect rights over output as the loss of some share of q to a general output fund, which is then shared equally among all agents. Let ϕ_Q denote the share of own output retained by the agent so that $1 - \phi_Q$ of each agent's output is contributed to the output pool. Then we can write the total income received by an agent as a function of the degree of definition of property rights as captured by different values of ϕ_Q and ϕ_T, assuming that each agent gets an equal share of the total output shared with others:

$$y_{it} = \phi_Q q_{it} + (1 - \phi_Q)\frac{\sum_{j=1}^{N_t} q_{jt}}{N_t} \quad i = m, e \tag{26}$$

Substituting into (26) our expressions for outputs in (20) gives:

$$y_{it} = \phi_Q \left(A_{it} F_L + \sigma_{it} F_T T\right) + (1 - \phi_Q)\frac{F(L_t, T)}{N_t} \quad i = m, e \tag{27}$$

In (27) we see that imperfect ownership of output removes a bit of output from each agent but entitles an agent to a share of average output.

4.3.3 Property rights in general

A stylized fact is that property rights tend to develop in tandem; ownership of resources and the output created by those resources seem to evolve in the same direction.[11] We model this fact by assuming that ϕ_T and ϕ_Q are linked but do not necessarily move in lockstep. To allow for our two types of property rights to develop at different rates yet still be linked, we introduce ρ as a parameter characterizing the relative speed at which ownership of output and inputs co-evolve and then specify that $\phi_T = \phi_Q^\rho$. When $\rho > 1$, $\phi_T = \phi_Q^\rho < \phi_Q$, and rights over output are more developed than rights over assets for any interior value of ϕ_Q. Alternatively, if $\rho < 1$, the opposite is true: rights over assets are more developed than rights over output, as $\phi_T > \phi_Q$. To save on notation, going forward we will therefore drop the subscript and use ϕ to denote ϕ_Q, so that $\phi_T = \phi^\rho$.

4.3.4 Property rights and relative treatment of the elderly

We now can relate the development of property rights to inculcation, treatment of the elderly, and cultural transmission. Substituting (24) and (25) into (27), and forming the ratio $\frac{y_{et}}{y_{mt}}$ gives:

$$\frac{y_{et}}{y_{mt}} = \frac{\phi\left(A_{et}F_L + \left[\frac{A_{et}(1-\phi^\rho)}{L_t} + \frac{\phi^\rho}{N_{et}}\right]F_T T\right) + (1-\phi)\frac{F(L,T)}{N_{et}+N_{mt}}}{\phi\left(A_{mt}F_L + \frac{A_{mt}(1-\phi^\rho)}{L_t}F_T T\right) + (1-\phi)\frac{F(L,T)}{N_{et}+N_{mt}}} \tag{28}$$

Assume that the aggregate production function is Cobb-Douglas: $F(L,T) = L^\alpha T^{1-\alpha}$. Then, expression (28) becomes:

$$\frac{y_{et}}{y_{mt}} = \frac{\phi\left(A_{et}\alpha + \left[A_{et}(1-\phi^\rho) + \frac{\phi^\rho L_t}{N_{et}}\right](1-\alpha)\right) + (1-\phi)\frac{L_t}{N_{et}+N_{mt}}}{\phi\left(A_{mt}\alpha + A_{mt}(1-\phi^\rho)(1-\alpha)\right) + (1-\phi)\frac{L_t}{N_{et}+N_{mt}}} \tag{29}$$

Expression (29) links relative elderly income, technology of production, and property rights. It provides direct insight into how well the elderly are treated given the fundamental characteristics of the economy on its own, but it also functions as the driving variable in whether or not we expect to see inculcation and a cultural factor in the treatment of the elderly as it appears in the inequality (13) in Proposition 2. When $\phi = 0$, (29) collapses to unity. This is because when all output is shared equally, elderly and middle-aged are the same. In Proposition 3, we collect the key results concerning relative income and the

[11] Developing a theory of the development of property rights is beyond the scope of this paper. For a recent review and one modeling approach, see Baker and Conning (2024). In particular see Baker (2003, 2008) for a model in which rights over assets emerge endogenously, and Baker and Swope (2021) for a model in which ownership of resources and output-sharing are interrelated.

definition of property rights embodied in (29).

Proposition 3 (Property rights and the relative income of the elderly)**.** *The relative income of the elderly, $\frac{y_{et}}{y_{mt}}$ is U-shaped in the degree of definition of property rights ϕ, provided a) production is not too labor-intensive (α is not too large), and b) provided $A_e < A_m$; the elderly have a relatively smaller endowment of labor.*

Proof: In what follows, the total population is $N_{et} + N_{mt} = N_t$. Taking the derivative of relative income $\frac{y_{et}}{y_{mt}}$ in (29) and simplifying gives:

$$\frac{\partial\left(\frac{y_{et}}{y_{mt}}\right)}{\partial\phi} = \frac{N_t L_t \left(A_{et}N_{et} + A_{mt}(N_t\phi^{\rho}(1-\alpha)(1+\rho) - N_{et})\right)}{N_{et}\left((1-\alpha)A_{mt}N_t\phi^{\rho+1} - (A_{mt}-A_{et})N_{et}\phi - L_t\right)^2} \tag{30}$$

Evaluating (30) at $\phi = 0$ gives:

$$\frac{\partial\left(\frac{y_{et}}{y_{mt}}\right)}{\partial\phi} = (A_{et} - A_{mt})\frac{N_t}{L_t} \tag{31}$$

Which is negative so long as $A_{et} < A_{mt}$. Therefore, the relative income ratio starts at 1 and initially decreases in ϕ. The sign of the derivative in (30) thereafter depends wholly on the expression in the numerator of (30):

$$A_{et}N_{et} + A_{mt}(N_t\phi^{\rho}(1-\alpha)(1+\rho) - N_{et}) \tag{32}$$

This expression is increasing in ϕ and equals zero at a critical value of ϕ, ϕ^*, given by:

$$\phi^* = \left(\frac{(A_{mt}-A_{et})N_t}{A_{mt}N_t(1-\alpha)(1+\rho)}\right)^{\frac{1}{\rho}} \tag{33}$$

As the derivative in equation (31) is initially negative, equals zero at a unique point $\phi^* \in (0,1)$ and then becomes positive, relative income is U-shaped in the degree to which property rights are developed, ϕ. □

Proposition 3 starts with the assumption that $A_{et} < A_{mt}$, which means that an elderly agent provides fewer effective units of labor than a middle-aged agent. Another assumption is that α is not very large; if it were ϕ^* would be outside the $(0,1)$ range and relative elderly income would only decrease in ϕ. When $\phi = 1$ we have:

$$\frac{y_{et}}{y_{mt}} = \frac{1}{\alpha}\frac{A_{et}}{A_{mt}} + \frac{1-\alpha}{\alpha}\frac{N_{mt}}{N_{et}} \tag{34}$$

The limit ratio in (34) can be greater than one or less than one, depending on the relative elderly population and their relative productivity. For small enough α (that is, production is resource intensive), the ratio in (34) can be greater than one even if $A_{et} = 0$ (the elderly do not supply any material labor). Then, the elderly can achieve a high level of prestige measured by relative income even in the absence of inculcation. This is because the elderly have accumulated assets in middle age.

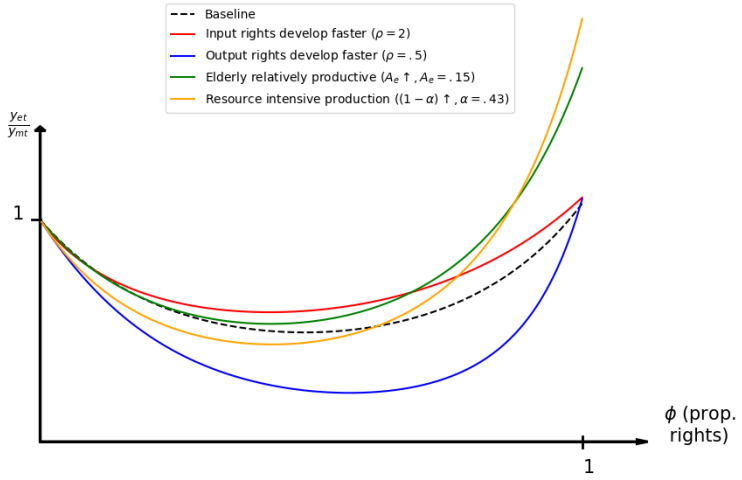

Figure 1: Relative income of the elderly ($\frac{y_{et}}{y_{mt}}$), as functions of the development of property rights in output and productive resources from nonexistent ($\phi = 0$) to complete ($\phi = 1$). Baseline parameter values of $A_m = 1$, $A_e = 0.025$, and $\alpha = 0.5$.

Figure 1 plots the relative income ratio (29) as a function of property rights development, ϕ, under varying assumptions about production and the relative development of rights over output and inputs ρ. While model parameters can shift the curve's position, its overall shape remains consistent. When $\phi = 0$, relative incomes for the elderly and middle-aged are exactly the same because everyone shares output equally. But as ϕ increases, the elderly do not get as great a share of output so their relative income falls. Eventually, however, better definition of ownership of productive assets dominates, which increases the relative income of the elderly.

Figure 2 combines results from Propositions 2 and 3. As property rights develop (ϕ increases) and the economy moves rightward along the x-axis, the relative consumption ratio $\frac{c_{et}}{c_{mt}}$ (equivalent to $\frac{y_{et}}{y_{mt}}$ in this range) initially declines for the same reasons the income ratio declines. But, ultimately, the Y^* threshold from Proposition 2 is crossed. At this

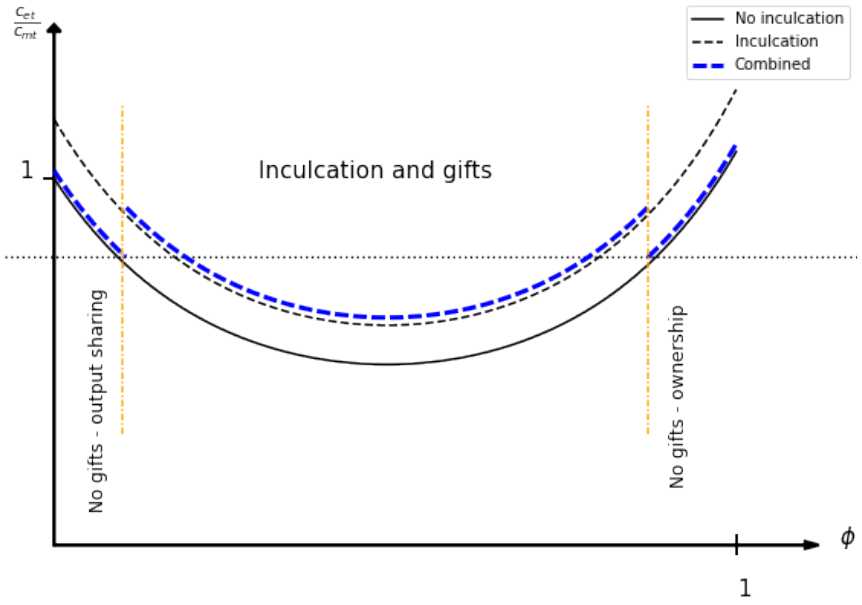

Figure 2: Relative consumption of the elderly ($\frac{c_{et}}{c_{mt}}$), as a function of the degree to which property rights are developed, ϕ, with endogenous inculcation. Baseline parameter values of $A_m = 1$, $A_e = 0.025$, and $\alpha = 0.5$.

point, inculcation begins, encouraging young people to support the elderly, mitigating the decline in relative treatment. However, once property rights become sufficiently advanced, inculcation ceases, as shown in the figure. This analysis highlights the complexity of linking culture, inculcation, and elderly prestige, suggesting a nonlinear relationship between culture, production, and elderly treatment.

4.4 Savings, Capital Accumulation, and Inculcation

We now analyze a version of the model where assets are accumulated through conscious savings decisions, exploring how this interacts with inculcation and gifts to the elderly. One can imagine that this characterizes a situation in which property rights are over an accumulated asset such as capital, not an asset in fixed supply such as land. This approach also connects inculcative investment with savings and aligns the exposition with classical growth models featuring technological progress. We model the inculcation of children as a continuous choice η_{t+1} made by the current middle-aged generation. We assume that the costs of inculcation enter utility linearly, so that $d_t(\eta_{t+1}) = d_t\eta_{t+1}$. As in the previous section, ultimately we shall use the assumption that the per-unit cost of inculcation is scaled with contemporaneous income, so that $d_t = \delta y_{mt}$.

The optimization problem of a current middle-aged agent can be written as the problem of maximizing U_t in (1) subject to constraints (2) and (3), as follows:

$$\begin{aligned} \max_{g_t, s_{mt}, \eta_{t+1}} \quad & (1-\eta_t)\ln c_{mt} + \eta_t \ln g_{mt} + \beta \ln c_{et+1} \\ \text{s.t.} \quad & c_{mt} = y_{mt} - d_t \eta_{t+1} - s_{mt} - g_{mt}, \\ & c_{et+1} = s_{mt} R_{t+1} + (1+n) g_{et+1} + y_{et+1} \end{aligned} \tag{35}$$

The solution of (35) presents two challenges. First, a solution must take into account that current middle-aged agents' future gifts depend on current inculcative investment through the variable η_{t+1}, and in an equilibrium solution to the model, beliefs about this dependence must be correct. Second, a solution must admit the possibility of solutions in which $\eta_t^* = 0$. The subgame-perfect Nash equilibrium solution to the problem (35) has a structure in which agents give gifts in proportion to the present discounted value of lifetime income, with this proportion depending on η_t. For the time being, we have bypassed the issue of the determination of η_t^* and skip to the form of the gift-giving function, which is given in Proposition 4:

Proposition 4 (Gifts with accumulation)**.** *If $\eta_t > 0$ in equilibrium, gifts g_{mt}^* are given by:*

$$g_{mt}^* = \frac{\eta_t}{1+\beta}\left(y_{mt} + \frac{y_{et+1}}{R_{t+1}}\right) \tag{36}$$

Proof: See Appendix B. □

Proposition 4 shows how equilibrium gifts and therefore, by analogy to Proposition 1, cultural transmission, are proportional to lifetime income, as was the case in the version of the model presented previously. Once the expression for g_{mt}^* in the proposition has been obtained, additional aspects of the middle-aged agents' decision problem can also be fleshed out. For one, total savings, which in our case consists of both inculcative efforts and resources devoted to asset accumulation can be described. f $\eta_t > 0$ in equilibrium, middle-aged agents' aggregate savings - the sum of inculcative investments and conventional savings - is described by:

$$s_{mt} + \eta_{t+1} d_t = \frac{\beta y_{mt} - \frac{y_{et+1}}{R_{t+1}}}{1+\beta} \tag{37}$$

Moreover, one can also describe the gross rate of return on conventional savings (i.e., on assets) as:

$$R_t = \frac{1+n}{1+\beta}\frac{y_{mt} + \frac{y_{et+1}}{R_{t+1}}}{d_{t-1}} \tag{38}$$

These two results derive from the proof of Proposition 4 in Appendix B.

Equation (37) describes the total amount middle-aged agents wish to allocate to future consumption. Expenditures on savings and inculcation add up to the income a middle-aged agent wishes to save, which depends upon current income less discounted future income. Equation (38) requires that the rates of return on the different means of transferring current wealth to the future in (37) be equilibrated. The rate of return on inculcative investments and conventional savings must be equal; otherwise, middle-aged agents would not employ both savings instruments. As we maintain the assumption that d_t is proportional to income ($d_t = \delta y_{mt}$), we can interpret (38) to mean that returns to assets such as capital must be equal in equilibrium to the unit return on inculcative investment.

The question remains whether an equilibrium with gifts and inculcation is sustainable; i.e., whether $\eta_t > 0$ in equilibrium. We need to round out the model to see how η_t, s_t, and R_t depend on the underlying nature of the economy, as they are quantities determined in equilibrium and require specification of the production side of the economy.

4.4.1 Production and Economic Growth

We again use a Cobb-Douglas production technology in which production occurs according to the aggregate production function $Y_t = L_t^{\alpha} K_t^{1-\alpha}$, where K_t now denotes the total capital stock and as before L_t denotes total effective labor supply:

$$L_t = A_{mt} N_{mt} + A_{et} N_{et} \tag{39}$$

We assume that $A_{it}, i = e, m$ grows at a constant exogenous rate a, while the population grows at a rate n. Constant population growth means that $N_{mt} = (1+n)N_{et}$, and that $\frac{1}{1+n}$ is a measure of the relative size of the elderly population.

We use (39) and the production technology to obtain the following expressions for middle-aged labor income, elderly labor income, and the gross rate of return on capital, assuming that all resources are paid their marginal products, where $k_t = \frac{K_t}{L_t}$ is capital per effective unit of labor:

$$\begin{aligned} y_{mt} &= \alpha A_{mt} \left(\frac{K_t}{L_t}\right)^{1-\alpha} = \alpha A_{mt} k_t^{1-\alpha} \\ y_{et} &= \alpha A_{et} \left(\frac{K_t}{L_t}\right)^{1-\alpha} = \alpha A_{et} k_t^{1-\alpha} \\ R_t &= (1-\alpha) \left(\frac{K_t}{L_t}\right)^{-\alpha} = (1-\alpha) k_t^{-\alpha} \end{aligned} \tag{40}$$

We also define some new terms:

$$\begin{aligned} \tau_{et} &= \tfrac{A_{et}}{A_{mt}} &&= \text{relative effective labor endowment of an elderly agent.} \\ \gamma_{et} &= \tfrac{N_{et}A_{et}}{L_t} &&= \text{relative aggregate labor supply of the elderly.} \end{aligned} \tag{41}$$

Given our assumptions of a constant rate of technological progress, we can omit time subscripts for the terms introduced in (41) and write τ_e and γ_e. One can also show that τ_e and γ_e are related via $\gamma_e = \frac{\tau_e}{\tau_e+(1+a)}$. Application of factor returns in (40) to (37) and (38), and using the cost scaling assumption that $d_t = \delta y_t$ allow us to render the model into a pair of dynamic equations that describe the evolution of the capital stock and inculcation; the algebra behind the calculation appears in Appendix C. The effective capital stock evolves over time according to:

$$(1-\alpha)k_t^{-\alpha} = \frac{(1+n)(1+a)}{(1+\beta)\delta}\left(\left(\frac{k_t}{k_{t-1}}\right)^{1-\alpha} + \frac{\tau_e(1+a)}{1-\alpha}\frac{k_{t+1}}{k_{t-1}^{1-\alpha}}\right) \tag{42}$$

while the inculcative parameter η_t evolves over time according to:

$$\eta_{t+1} = \frac{\beta}{(1+\beta)\delta} - \frac{k_{t+1}}{k_t^{1-\alpha}}\left(\frac{\tau_e(1+a)}{(1-\alpha)(1+\beta)\delta} + \frac{(1+n)(1+a)}{\alpha\delta(1-\gamma_e)}\right) \tag{43}$$

Equation (43) describes the dynamics of inculcation but also determines whether there will be any inculcative investment at all in equilibrium, a question we have delayed addressing until now. When the right-hand side of (43) is positive, $\eta_{t+1} > 0$ in equilibrium. Equation (42) describes the dynamics of the capital stock, which are seen to be independent of the degree of inculcation, and are always positive. In a steady state, in which $k_{t+1} = k_t = k_{t-1}$, the equation always yields a positive solution, k^*, as follows:

$$k^{*\alpha} = \frac{\sqrt{1+\tau_e\frac{4(1+\beta)\delta}{(1+n)}} - 1}{2\frac{\tau_e(1+a)}{(1-\alpha)}} \tag{44}$$

The corresponding steady-state level of inculcation is:

$$\eta^* = \frac{\beta}{(1+\beta)\delta} - k^{*\alpha}\left(\frac{\tau_e(1+a)}{(1-\alpha)(1+\beta)\delta} + \frac{(1+n)(1+a)}{\alpha\delta(1-\gamma_e)}\right) \tag{45}$$

Equation (45) can be interpreted as a condition as to whether or not η^* will occur as parameters must be such that $\eta^* > 0$ in equation (45), in which case inculcation is sustainable as an equilibrium outcome. A central implication of the model is that comparative statics for

inculcation are generally ambiguous and nonlinear. Changes in a given parameter can affect steady-state inculcation through multiple, offsetting channels. For example, an increase in τ_e lowers k^α since it appears in the denominator outside the square root in equation (44), which tends to raise steady-state inculcation η^*. At the same time, τ_e enters equation (45) directly in a manner that reduces η^*. These opposing effects preclude a clear monotonic relationship between τ_e and inculcation in equilibrium. By contrast, some parameters yield unambiguous effects: increases in either γ_e or the inculcation cost parameter δ strictly reduce η^*, making inculcation less likely. A fuller characterization of parameter values under which η^* collapses to zero is deferred to the simplified versions of the model presented below. For present purposes, it suffices to note that the model admits equilibria with both $\eta^* > 0$ and $\eta^* = 0$. We therefore turn next to other implications of the model, such as the relative consumption of the elderly, $\frac{c_{et}}{c_{mt}}$, which follows directly from equilibrium savings, inculcation, and gifts. For one, a value of the relative consumption ratio of the elderly $\frac{c_{et}}{c_{mt}}$ can be found using the equilibrium values of savings, inculcation, and gifts. In Appendix D, we describe the calculations that lead to Proposition 5:

Proposition 5 (Relative consumption, inculcation, and growth)**.** *In equilibrium, when* $\eta_t^* > 0$*, the relative ratio of elderly to middle-age consumption is:*

$$\frac{c_{et}}{c_{mt}} = \frac{\beta R_t}{1-\eta_t} \frac{y_{mt-1} + \frac{y_{et}}{R_t}}{y_{mt} + \frac{y_{et+1}}{R_{t+1}}} \tag{46}$$

Otherwise, relative consumption is simply determined by relative incomes; that is

$$\frac{c_{et}}{c_{mt}} = \frac{y_{et} + R_t s_{t-1}}{y_{mt}} \tag{47}$$

Proof: See Appendix D. □

Proposition 5 indicates that the relative consumption ratio depends on relative lifetime incomes, and therefore the overall growth rate of the economy. The proposition also suggests that equilibrium asset returns, R, and the magnitude of η are important in driving relative consumption. This is particularly true along a balanced growth path, as in a balanced growth equilibrium, incomes grow at a rate a, and asset returns are constant. Along a balanced growth path, (46) reduces to:

$$\frac{c_e}{c_m} = \frac{\beta R}{(1-\eta)(1+\alpha)} \tag{48}$$

Equation (48) indicates that parameters such as α, the labor intensity of production, n,

the growth rate of population, and δ, the per-unit-income costs of inculcation will influence the relative consumption of the elderly by exerting an impact on the level of inculcation η and equilibrium asset returns R. However, η and R are somewhat complicated functions of model parameters, as discussed in Section 4.5.2.

4.5 Analysis with accumulation

This final modeling section analyzes the implications of Propositions 4 and 5. We first solve a simplified version of the model in which all elderly income derives from asset accumulation, and $y_e = 0$ at every t, which is equivalent to assuming that $\tau_e = \gamma_e = 0$, so the elderly do not contribute any productive labor and only provide previously accumulated capital to the economy.

4.5.1 Asset income as the sole source of elderly income

When $y_{et} = 0$, the equilibrium gift function (36) reduces to:

$$g^*_{mt} = \frac{\eta_t}{1+\beta} y_{mt} \tag{49}$$

And the rate equilibration condition (38) is:

$$R_t = \frac{1+n}{1+\beta} \frac{y_{mt}}{\delta y_{mt-1}} \tag{50}$$

The sum of cultural investment and asset savings (37) becomes:

$$s_{mt} + \eta_{t+1} d_t = \frac{\beta}{1+\beta} y_{mt} \tag{51}$$

Equations (49), (50) and (51) reflect that when there is no elderly labor income, the decisions of current middle-ageds reduce to allocating shares of income between overall savings, gift-giving and inculcation, in such a way that the returns between inculcative investment and asset accumulation are equilibrated.

The general equilibrium aspects of the model can be deduced by substituting $\tau_e = 0$ into (42) to get a simple recursion for the stock of capital per effective unit labor:

$$k_{t+1} = \frac{(1-\alpha)(1+\beta)\delta}{(1+n)(1+a)} k_t^{1-\alpha} \tag{52}$$

Using $\gamma_e = 0$ and $\tau_e = 0$ in (43), the equilibrium inculcative investment, allows this expression to also be written in terms of the current and future value of the capital stock:

$$k_{t+1} = \frac{\alpha}{(1+a)(1+n)} \left(\frac{\beta}{1+\beta} - \delta\eta_{t+1} \right) k_t^{1-\alpha} \tag{53}$$

Equation (53) shows how the possibility of inculcation and gifts impacts the canonical overlapping-generations model with population and technological progress, as developed in Acemoglu (2009). But for the $\delta\eta_{t+1}$ term in (53), the accumulation condition is a standard capital accumulation condition in growth models, so the possibility of inculcative investment reduces the amount of capital per effective unit of labor, which will increase equilibrium asset return rates. Dividing (52) by (53) and solving the result for η_{t+1} gives a time-independent solution for the inculcative parameter η:

$$\eta_{t+1}^* = \eta^* = \frac{\beta}{(1+\beta)\delta} - \frac{1-\alpha}{\alpha}(1+\beta) \tag{54}$$

Equation (54) indicates that a larger δ reduces the equilibrium size of η^*. An increase in the relative intensity of capital in production, measured by $\frac{1-\alpha}{\alpha}$, also negatively impacts η. Societies that employ more capital-intensive means of production, other things equal, will have lower degrees of inculcation. Indeed, one might expect that as a society becomes more developed, α would decrease.

As we discussed following equation (45), equation (54) can be used to assess whether inculcation and gifts are sustainable in equilibrium. If parameters are configured so that $\eta^* \leq 0$, in equilibrium $\eta = 0$, and there is no inculcative investment. The elderly ensure their livelihood as they would in the typical overlapping generations model: through prior accumulation of productive assets. Setting (54) to zero and solving for α gives an interpretation of (54) as a condition for inculcation to occur in terms of the relative capital intensity of production:

$$\frac{\beta}{\delta(1+\beta)^2} \geq \frac{1-\alpha}{\alpha} \tag{55}$$

This threshold depends positively on the costs of inculcation, and on β, which influences the relative weight placed on consumption in old age in utility. If (55) is not satisfied and no inculcation occurs, we recover the law of motion for the capital stock by using $\eta = 0$ in (53). In forming the relative ratio of consumption, we find it most straightforward to solve the model in terms of R, equilibrium asset returns, rather than in terms of k, the equilibrium per unit of labor capital stock. We find a steady-state value of k, $\overline{k}$, and then use this to compute the balanced-growth rate of asset returns $\overline{R} = (1-\alpha)\overline{k}^{-\alpha}$.

When no inculcation occurs (that is, (55) is not satisfied), equilibrium returns can be found by using $\eta = 0$ in (53). Writing the resultant expression in terms of $\overline{R}$ gives:

$$\overline{R} = (1-\alpha)\frac{(1+a)(1+n)(1+\beta)}{\beta\alpha} \tag{56}$$

When (55) is satisfied, we find η^* as given in (54), and equilibrium asset returns follow from (53). These are:

$$\overline{R} = \frac{(1+a)(1+n)}{(1+\beta)\delta} \tag{57}$$

Collecting all of these results gives us a relative consumption ratio that depends on whether or not inculcation and gift giving will occur in equilibrium, which can be obtained by using equilibrium values of $\overline{R}$ and η in Equation (48):

$$\begin{aligned} \frac{c_e}{c_m} = & \frac{\beta(1+n)}{\delta(1+\beta)(1+\frac{1-\alpha}{\alpha}(1+\beta))-\beta}, & \eta^* > 0 \\ & \frac{1-\alpha}{\alpha}(1+\beta)(1+n), & \eta^* = 0 \end{aligned} \tag{58}$$

Population growth increases the relative well-being of the elderly, whether or not gifts are involved. In a high-capital-intensity setting without gift-giving or inculcation, this occurs because population growth raises the relative scarcity of capital, boosting returns on accumulated assets and benefiting the elderly. In cases with gift-giving, this effect is amplified by the greater number of young people, leading to more gifts being distributed to the elderly.

The capital intensity of production, $\frac{1-\alpha}{\alpha}$, significantly influences the relative treatment of the elderly. As in the model from Section 4.2, more labor-intensive production tends to lower the relative treatment of the elderly. However, cultural practices such as inculcation and acculturation emerge to mitigate this decline when income primarily depends on labor rather than accumulated assets, providing a way to transfer income to the elderly. Conversely, in more asset-intensive production, the elderly's relative treatment improves due to asset income, but cultural acculturation to support the elderly diminishes.

Figure 3 illustrates this dynamic, showing the relative consumption of the elderly, $\frac{c_e}{c_m}$, from (58) as a function of capital intensity. The figure reveals a nonlinear, U-shaped relationship between elderly treatment and capital intensity, similar to the pattern seen in the property-rights model of Section 4.2.

4.5.2 Full model solution

When the elderly have a source of labor income as well as having had the option to save in middle age, the model is more complex because elderly labor income provides sustenance and also raises lifetime income. This makes it difficult to accurately state how changes in model parameters influence inculcation, accumulation, and relative treatment of the elderly.

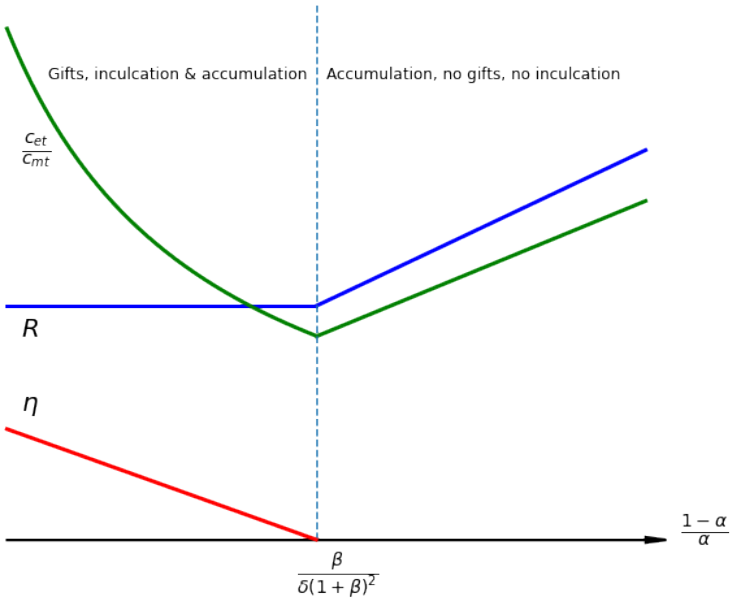

Figure 3: Relative consumption of the elderly ($\frac{c_{et}}{c_{mt}}$), as a function of the capital intensity of production, $\frac{1-\alpha}{\alpha}$.

With $\tau_e, \gamma_e > 0$, the steady-state relationships corresponding to (42) and (43) in Proposition 5 can be written as:

$$R = \frac{(1+n)(1+a)}{(1+\beta)\delta}\left(1 + \frac{(1+a)\tau_e}{R}\right) \tag{59}$$

with

$$\eta = \frac{\beta}{\delta(1+\beta)} - \frac{(1+a)}{\delta R}\left(\frac{\tau_e}{1+\beta} + \frac{(1+n)}{(1-\gamma_e)}\frac{1-\alpha}{\alpha}\right) \tag{60}$$

Solving (59) for the equilibrium asset return rate gives:

$$R = \frac{(1+n)(1+a)}{2\delta(1+\beta)}\left(1 + \sqrt{1 + \frac{4(1+\beta)\delta}{(1+n)}r_e}\right) \tag{61}$$

From (59), we see that as τ_e increases, meaning that the elderly have a relatively larger source of income, R increases in an equilibrium with a positive amount of inculcation ($\eta > 0$). When a future source of income is available, the incentives to save are deadened. Similarly, increases in τ_e lessen inculcative investments, as is evident from (60).

When there is no inculcation, we can solve (43) with $\eta = 0$ and rearrange terms to get the following expression for asset returns:

$$R = \frac{1+a}{\beta}\left(\frac{(1+n)(1+\beta)}{1-\gamma_e}\frac{1-\alpha}{\alpha} + \tau_e\right) \tag{62}$$

Using (62) and $\eta = 0$ in (48), we find that relative consumption becomes:

$$\frac{c_e}{c_m} = \frac{(1+n)(1+\beta)}{1-\gamma_e}\frac{1-\alpha}{\alpha} + \tau_e \tag{63}$$

We can rearrange expression (48) to give a condition for inculcation to occur once again. This condition again reflects the key role played by the capital intensity of production. Inculcation and gift-giving occur in equilibrium so long as:

$$\left(\frac{R\beta}{(1+a)} - \tau_e\right)\frac{1-\gamma_e}{(1+\beta)(1+n)} > \frac{1-\alpha}{\alpha} \tag{64}$$

It is easiest to see how equilibrium is influenced when $\tau_e > 0$ compared to the case in which $\tau_e = 0$. as depicted on Figure 3. In Figure 4, we superimpose the critical line depicting the relative capital intensity at which η goes to zero, and the resulting consumption ratios when $\tau_e > 0$ on those depicted in 3.

Although Figure 4 suggests greater elderly labor income reduces the incidence of inculcative, gift-giving equilibria, it also indicates that the impact of labor income on relative elderly consumption are not obvious. On the left-hand side of the figure we see that the relative

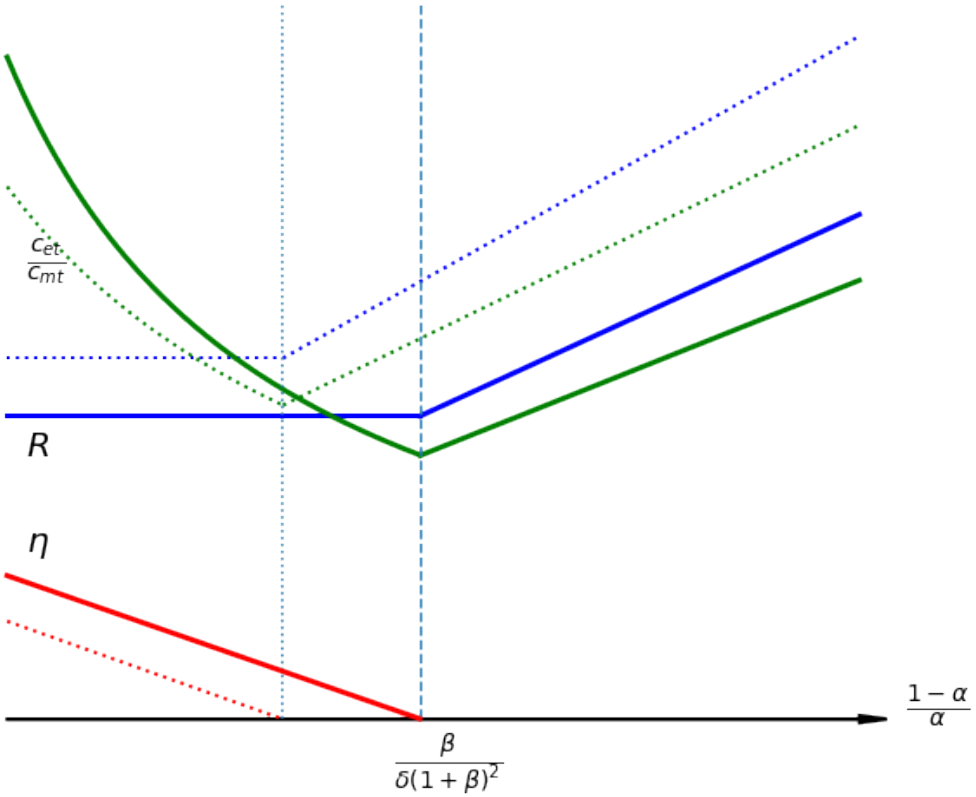

Figure 4: Relative consumption of the elderly ($\frac{c_{et}}{c_{mt}}$), as a function of relative capital intensity with $\tau_e > 0$. The solid lines show how the rate of return on capital is constant while η is positive. When capital intensity reaches a certain threshold, inculcation ends and the rate of returns starts rising. The dashed lines show how these relationships change when the elderly provide productive labor $\tau_e > 0$.

consumption ratio of the elderly goes down as a result of the increased income shift. This is because total labor supply increases, which depresses labor incomes in general.

This last set of results indicates how the advent or expansion of societal welfare targeted towards the elderly may impact the transmission and maintenance of culture, some of the particulars of which we described in Section 3. Such changes act to increase τ_e in the model, which may have a deleterious effect on inculcation, and therefore cultural transmission.

5 Discussion and Conclusions

The model in this paper builds on prior research into intergenerational transfers and their role in supporting the elderly while allowing for a deeper exploration of cross-cultural findings on elderly treatment. Our analysis spans both recent phenomena, such as the demographic transition, and historical shifts in elderly treatment across varying levels of technological sophistication. By incorporating the interplay between property rights, culture, and elderly treatment, the model centers attention on elderly well-being rather than intermediate economic features like transfer patterns, and tries to move the emphasis from individual family-based transfers to society-wide norms and their perpetuation across generations. But this also leads naturally to consideration of the role of modernization and how treatment of the elderly has pivoted from being a societal responsibility to a responsibility of each generation to ensure its own well-being during old age through accumulation of capital during middle age.

The model highlights the complexity of relationships between property rights, accumulation, production, and societal norms regarding treatment of the elderly, providing theoretical support for observed ethnographic patterns including the 'curvilinear hypothesis.' It also addresses how accumulation in production impacts the elderly, showing that while initial accumulation may disadvantage them, increasing its importance can eventually benefit their relative status. These findings align with the hypothesis of a nonlinear/curvilinear relationship between familial complexity and degree of modernization (Nimkoff and Middleton, 1960; Blumberg and Winch, 1972).[12]

Several avenues for future research emerge from this work. One is the interplay between family structure, technological change, and elderly treatment. While our model touches on these issues through its focus on gift-giving and familial ties, deeper exploration of the connections between elderly treatment, marriage, and fertility is warranted.[13] Gender differences

[12]Similar patterns are discussed in the context of land inheritance by Baker and Miceli (2005) and marriage institutions by Baker and Jacobsen (2007a,b).

[13]See related discussions in Cigno et al. (2021) and Bisin and Verdier (2000).

in elderly treatment also deserve attention, as emphasized by Simmons (1970). Furthermore, the dynamics of inculcation and cultural transmission, including their public-goods and behavioral aspects, remain ripe for investigation (Bowles, 1998). Finally, while our focus has been on inter-societal well-being of the elderly, future research could address inequality among the elderly, examining how poverty and disparities relate to cultural transmission and gift-giving practices. We hope this framework will inspire further inquiry into these important topics.

Appendix A Data Appendix

We describe the data underlying the analysis presented in Tables 1 and 2 of the text and also provide an overview of the data in Simmons (1970).[14] Simmons developed variables to measure the presence and importance of material, social, and cultural characteristics across 71 cultures, including hunters, pastoralists, nomads, and agriculturalists. Features were coded as + (very important), = (somewhat important), − (present but unimportant), or 0 (absent). We recoded nonmissing values numerically, ranging from 3 (very important) to 0 (absent).

Simmons's data includes 224 features, with some values specific to women, men, or the elderly. However, missing values and vague variable definitions make formal analysis beyond Simmons's cross-tabulations challenging and potentially misleading. Therefore, we adopted a descriptive approach, compiling summary indices from his data. The evidence presented in the text is based on these indices, whose construction we now discuss.

Table A1 describes the variables that we judge as capturing the market-openness of the economic environment present; specifically, the degree to which property rights, exchange, and market orientation are features of a society.

	Mean	SD	Min	Max	N
Trade presence	2.33	0.75	1	3	67
Money in use	1.70	1.07	0	3	57
Private ownership of objects	2.60	0.71	1	3	63
Private ownership of land	1.37	1.19	0	3	54
Male property rights	2.58	0.72	1	3	53
Female property rights	1.56	0.98	0	3	32
Communal ownership of land	2.21	0.76	0	3	56

Table A1: Variables included in the openness of economy index, which captures the degree to which a market-oriented economy might be present in each society

Our market openness index is constructed by simply adding and subtracting characteristics. While more complex methods like principal components could be used, experimentation showed little benefit compared to this transparent approach. We sum the first six characteristics in Table A1 and subtract the last (communal land ownership). Summary statistics for the index are in Table A8.

Simmons also notes how actively the elderly participate in aspects of the economy. The variables summarized in Table A2 include jobs that the elderly do in society that we judge

[14] All data are derived directly from Simmons (1970), and are available on request from the authors.

to directly support the production of physical output in a society, or perform functions that free other members of society to engage in direct production.

	Mean	SD	Min	Max	N
Male traders	2.35	0.75	1	3	20
Female traders	1.33	0.52	1	2	6
Male provision of infant services	1.79	0.93	0	3	24
Female provision of infant services	2.49	0.83	0	3	47
Male education of young	2.83	0.45	1	3	40
Female education of young	2.86	0.35	2	3	36
Male nurses	2.90	0.31	2	3	20
Female nurses	2.67	0.72	1	3	15
Males aid with agriculture	1.82	1.38	0	3	17
Females aid with agriculture	2.15	1.31	0	3	20
Males aid with hunting	2.53	0.62	1	3	17
Females aid with hunting	2.67	0.52	2	3	6
Males aid with herding	1.29	1.44	0	3	14
Females aid with herding	0.83	1.27	0	3	12
Males aid with collecting	2.50	0.71	2	3	2
Females aid with collecting	2.67	0.52	2	3	6
Males aid in household	2.55	0.52	2	3	11
Females aid in household	2.84	0.37	2	3	32
Males make toys and tools	2.36	0.63	1	3	14
Females make toys and tools	2.17	1.17	0	3	6
Male elderly fees for services	2.80	0.41	2	3	25
Female elderly fees for services	2.56	0.62	1	3	18

Table A2: Variables included in market development and sophistication index

From these variables, we form what we call a direct production index by simply adding all the variables in the table, treating missing values as zeros. The resulting index is summarized in Table A8 and is designed to capture something about the degree to which the elderly contribute to material life in each culture.

The next set of variables we use to construct an index of the degree to which the elderly perform important ritualistic or social functions. These variables are summarized on table A3; the sum of the variables comprises our index of social functions, also summarized in table A8.

	Mean	SD	Min	Max	N
Male rites of initiation	2.40	1.00	0	3	25
Female rites of initiation	1.90	0.94	0	3	21
Males perform marriage rites	2.77	0.43	2	3	31
Females perform marriage rites	2.43	0.60	1	3	21
Males perform funereal rites	2.60	0.76	0	3	25
Females perform funereal rites	2.54	0.51	2	3	26
Male priesthood	2.86	0.36	2	3	35
Female priesthood	1.85	0.69	0	3	13
Male shamans	2.86	0.39	1	3	59
Female shamans	2.49	0.69	0	3	47
Male decorators	2.33	0.58	2	3	3
Female decorators	2.67	0.50	2	3	9

Table A3: Social functions performed by the elderly

The variables summarized in Table A 4 describe the degree to which the elderly provide advice, store important social information, or perform other functions that require knowledge. We computed an index of knowledge provision based on just summing up these variables.

	Mean	SD	Min	Max	N
Males provide expert advice	2.84	0.37	2	3	25
Females provide expert advice	2.71	0.49	2	3	7
Male stores of social information	2.98	0.14	2	3	54
Female stores of social information	2.59	0.50	2	3	27
Males lead festivals	2.69	0.52	1	3	42
Females lead festivals	2.50	0.64	1	3	28

Table A4: Knowledge provision by the elderly

The variables in Table A5 describe the degree to which the elderly hold important titles in society, function as elders, judges, or chiefs. Our index of titular duties is created as a simple sum of these variables.

	Mean	SD	Min	Max	N
Male chiefs	2.37	0.71	1	3	62
Female chiefs	0.35	0.61	0	2	31
Male council of elders	2.60	0.65	0	3	57
Male judges	2.56	0.69	0	3	45
Female judges	0.62	0.87	0	2	13

Table A5: Titular functions of the elderly

Various variables catalog the degree to which the elderly are respected, supported by the community, or more generally viewed by society. These variables are collected in Table A6, and we collect these variables into an index that is a simple sum of these variables.

	Mean	SD	Min	Max	N
Male elderly respected	2.81	0.47	1	3	63
Female elderly respected	2.29	0.81	0	3	51
Male elderly community support	2.09	0.84	0	3	33
Female elderly community support	1.97	0.81	0	3	30
Male elderly family support	2.80	0.48	1	3	60
Female elderly family support	2.58	0.57	1	3	57
Male son-in-law elderly support	1.82	1.05	0	3	22
Female son-in-law elderly support	2.06	1.06	0	3	16
Male elderly seen as distinguished	2.71	0.61	1	3	14
Female elderly seen as distinguished	3.00	.	3	3	1

Table A6: Positive treatment practices towards the elderly

Some variables actually measure the degree to which the elderly are pictured as having magical powers and related beliefs. We gather all of these variables into an index, which is a simple sum of the variables in Table A7.

	Mean	SD	Min	Max	N
Males glorified as daimons	2.64	0.54	1	3	36
Females glorified as daimons	2.44	0.65	1	3	25
Males glorified as heros	2.77	0.43	2	3	39
Females glorified as heros	2.55	0.68	1	3	31
Males friends of children	2.62	0.52	2	3	8
Females friends of children	2.45	0.82	1	3	11

Table A7: Inculcated beliefs about the elderly

Table A8 contains a summary of all indices that we have created. These indices are used to calculate the correlations in Table 1 in the text.

	Mean	SD	Min	Max	N
Openness of economy index	6.49	4.27	-3	14	71
Elderly contribution to direct production index	6.99	4.35	0	17	71
Contribution to social production index	8.72	3.71	0	18	71
Knowledge and advice provision index	3.55	2.14	0	8	71
Titular duties of elderly index	3.02	1.44	0	6	71
Positive treatment of elderly index	5.99	2.68	0	13	71
Positive attitudes to elderly inculcation index	2.75	2.22	0	9	71
Elderly social functions index	5.70	2.98	0	14	71
Total elderly contributions in production index	19.25	8.88	2	40	71

Table A8: Summary statistics for constructed indices used in Table 1.

Appendix B Proof of Proposition 4

The solution to (35) starts by assuming an interior solution and then checking when this solution works. Assume that agents maintain the belief that gifts are a multiplicative function of the value of η_t:

$$g_{mt+1} = \eta_{t+1}\Psi_{t+1} \tag{B.1}$$

where Ψ_{t+1} is to be determined. Substituting for g_{mt+1} using (B.1) into the middle-aged agent's optimization problem (35) and differentiating gives first-order conditions:

$$\begin{aligned}
&-\frac{1-\eta_t}{y_{mt}-d_t\eta_{t+1}-s_{mt}-g_{mt}}+\frac{\eta_t}{g_{mt}} &&= 0\\
&-\frac{1-\eta_t}{y_{mt}-d_t\eta_{t+1}-s_{mt}-g_{mt}}+\beta\frac{R_{t+1}}{s_{mt}R_{t+1}+(1+n)g_{et+1}+y_{et+1}} &&= 0\\
&-\frac{(1-\eta_t)d_t}{y_{mt}-d_t\eta_{t+1}-s_{mt}-g_{mt}}+\beta\frac{(1+n)\Psi_{t+1}}{s_{mt}R_{t+1}+(1+n)g_{et+1}+y_{et+1}} &&= 0
\end{aligned} \tag{B.2}$$

Rearranged, the first expression in (B.2) implies that gifts are proportional to income:

$$g_{mt} = \eta_t(y_{mt} - d_t\eta_{t+1} - s_{mt}) \tag{B.3}$$

Substituting g_{mt} from (B.3) back into (B.2) gives two conditions describing savings and inculcation behavior:

$$\begin{aligned}
&-\frac{1}{y_{mt}-d_t\eta_{t+1}-s_{mt}}+\beta\frac{R_{t+1}}{s_{mt}R_{t+1}+(1+n)g_{et+1}+y_{et+1}} &&= 0\\
&-\frac{d_t}{y_{mt}-d_t\eta_{t+1}-s_{mt}}+\beta\frac{(1+n)\Psi_{t+1}}{s_{mt}R_{t+1}+(1+n)g_{et+1}+y_{et+1}} &&= 0
\end{aligned} \tag{B.4}$$

Equations (B.4) imply that for both savings and inculcation to occur, it must be that:

$$\Psi_{t+1} = \frac{d_t R_{t+1}}{1+n} \tag{B.5}$$

Multiplying both sides of (B.5) by η_{t+1} gives g_{mt+1} in B.1:

$$g_{mt+1} = \eta_{t+1} \frac{d_t R_{t+1}}{(1+n)} \tag{B.6}$$

Since $g_{et+1} = (1+n)g_{mt+1}$, we find that $g_{et+1} = \eta_{t+1} d_t R_{t+1}$. Using this in either part of (B.4) gives an expression describing how total savings are distributed between asset accumulation s_{mt} and inculcation η_{t+1}, which is equation (37) in the text:

$$s_{mt} + \eta_{t+1} d_t = \frac{\beta y_{mt} - \frac{y_{et+1}}{R_{t+1}}}{1+\beta} \tag{B.7}$$

Inserting the right-hand side of (B.7) into the right-hand side of (B.3) gives the equilibrium gift function in the text, equation (36):

$$g^*_{mt} = \frac{\eta_t}{1+\beta} \left(y_{mt} + \frac{y_{et+1}}{R_{t+1}} \right) \tag{B.8}$$

Comparing (B.1) and (B.8), we see that

$$\Psi_t = \frac{y_{mt} + \frac{y_{et+1}}{R_{t+1}}}{1+\beta} \tag{B.9}$$

To find the gross rate of return on total savings, iterate (B.5) back one period and substitute the value of Ψ_t into (B.9) to get:

$$R_t = \left(\frac{1+n}{1+\beta} \right) \frac{y_{mt} + \frac{y_{et+1}}{R_{t+1}}}{d_{t-1}} \tag{B.10}$$

Which (B.10) appears in the text as (38).

Appendix C Accumulation and Inculcation

We begin by rewriting (37) as follows, using our maintained assumption that $d_t = \delta y_{mt}$:

$$\eta_{t+1} = \frac{\beta}{(1+\beta)\delta} - \frac{y_{et+1}}{\delta y_{mt}} \frac{1}{R_{t+1}(1+\beta)} - \frac{s_{mt}}{\delta y_{mt}} \tag{C.1}$$

Substitution for R_{t+1}, y_{mt} and y_{et+1} using (40) in (C.1), and also noting that the future

capital stock depends on savings by middle-aged agents in the present, $K_{t+1} = s_{mt}N_{mt}$, gives:

$$\eta_{t+1} = \frac{\beta}{(1+\beta)\delta} - \frac{A_{et+1}k_{t+1}}{(1-\alpha)(1+\beta)\delta A_{mt}k_t^{1-\alpha}} - \frac{K_{t+1}}{N_{mt}\delta\alpha A_{mt}k_t^{1-\alpha}} \tag{C.2}$$

Multiplying the last term on the right by L_{t+1}/L_{t+1}, and substituting $N_{mt+1} = (1+n)N_{mt}$, $A_{mt+1} = (1+a)A_{mt}$, and $A_{et+1} = (1+a)A_{et}$ into (C.2), we have:

$$\eta_{t+1} = \frac{\beta}{(1+\beta)\delta} - \frac{A_{et}(1+a)k_{t+1}}{(1-\alpha)(1+\beta)\delta A_{mt}k_t^{1-\alpha}} - \frac{K_{t+1}}{L_{t+1}}\frac{(1+a)(1+n)}{\frac{N_{mt+1}A_{mt+1}}{L_{t+1}}\delta\alpha k_t^{1-\alpha}} \tag{C.3}$$

Collecting terms and using $\tau_e = \frac{A_e}{A_m}$, and noting that $\frac{N_{mt+1}A_{mt+1}}{L_{t+1}}$, the middle-aged share in total labor supply is constant over time and equal to $1-\gamma_e$, one less the elderly share, we have:

$$\eta_{t+1} = \frac{\beta}{(1+\beta)\delta} - \frac{k_{t+1}}{k_t^{1-\alpha}}\left(\frac{\tau_e(1+a)}{(1-\alpha)(1+\beta)\delta} + \frac{(1+n)(1+a)}{\alpha\delta(1-\gamma_e)}\right) \tag{C.4}$$

This appears as (43) in the text. For equilibrium relationship (42), we begin by substituting the expressions in (40) into (38) to get:

$$R_t = \frac{1+n}{1+\beta}\left(\frac{A_{mt}k_t^{1-\alpha}}{\delta A_{mt-1}k_{t-1}^{1-\alpha}} + \frac{\frac{A_{et+1}k_{t+1}^{1-\alpha}}{R_{t+1}}}{\delta A_{mt-1}k_{t-1}^{1-\alpha}}\right) \tag{C.5}$$

Using $A_{mt+1} = (1+a)A_{mt}$, $A_{mt-1} = \frac{A_{mt+1}}{(1+a)^2}$, and $\tau_e = \frac{A_{et}}{A_m t}$, gives:

$$R_t = \frac{1+n}{1+\beta}\left(\frac{1+a}{\delta}\left(\frac{k_t}{k_{t-1}}\right)^{1-\alpha} + \frac{r_e(1+a)^2}{R_{t+1}\delta}\left(\frac{k_{t+1}}{k_{t-1}}\right)^{1-\alpha}\right) \tag{C.6}$$

Putting in (C.6) the expression for asset returns, $R_t = (1-\alpha)k_t^{-\alpha}$, gives expression (42) in the text. One convenience of equation (C.6) is that it yields a simple steady-state relationship for asset returns:

$$R = \frac{1+n}{1+\beta}\left(\frac{1+a}{\delta} + \frac{(1+a)^2 r_e}{\delta R}\right) \tag{C.7}$$

which easily factors into equation (59) in the text.

Appendix D Proof of Proposition 5

We derive the relative consumption ratio for both the case in which inculcation occurs and when it does not, starting with the latter case. In this case, elderly consumption is current income plus income earned from asset accumulation in the prior period:

$$c_{et} = y_{et} + s_{mt-1}R_t \tag{D.1}$$

While for middle-aged agents, if there is no inculcative investment, current consumption is current income less savings:

$$c_{mt} = y_{mt} - s_{mt} \tag{D.2}$$

Moreover, one can use (37) to conclude that savings is determined by:

$$s_{mt} = \frac{\beta y_{mt} - \frac{y_{et+1}}{R_{t+1}}}{1+\beta} \tag{D.3}$$

Plugging (D.3) into (D.2) gives:

$$c_{mt} = \frac{y_{mt} + \frac{y_{et+1}}{R_{t+1}}}{1+\beta} \tag{D.4}$$

One can also use (D.3) to deduce that elderly consumptio in (D.1) can be written as:

$$c_{et} = \frac{\beta}{1+\beta}\left(y_{et} + R_t y_{mt-1}\right) \tag{D.5}$$

Forming the ratio of expressions and factoring out R_t gives:

$$\frac{c_{et}}{c_{mt}} = \beta R_t \left(\frac{y_{mt-1} + \frac{y_{et}}{R_t}}{y_{mt} + \frac{y_{et+1}}{R_{t+1}}} \right) \tag{D.6}$$

In the case where there is inculcation, we observe that consumption for the elderly is now:

$$c_{et} = y_{et} + (1+n)g_{mt} + s_{mt-1}R_t \tag{D.7}$$

while consumption for the middle-aged is:

$$c_{mt} = y_{mt} - g_{mt} - s_{mt} - d_t\eta_{t+1} \tag{D.8}$$

Elderly consumption is most easily found using (B.4), which allows us to conclude that:

$$s_{mt-1}R_t + (1+n)g_{mt} + y_{et} = \beta R_t(y_{mt-1} - d_{t-1}\eta_t - s_{mt-1}) \tag{D.9}$$

Using (D.9) in (D.7) gives:

$$c_{et} = R_t(y_{mt-1} - d_{t-1}\eta_t - s_{mt-1}) \tag{D.10}$$

Eliminating gifts in (D.8) using (36) gives:

$$c_{mt} = (1-\eta)(y_{mt} - s_{mt} - d_t\eta_{t+1}) \tag{D.11}$$

For both (D.9) or (D.11), we can apply (37). Then, forming the relative consumption ratio gives:

$$\frac{c_{et}}{c_{mt}} = \beta R_t \frac{y_{mt-1} + \frac{y_{et}}{R_t}}{y_{mt} + \frac{y_{et+1}}{R_{t+1}}} \tag{D.12}$$

which is expression (46) in the text.

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