To Plan, or Not to Plan? Optimal Planning and Saving for Retirement*

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Abstract

A large percentage of U.S. households arrive at retirement with little or no financial wealth. Empirical evidence suggests that many of these households undertook little or no planning for retirement while young. We demonstrate how the decision to avoid planning and saving for retirement while young can arise as an optimal choice made by forward-looking, utility maximizing households facing an exogenous retirement date. In our model, boundedly rational households select the length of their planning horizon optimally each period, in addition to making an optimal consumption and saving decision. Planning is costly insofar as households must expend effort, cognitive or otherwise, to plan for the future. In a calibrated version of our model, the average household avoids planning and saving for retirement while young and, as a result, arrives at retirement with less than one-fifth of the wealth that they otherwise would have accumulated had they instead planned for their entire remaining lifetime, as in a standard life-cycle model.

Keywords: Planning; Retirement; Life-cycle Model; Short-Planning Horizon
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1 Introduction

A large percentage of U.S. households arrive at retirement with little or no financial wealth.[1] Empirical evidence suggests that many of these households undertook little or no planning for retirement while young.[2] These empirical findings, however, stand in stark contrast to a standard life-cycle model in which households anticipate the decline in income at retirement and plan accordingly by saving during their working years.

In this paper, we demonstrate how the decision to avoid planning and saving for retirement while young can arise as an optimal choice made by forward-looking, utility maximizing households. Specifically, we construct an overlapping generations, life-cycle model in which boundedly rational households select the length of their planning horizon optimally each period, in addition to making an optimal consumption and saving decision. We define a household's planning horizon to be the number of model periods into the future that they take into account when making their optimal consumption and saving decision in the current period.[3] Households pay a utility cost to plan, which is increasing in the length of their chosen planning horizon and is intended to capture the effort, cognitive or otherwise, that households must expend to plan for the future.[4] In our model, planning for retirement while young is also costly because planning for periods in which income is expected to be relatively low (e.g., retirement), given the inherent desire to smooth consumption over the life-cycle, implies the need to reduce consumption today.[5] Households will therefore only choose to plan for retirement while young if these costs are relatively low. Otherwise, young households will find it optimal to simply ignore retirement altogether and enjoy the present.[6]

[1] See, for example, Gustman and Juster (1996), Smith et al. (1997), and Venti and Wise (1998).

[2] The lack of planning for retirement has been documented empirically by Ameriks et al. (2003), Lusardi (2003), Lusardi and Mitchell (2007), and Lusardi and Mitchell (2011), among others. The failure to plan for retirement was identified empirically by Hurst (2004) as an important reason why some households under-save for retirement. Survey data suggests that many households do not plan for their full life-cycle but rather they employ short planning horizons when making financial decisions. See Caliendo and Aadland (2007) for a discussion of the empirical evidence surrounding planning horizon choice.

[3] For example, a household could choose to plan for five model periods, in which case they would plan consumption and saving to maximize their utility using the resources available to them over the next five model periods, ignoring any utility they might derive or income they might earn later in life.

[4] Using data from the HRS, Lusardi (2003) finds suggestive evidence in support of the hypothesis that many households avoid planning for retirement because it is painful to think about. See also Capra et al. (2022) and Ganguly and Tasoff (2017) for behavioral evidence about people's desire to avoid painful information. In order to plan, a household might open a brokerage account, fill out paperwork to start an IRA, opt into a 401(k) program a work, select an asset allocation, re-balance their portfolio, or consult with a financial advisor. Lusardi (2003) documents that households use several sources of information to make financial plans, such as consulting relatives or friends, relying on planners or brokers, or reading magazines and newspapers, among other sources.

[5] We assume the marginal cost of planning is constant, although our results are robust to this assumption as long as the cost of planning is increasing in the length of the planning horizon.

[6] Households "plan for retirement" only via their consumption and saving decisions. Labor supply and

We solve our model numerically in order to assess its quantitative implications for planning, consumption, and wealth over the life-cycle. In our simulations, households do indeed tend to postpone the arduous process of planning and saving for retirement until late into their working lives. Specifically, young households, on average, select an optimal planning horizon of just 15 years and, therefore, optimally ignore retirement. As they age, households select shorter and shorter planning horizons in an effort to avoid planning for retirement. It is only when households reach middle age that they tend to begin including retirement within their optimal planning horizons, and it is not until late in life that households choose to plan for their entire remaining lifetime.

Optimally electing to employ short planning horizons while young has profound implications for wealth accumulation over the life-cycle. The average household in our model has just one-fifth of the wealth at retirement that they otherwise would have accumulated had they instead planned for their entire lifetime, as in a standard life-cycle model. This result is consistent with Ameriks et al. (2003), Lusardi (2003) and Lusardi and Mitchell (2007, 2011), who all find a positive empirical relationship between planning and saving for retirement.[7]

Our model also makes sharp predictions about how optimal planning horizons vary with education. Consistent with recent empirical evidence, our model produces a positive relationship between planning and education, with highly educated households tending to plan further into the future, on average, than their less educated peers.[8] Specifically, the average planning horizon selected by college educated households under age 65 in our model is 18 years compared to just 7 years for high school dropouts.

Our baseline model contains a number of "bells and whistles" typically absent in exogenous short horizon models. These include a borrowing wedge, stochastic income process, and a bequest motive. While these features of our baseline model are critical for generating quantitatively plausible patterns of consumption and savings over the life cycle, as well as the distribution of wealth across households, they have little, if any, effect on the optimal planning horizons selected by households. The lone exception is the presence of a bequest motive. Given that bequests in our baseline model are a luxury good, the presence of a bequest motive induces high income, high wealth households to modestly increase their optimal planning horizons since they derive a higher marginal utility from leaving resources to their descendants than low income, low wealth households.[9]

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the retirement age are both exogenously given in our model.

[7]In a related vein, Munnell et al. (2001) find that households with longer planning horizons are more likely to contribute to 401(k)s.

[8]See Ameriks et al. (2003), Munnell et al. (2001), Rosen and Wu (2004), Samwick (1998) and Lusardi (1999, 2003), among others.

[9]See Appendix B for details.

The optimal (short) planning horizon mechanism we propose here has a number of advantages over alternative explanations for why many households tend to arrive at retirement with lower levels of wealth than would otherwise have been predicted by a standard life-cycle model. First, it is consistent with a large body of survey evidence suggesting that many households plan for less than their remaining lifetime when making economic decisions, particularly around saving for retirement. For example, Yakoboski and Dickemper (1997) find that only about a third of households in the 1997 Retirement Confidence Survey have made a saving plan and projected their financial needs for retirement. Indeed, the authors document that the likelihood of planning for retirement is increasing with age and in many cases only takes place once households are relatively close to retirement. Similarly, using data from the 1992 wave of the Health and Retirement Survey, Caliendo and Aadland (2007) document that more than half of respondents age 51 to 61 reported employing a planning horizon of less than 5 years when making consumption and saving decisions. Yet retirement for these households, and the associated predictable decline in income, is (presumably) just around the corner.

Second, the optimal (short) planning horizon mechanism we propose here is capable of explaining the levels of wealth at retirement and differences in retirement preparedness conditional on educational attainment without appealing to hyperbolic discounting, deficiencies in financial literacy, or low stock market participation rates, among other explanations. Moreover, our model does not assume that households are ignorant about their future earnings prospects and, in particular, the predictable decline in their income at retirement. Indeed, households in our model *optimally* choose to employ a short planning horizon in spite of knowing their future earnings prospects. Finally, the optimal (short) planning horizon mechanism that we propose here, like the exogenous short planning horizon model proposed by Caliendo and Aadland (2007), is also capable of producing an empirically reasonable consumption hump without appealing to family-size effects, consumption-leisure trade-offs, wage uncertainty, mortality risk, or durable consumption.

The main contribution of our paper is to demonstrate how the failure to plan and save for retirement can arise as an optimal choice made by boundedly rational, forward-looking, utility maximizing households who face a utility cost to plan. Friedman's (1957) seminal contribution, *Theory of the Consumption Function*, was the first to allow for the possibility that households do not plan for their entire remaining lifetime. In the decades since, life-cycle models in which households make optimal consumption and saving decisions conditional on an exogenously determined (short) planning horizon have been employed extensively in the economics literature, for example, to determine the optimal level of Social Security benefits (Feldstein (1985)) and to explain the hump-shaped pattern of consumption over the life-cycle

(Caliendo and Aadland (2007)). However, the policy implications derived from this class of models tend to be highly sensitive to the length of the exogenously chosen planning horizon.

Our model is most closely related to Park and Feigenbaum (2018) who rationalize the empirically observed consumption hump within a general equilibrium, overlapping generations, life-cycle model in which households employ an exogenously determined short planning horizon. While we abstract from the general equilibrium determination of prices which features prominently in Park and Feigenbaum (2018), our model includes income and mortality risk, a bequest motive, and inter-generational transfers of wealth and education. Like Park and Feigenbaum (2018), our model also generates a hump-shaped profile for average consumption that compares favorably to that documented empirically by Gourinchas and Parker (2002). In addition, our model generates an empirically plausible distribution of wealth. But perhaps most importantly, whereas in Park and Feigenbaum (2018) households use of a short planning horizon is imposed exogenously, households in our model endogenously choose to employ a short planning horizon as an intentional strategy aimed at maximizing their discounted lifetime utility.[10]

Our paper is also related to Park (2023) who models labor supply decisions in a model with an exogenous short planning horizon. The focus of Park (2023) is on the interaction of a short planning horizon with the decision of when to retire. In contrast, the focus of our paper is how the optimal planning horizon length is determined and its implications for wealth at retirement, taking labor supply and the age of retirement as given.

The remainder of this paper is structured as follows. Section 2 describes our overlapping generations, life-cycle model and explores theoretically the factors that determine a household's optimal planning horizon. Section 3 presents our calibration and main quantitative results. Finally, Section 4 concludes.

2 The Model

Our model economy is populated by overlapping generations of households, each with measure one and linked to previous generations through inter-generational transfers of wealth and education. Prior to retirement, households receive a stochastic income endowment of the homogeneous consumption good. During retirement, households face mortality risk and receive a non-stochastic income endowment of the homogeneous consumption good that depends on their income at retirement. There is one asset, a risk free bond, which households

[10]In this sense, the model we develop here is also similar in many ways to Becker and Mulligan (1997) who construct a model of endogenous patience formation in which households can exert effort in order to increase their subjective discount factor. In both our model and theirs, the way in which households discount future utility is determined endogenously.

can use to self-insure against income and lifespan risk. The novel feature of our model is that at each age, households select an optimal planning horizon within which to make an optimal consumption-saving plan. Planning further into the future is costly insofar as the household must expend effort, cognitive or otherwise, to make a corresponding optimal consumption plan.

2.1 Demographics

Households enter the model at age T_0, work until retirement at age T_R, and live to the maximum age T_M. Households are endowed with the education level of their parents when they enter the model indexed by $j \in \{D, H, C\}$ and corresponding to high school dropout (D), high school graduate (H), or college graduate (C).[11] Retired households face an age-specific probability Ψ_t of surviving to age t, with $\Psi_t = 1$ prior to retirement. Upon the death of a household, a bequest is made to their heirs. A fraction Υ of the bequest is transferred to the grandchildren of the deceased, while the remainder is transferred to the children. Thus, a household receives a bequest twice during their life-cycle, once at age T_0 upon entry into the model which corresponds to the passing of their grandparent, and once at a stochastically determined age later in life that corresponds to the death of their parent. In order to maintain computational tractability, we assume that the second bequest is unanticipated both in terms of its size and timing.[12] Each household in the model has either a parent or a child that is also active in the model in any given period. The demographic patterns are assumed to be stable, meaning that age t households make up a constant fraction of the population at every point in time. Since we consider only stationary environments, all variables are indexed by the age t of households with the index for time left implicit.

[11] For the purposes of mapping the model to the data in the calibration section that follows, to be considered a college graduate, the head of household must have at least a four year college degree. Thus, high school graduates include those with some college experience, for example, heads of households that have an associates degree or were college dropouts.

[12] De Nardi (2004) develops a model with inter-generational transfers of wealth in which bequest timing is stochastic and children infer the size of the bequest they are likely to receive by observing their parent's labor productivity at entry into the model. See Cottle Hunt and Caliendo (2022) for a similar approach. However, this comes at the cost of increasing the model's state space and, therefore, the required computational time. To reduce our computational burden, we assume that bequests are unanticipated by their recipients, both in terms of timing and size.

2.2 Preferences

Each household i derives utility from consumption $c_{i,j,t}$ and has preferences over the size of bequest they leave to their descendants. The period utility function is CRRA

$$u(c_{i,j,t}) = \begin{cases} \frac{c_{i,j,t}^{1-\gamma}-1}{1-\gamma} & \gamma \neq 1 \\ \log(c_{i,j,t}) & \gamma = 1. \end{cases} \tag{1}$$

and preferences over bequests $d_{i,j,t}$ are represented by

$$v(d_{i,j,t}) = \begin{cases} \left(\frac{\omega}{1-\omega}\right)^{\gamma} \frac{\left(\omega(1-\omega)^{-1}\hat{c}+d_{i,j,t}\right)^{1-\gamma}}{1-\gamma} & \omega \in (0,1) \\ \hat{c}^{-\gamma}(d_{i,j,t}) & \omega = 1 \\ 0 & \omega = 0, \end{cases} \tag{2}$$

where $\omega \in [0,1]$ governs the strength of the bequest motive and $\hat{c}$ determines the extent to which bequests are a luxury good.[13]

Households experience disutility of planning which is increasing in the length $h_{i,j,t} \in H_t \equiv \{1, ..., T_M - t + 1\}$ of their chosen planning horizon. This planning cost represents both the cognitive cost of planning for the future plus the anticipated periodic disutility of implementing the plan. Choosing a longer planning horizon is more costly than a shorter horizon for two reasons: first it requires thinking about more periods which requires more information. Second, households anticipate that it will be difficult to implement or stick to a plan, and factor this additional disutility into their decision.

Let A_j represent the education-specific, constant marginal utility cost to implement a given plan. If a household plans for $h_{i,j,t}$ periods today, then they anticipate experiencing disutility $A_j h_{i,j,t}$ today, $A_j(h_{i,j,t} - 1)$ tomorrow, $A_j(h_{i,j,t} - 2)$ two periods from now, and so on in order to implement their plan. Since the periodic anticipated disutility associated with implementing a particular plan is additively separable, the discounted sum of anticipated implementation costs associated with selecting planning horizon $h_{i,j,t}$ can be written as follows:

$$pc(h_{i,j,t}) = \sum_{s=t}^{t-1+h_{i,j,t}} \beta^{s-t} \left(\frac{\Psi_s}{\Psi_t}\right) A_j(t - s + h_{i,j,t}). \tag{3}$$

where β is the subjective discount factor and the ratio Ψ_s/Ψ_t represents the probability of surviving to age s conditional on having survived to age t. We assume that households

[13] This functional form is taken from Lockwood (2018), who shows that this equation nests nearly all functional forms commonly used in the literature, including De Nardi (2004).

experience the full anticipated discounted planning cost $pc(h_{i,j,t})$ at the time of planning.[14]

2.3 Stochastic Income Process

Prior to retirement ($t < T_R$), the stochastic income endowment of household i at age t given education level j is

$$y_{i,j,t} = \exp(f_{j,t} + e_{i,j,t} + \nu_{i,j,t}) \tag{4}$$

where $f_{i,j,t}$ represents the deterministic age and education-specific component of earnings, $e_{i,j,t} \sim N(0, \sigma_{e_j})$ is an i.i.d. idiosyncratic transitory shock with education-specific volatility σ_{e_j}, and $\nu_{i,j,t}$ is a persistent component of income that evolves according to the random walk process

$$\nu_{i,j,t} = \nu_{i,j,t-1} + \xi_{i,j,t} \tag{5}$$

where $\xi_{i,j,t} \sim N(0, \sigma_{\xi_j})$ is an i.i.d. idiosyncratic permanent shock with education-specific volatility σ_{ξ_j}.

During retirement ($t \geq T_R$), households receive a non-stochastic income endowment equal to a constant education-specific fraction λ_j of the permanent component of their income at retirement

$$y_{i,j,t} = \lambda_j \exp(f_{i,T_R} + \nu_{i,j,T_R}). \tag{6}$$

2.4 Optimal Consumption and Saving Decision

The decision problem of a household within each model period takes place in two stages. First, the household chooses optimal consumption and saving for a given planning horizon $h_{i,j,t}$. Second, the household selects the planning horizon $h_{i,j,t}$ that maximizes their expected discounted utility.

At every age t, given their education level j, persistent component of income $\nu_{i,j,t}$, and current assets $b_{i,j,t}$, household i chooses the plan for consumption and saving, $\{\hat{c}_{i,j,s}(h_{i,j,t}), \hat{b}_{i,j,s+1}(h_{i,j,t})\}_{s=t}^{t+h_{i,j,t}}$, that maximizes their discounted utility realized within a

[14] Lusardi (2003) argues that the effort of planning for retirement is influenced by how unpleasant the task is. She finds evidence that thinking about retirement is unpleasant for some households in the HRS. She also finds that obtaining and evaluating financial information can be unpleasant for those with low financial literacy which motives our use of an education-specific, constant marginal utility cost to implement a given plan.

given planning horizon $h_{i,j,t} \in H_t$:[15]

$$U(b_{i,j,t}; h_{i,j,t}) \equiv \max_{\{\hat{c}_{i,j,s}(h_{i,j,t}),\hat{b}_{i,j,s+1}(h_{i,j,t})\}_{s=t}^{t+h_{i,j,t}}} \sum_{s=t}^{t-1+h_{i,j,t}} \beta^{s-t} \Bigg[\left(\frac{\Psi_s}{\Psi_t}\right) u\left(\hat{c}_{i,j,s}(h_{i,j,t})\right) \cdots \tag{7}$$

$$+ \left(1 - \frac{\Psi_s}{\Psi_t}\right) v(\hat{b}_{i,j,s+1}(h_{i,j,t}))\Bigg]$$

subject to the period budget constraints

$$\hat{c}_{i,j,s}(h_{i,j,t}) + \hat{b}_{i,j,s+1}(h_{i,j,t}) \leq y_{i,j,s} + \left[1 + r_s \mathbb{I}_{\hat{b}_{i,j,s}(h_{i,j,t}) \geq 0} + r_d \mathbb{I}_{\hat{b}_{i,j,s}(h_{i,j,t})<0}\right] \hat{b}_{i,j,s}(h_{i,j,t}), \tag{8}$$

and the borrowing constraints

$$\hat{b}_{i,j,s+1}(h_{i,j,t}) \geq - \sum_{s=t}^{t-1+h_{i,j,t}} \frac{y_{i,j,s}}{(1+r_d)^{s-t}}, \tag{9}$$

for $s = t, ..., t + h_{i,j,t}$ where $\beta \in (0, 1)$ is the time-consistent subjective discount factor, r_s is the risk-free real interest rate earned on savings, r_d is the real interest rate charged on debt, and Ψ_s/Ψ_t is the probability of surviving to age s, conditional on surviving to age t. If the planning horizon is equal to a household's entire remaining lifetime, the constraints in Equation (9) are equivalent to imposing a natural borrowing constraint (i.e., the household cannot borrow more than they can commit to repay within their remaining lifetime). If the planning horizon is less than a household's entire remaining lifetime, the constraints in Equation (9) prevent the household from borrowing more than they can commit to repay within their planning horizon.[16] In other words, we assume that households fully discount income received outside of their planning horizon when formulating their optimal consumption-saving plan.

[15] Each household plans consumption and saving for all periods within their planning horizon, naively assuming they will follow their plan beyond the current period. However, if a household chooses to update their planning horizon in the following period (i.e, if $h_{i,j,t+1} \neq h_{i,j,t} - 1$), they re-optimize and implement a new consumption and saving plan.

[16] The constraints in Equation (9) ensure that the household does not implicitly plan to have negative consumption outside of their planning horizon which would occur if the present value of planned consumption exceeds the present value of available resources within their planning horizon. In practice, the constraints in Equation (9) are thus equivalent to assuming that households plan to hold zero assets at the end of their planning horizon (i.e., $b_{i,j,t+h_{i,j,t}} = 0$), as in Park and Feigenbaum (2018) and Caliendo and Aadland (2007).

2.5 Selecting an Optimal Planning Horizon

Each period, household i selects the planning horizon $h_{i,j,t}$ given the corresponding optimal plan for consumption and saving $\{\hat{c}_{i,j,s}(h_{i,j,t}), \hat{b}_{i,j,s+1}(h_{i,j,t})\}_{s=t}^{t+h_{i,j,t}}$ that maximizes their discounted expected lifetime utility net of planning costs:

$$h^*_{i,j,t}(b_{i,j,t}) = \arg \max_{h_{i,j,t} \in H_t} U_{i,j,t}\big(b_{i,j,t}; h_{i,j,t}\big) - pc(h_{i,j,t}). \tag{10}$$

Households search for the optimal planning horizon $h^*_{i,j,t}(b_{i,j,t})$ sequentially, starting with their current plan $h_{i,j,t} = h_{i,j,t-1} - 1$. The household considers increasing their planning horizon by one period, and sees if that will increase their discounted expected lifetime utility net of planning costs. They continue this process until extending their planning horizon lowers their expected utility. This incremental approach ensures that if the household's current planning horizon is optimal (i.e., $h^*_{i,j,t} = h^*_{i,j,t+1} - 1$), they only check one additional horizon and do not need to solve multiple household problems each period.[17] Moreover, the planning cost in Equation (3) ensures that households do not incur any additional disutility if they choose to continue following the consumption-saving plan they constructed in a previous period as effort associated with implementing their previously constructed plan was already accounted for in the planning cost incurred by the household when they first constructed their current plan.[18]

The optimal consumption and saving for a household with current assets $b_{i,j,t}$ is thus given by $\big(c^*_{i,j,t}, b^*_{i,j,t+1}\big) = \big(\hat{c}_{i,j,t}(h^*_{i,j,t}), \hat{b}_{i,j,t+1}(h^*_{i,j,t})\big)$. The realized path of consumption and saving for a household is given by the optimal consumption and saving choice at each age $\{c^*_{i,j,s}, b^*_{i,j,s+1}\}_{s=0}^{T_D}$. The household does not necessarily follow a particular plan $\{\hat{c}_{i,j,s}(h_{i,j,t}), \hat{b}_{i,j,s+1}(h_{i,j,t})\}_{s=t}^{t+h_{i,j,t}}$ for more than one period, since they are able to choose a new planning horizon (and thus select a new consumption-saving plan) each period. This type of dynamic inconsistency is also present in models with exogenous short planning horizons (e.g., Park and Feigenbaum (2018)).[19]

[17]If $U\big(b_{i,j,t}; h_{i,j,t}\big)$ is strictly concave in $h_{i,j,t}$ for all $b_{i,j,t}$, then the optimal planning horizon $h^*_{i,j,t}(b_{i,j,t})$ is that for which $U\big(b_{i,j,t}; h^*_{i,j,t} - 1\big) < U\big(b_{i,j,t}; h^*_{i,j,t}\big)$ and $U\big(b_{i,j,t}; h^*_{i,j,t}\big) > U\big(b_{i,j,t}; h^*_{i,j,t} + 1\big)$.

[18]When solving the model numerically, we assume households experience the disutility of formulating their plan and then implementing their chosen plan period-by-period rather than all at once in order to preserve the recursive nature of households' optimization problem. We demonstrate the equivalence of our numerical approach and the model described here in Appendix A.

[19]The time inconsistency in our model is conceptually similar to naive quasi-hyperbolic discounting. Households with quasi-hyperbolic preferences can either be naive or sophisticated with regard to their own present bias (see, for example, Laibson (1997), O'Donoghue and Rabin (1999), and İmrohoroğlu et al. (2003)). Sophisticated households are modeled as a sequence of T temporal selves making choices in a dynamic game, where the strategy of each age t player is the optimal consumption and saving choices given their age-specific preferences. The resulting life-cycle path of consumption and saving are the subgame-perfect equilibrium of

2.6 Discussion

Before moving on, it is useful to explore some intuition behind how a household selects their optimal planning horizon.

Increasing the planning horizon changes discounted utility over the planning horizon in four ways. First, increasing the planning horizon increases the number of terms in the sum of discounted utility, i.e. in Equation (7). All else equal, this increases the household's planned discounted utility.[20] Second, increasing the planning horizon increases the effort the household must exert, cognitive or otherwise, to implement the corresponding optimal consumption plan, i.e., $u_h < 0$. This decreases planned discounted utility. Third, increasing the planning horizon changes the household's planned consumption and saving—which can either increase or decrease discounted utility. Finally, extending the planning horizon has the potential to make a bequest motive more salient to the household, which could either increase of decrease their planned discounted utility.

To fix ideas, we consider here a simplified version of our model that abstracts from mortality and income risk, among other things, in order to focus our attention exclusively on how a household selects their optimal planning horizon.

Specifically, consider a household that lives for two-periods and must optimally choose their planning horizon and make a consumption-saving decision in the first period.[21] The household solves the problem in two stages. First, they determine their optimal consumption and saving plan for each possible planning horizon ($h = 1$ and $h = 2$). Second, they choose the planning horizon that maximizes their discounted utility.

For a planning horizon of $h = 2$, the household chooses consumption and saving to

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the dynamic game. In contrast, households in our model, and in models with exogenous short planning horizons like Park and Feigenbaum (2018), are naive with regard to their own present bias. In particular, households in our model make optimal consumption and saving plans each period not realizing that their future selves might deviate from their chosen plan.

[20] Note that utility of consumption is positive for values of consumption larger than 1 (given our CRRA utility function 1, which subtracts 1 from the numerator). We will parameterize income to be large enough that consumption is always larger than one, thus adding an additional term to $U_{t,j}(.)$ makes the expression larger, all else equal.

[21] In principle, a three-period life-cycle is necessary to make an analytical comparison of behavior with one- and two-step ahead planning horizons. The bequest motive effectively gives the household a third period.

maximize:

$$U(2) = \max_{c_1,c_2,b_2,b_3} u(c_1) + \beta u(c_2) + \beta v(b_3) \tag{12}$$

$$\text{subject to:} \tag{13}$$

$$c_1 + b_2 \leq y_1 \tag{14}$$

$$c_2 + b_3 \leq (1+r)b_2 + y_2, \tag{15}$$

where we have assumed that initial assets b_1 are equal to zero, the utility of consumption $u(c)$ is CRRA as given by Equation (1), and utility of bequests $v(d)$ is given by

$$v(d) = \left(\frac{\omega}{1-\omega}\right)^{\gamma} \frac{d^{1-\gamma}}{1-\gamma}. \tag{11}$$

In this special case, the parameter that governs the degree to which bequests are a luxury good ($\hat{c}$) has been set to zero and we have imposed that $r_s = r_d = r$ (i.e., there are no credit market imperfections).

The solution to this problem is:

$$c_1^*(2) = \frac{(1-\omega)\left((1+r)y_1 + y_2\right)}{(1-\omega)(1+r) + (\beta(1+r))^{1/\gamma}} \tag{12}$$

$$c_2^*(2) = (\beta(1+r))^{1/\gamma} c_1^*(2) \tag{13}$$

$$b_2^*(2) = \frac{(\beta(1+r))^{1/\gamma} y_1 - (1-\omega)y_2}{(1-\omega)(1+r) + (\beta(1+r))^{1/\gamma}} \tag{14}$$

$$b_3^*(2) = \frac{(\beta(1+r))^{1/\gamma} \omega \left(y_1(1+r) + y_2\right)}{(1-\omega)(1+r) + (\beta(1+r))^{1/\gamma}} \tag{15}$$

where the notation $c_1^*(2)$ denotes planned consumption in the first period given a planning horizon of $h = 2$.

For a planning horizon of $h = 1$, the household chooses to consume their income in the first period and not to save for the second period (which falls outside their planning horizon). They also choose not to leave a bequest, since utility from their bequest falls outside their planning horizon. The solution to this problem is thus:

$$c_1^*(1) = y_1 \tag{16}$$

$$b_2^*(1) = 0 \tag{17}$$

$$b_3^* = 0. \tag{18}$$

The household chooses the planning horizon h^* such that

$$h^* = \arg\max_{h\in[1,2]} U(h) - pc(h), \tag{19}$$

where the disutility of planning is given by equation (3) with $\Psi_1 = \Psi_2 = 1$ (i.e., there is no mortality risk)

$$pc(h) = \begin{cases} A & h = 1 \\ (1+\beta)A & h = 2. \end{cases} \tag{20}$$

The household's choice of planning horizon depends on the shape of their income profile, the strength of the bequest motive, and the disutility of planning. We formalize this trade off with the following Proposition:

Proposition 2.1 *The household optimally chooses to plan for retirement (i.e., $h^* = 2$) if and only if the marginal disutility of planning A is below a threshold A^*:*

$$A^* = \frac{1}{(1+\beta)(1-\gamma)}\left(c_1^*(2)^{1-\gamma} + \beta c_2^*(2)^{1-\gamma} + \beta\left(\frac{\omega}{1-\omega}\right)^{\gamma} b_3^*(2)^{1-\gamma} - y_1^{1-\gamma} - 2 - \beta\right). \tag{21}$$

Proof The household only chooses planning horizon $h = 2$ if the discounted planned utility of that horizon is larger than the planned utility of choosing planning horizon $h = 1$.

$$U(2) - (1+\beta)A > U(1) - A \tag{22}$$

$$\frac{c_1^*(2)^{1-\gamma} - 1}{1-\gamma} + \beta\frac{c_2^*(2)^{1-\gamma} - 1}{1-\gamma} + \beta\left(\frac{\omega}{1-\omega}\right)^{\gamma}\frac{b_3^*(2)^{1-\gamma}}{1-\gamma} - (1+\beta)A > \frac{y_1^{1-\gamma} - 1}{1-\gamma} - A \tag{23}$$

$$A < A^*. \tag{24}$$

Proposition 2.2 *The household is more willing to choose $h = 2$ and plan for retirement if retirement income y_2 is larger.*

Proof The household is willing to choose $h = 2$ rather than $h = 1$ if the marginal disutility of planning $A < A^*$. The threshold value A^* is increasing in retirement income y_2. Thus, if retirement income y_2 is larger, the threshold marginal disutility of planning the household is willing to experience A^* is also larger.

$$\frac{\partial A^*}{\partial y_2} = \frac{1}{1+\beta}\left(c_1^*(2)^{-\gamma}\frac{\partial c_1^*(2)}{\partial y_2} + \beta c_2^*(2)^{-\gamma}\frac{\partial c_2^*(2)}{\partial y_2} + \beta\left(\frac{\omega}{1-\omega}\right)^{\gamma} b_3^*(2)^{-\gamma}\frac{\partial b_3^*(2)}{\partial y_2}\right) > 0. \tag{25}$$

This expression is positive because all of the partial derivatives are positive:

$$\frac{\partial c_1^*(2)}{\partial y_2} = \frac{(1-\omega)y_2}{(1-\omega)(1+r) + (\beta(1+r))^{1/\gamma}} > 0 \tag{26}$$

$$\frac{\partial c_2^*(2)}{\partial y_2} = \frac{(\beta(1+r))^{1/\gamma}(1-\omega)y_2}{(1-\omega)(1+r) + (\beta(1+r))^{1/\gamma}} > 0 \tag{27}$$

$$\frac{\partial b_3^*(2)}{\partial y_2} = \frac{(\beta(1+r))^{1/\gamma}\omega y_2}{(1-\omega)(1+r) + (\beta(1+r))^{1/\gamma}} > 0. \tag{28}$$

Proposition 2.3 *Increasing the strength of the bequest motive ω can either increase or decrease the household's willingness to plan for retirement.*

Proof Increasing the strength of the bequest motive ω can have either a positive or negative effect on the threshold marginal cost of planning A^*.

$$\frac{\partial A^*}{\partial \omega} = c_1^*(2)^{-\gamma}\frac{\partial c_1^*}{\partial \omega} + c_2^*(2)^{-\gamma}\frac{\partial c_2^*}{\partial \omega} + \beta\left(\frac{\omega}{1-\omega}\right)^{\gamma} b_3^*(2)^{-\gamma}\left(\frac{\partial b_3^*(2)}{\partial \omega} + b_3^*(2)\frac{\gamma}{\omega(1-\omega)}\right) \lesseqgtr 0. \tag{29}$$

The first two terms are negative since consumption is decreasing in the strength of the bequest motive.

$$\frac{\partial c_1^*(2)}{\partial \omega} = \frac{-(\beta(1+r))^{1/\gamma}((1+r)y_1 + y_2)}{((1-\omega)(1+r) + (\beta(1+r))^{1/\gamma})^2} < 0 \tag{30}$$

$$\frac{\partial c_2^*(2)}{\partial \omega} = \frac{-(\beta(1+r))^{2/\gamma}((1+r)y_1 + y_2)}{((1-\omega)(1+r) + (\beta(1+r))^{1/\gamma})^2} < 0. \tag{31}$$

The third term is positive because the size of the bequest $b_3^*(2)$ is increasing in the strength of the bequest motive.

$$\frac{\partial b_3^*(2)}{\partial \omega} = \frac{(1+r+(\beta(1+r))^{1/\gamma})(\beta(1+r))^{1/\gamma}(y_1(1+r) + y_2)}{((1-\omega)(1+r) + (\beta(1+r))^{1/\gamma})^2} > 0. \tag{32}$$

The threshold A^* depends on the strength of the bequest motive ω, but in an ambiguous way. The partial derivative $\partial A^*/\partial\omega$ is comprised of two negative terms and a positive term. As the strength of the bequest motive increases, planned consumption in both stages of life decreases, $\partial c_1^*(2)/\partial\omega < 0$ and $\partial c_2^*(2)/\partial\omega < 0$. This effect reduces the threshold utility cost A^* that the household is willing to pay in order to plan for retirement. However, as the strength of the bequest motive increases, the bequest $b_3^*(2)$ the household plans to leave increases $\partial b_3^*(2)/\partial\omega > 0$, which increases the households utility. This effect increases the threshold utility cost A^* that the household is willing to pay in order to plan for retirement. Thus, the net effect depends on which effect dominates: the negative effect of smaller consumption, or the positive effect of leaving a larger bequest.

In summary, the timing of income and the desire to leave bequests both matter for the optimal path of consumption over the life-cycle when the household chooses their planning horizon optimally each period. Given that our model does not admit an analytical solution, we must proceed numerically. In the following section, we first calibrate our model and then simulate it in order to explore its quantitative implications for planning, consumption, and wealth over the life-cycle.

3 Quantitative Analysis

We first describe how we calibrate the model parameters. We then explore our calibrated model's quantitative implications for planning, consumption, and wealth over the life-cycle.

3.1 Calibration

To operationalize the model described in the previous section, we must specify and calibrate a number of parameters and processes. In particular, we need to choose preference parameters, demographic characteristics, income processes, and interest rates. We describe how we pin down each of these components of the model in turn. Table 1 summarizes the resulting model parameters.

Preference parameters Fully specifying preferences requires choosing a coefficient of relative risk aversion γ, discount factor β, bequest parameters (ω, $\hat{c}$, Υ), and marginal disutility of planning conditional on education (A_D, A_H, A_C). We start by setting $\gamma = 1.6$ and $\beta = 0.96$. We set $\omega = 0.954$, which governs the strength of the bequest motive, and $\hat{c} = \$24,800$, which governs the extent to which bequests are a luxury good, based on the corresponding estimates reported by Lockwood (2018). Υ represents the fraction of each bequest left to the grandchildren of the deceased. We set $\Upsilon = 0.10$ such that the median wealth held by household age 25–34 matches the corresponding moment in the 2019 SCF. Finally, the higher is the marginal disutility of planning, the less households, on average, will plan for retirement and, as a result, the less wealth they will accumulate over their working lives. We thus set $A_D = 0.0159$, $A_H = 0.068$, and $A_C = 0.056$ so that the median wealth held by age 55–64 high school dropouts, high school graduates, and college graduates, respectively, match the corresponding moments in the 2019 SCF.

Demographics Households enter the model at age 25 ($T_0 = 1$), retire at age 65 ($T_R = 41$), and live to a maximum age of 100 ($T_M = 75$).[22] Age-specific survival probabilities Ψ_t are taken from the NCHS mortality tables for males. We set the fraction of each cohort that are high school dropouts χ_D and high school graduates χ_H equal to 0.20 and 0.54, respectively, which correspond to the estimates reported by Love and Schmidt (2015).

[22] In our model, the age of retirement is given exogenously. The interaction between (exogenous) short planning horizons, endogenous labor supply, and retirement timing is the focus of a recent paper Park (2023).

Table 1: Calibration Summary

Description	Parameter Value
Preferences	
Coefficient of relative risk aversion (γ)	1.6
Discount factor (β)	0.96
Bequest parameters (ω, $\hat{c}$, Υ)	(0.954, \$24,800, 0.10)
Marginal disutility of planning (A_D, A_H, A_C)	$(0.159, 0.068, 0.056)$
Demographics	
Entry age ($t = 1$)	25
Retirement age (T_R)	41
Maximum age (T_M)	75
Survival probabilities (Ψ_t)	NCHS mortality table for males
Fraction of high school dropouts (χ_D)	0.20
Fraction of high school graduates (χ_H)	0.54
Income Processes	
High School Dropouts ($j = D$)	
Deterministic age-earnings profile ($f_{D,t}$)	$-2.14 + 0.168(t + 24)$ $-3.53(t + 24)^2/10^3 + 2.3(t + 24)^3/10^5$
Persistent income shock volatility (σ_{ξ_D})	0.325
Transitory income shock volatility (σ_{ν_D})	0.103
Replacement rate during retirement (λ_D)	0.89
High School Graduates ($j = H$)	
Deterministic age-earnings profile ($f_{H,t}$)	$-2.17 + 0.168(t + 24)$ $-3.2(t + 24)^2/10^3 + 2.0(t + 24)^3/10^5$
Persistent income shock volatility (σ_{ξ_H})	0.272
Transitory income shock volatility (σ_{ν_H})	0.103
Replacement rate during retirement (λ_H)	0.68
College Graduates ($j = C$)	
Deterministic age-earnings profile ($f_{C,t}$)	$-4.32 + 0.319(t + 24)$ $-5.8(t + 24)^2/10^3 + 3.3(t + 24)^3/10^5$
Persistent income shock volatility (σ_{ξ_C})	0.242
Transitory income shock volatility (σ_{ν_C})	0.130
Replacement rate during retirement (λ_C)	0.94
Interest Rates	
Real interest rate on savings (r_s)	3.5%
Real interest rate on debt (r_d)	8.0%

Income processes We follow Cocco et al. (2005) in specifying the income processes for households in our model, including the deterministic age-earnings profile $f_{j,t}$ depicted in Figure 1, persistent income shock volatility σ_{ξ_j}, transitory income shock volatility σ_{ν_j}, and replacement rate during retirement λ_j for each level of educational attainment $j = D, H, C$.

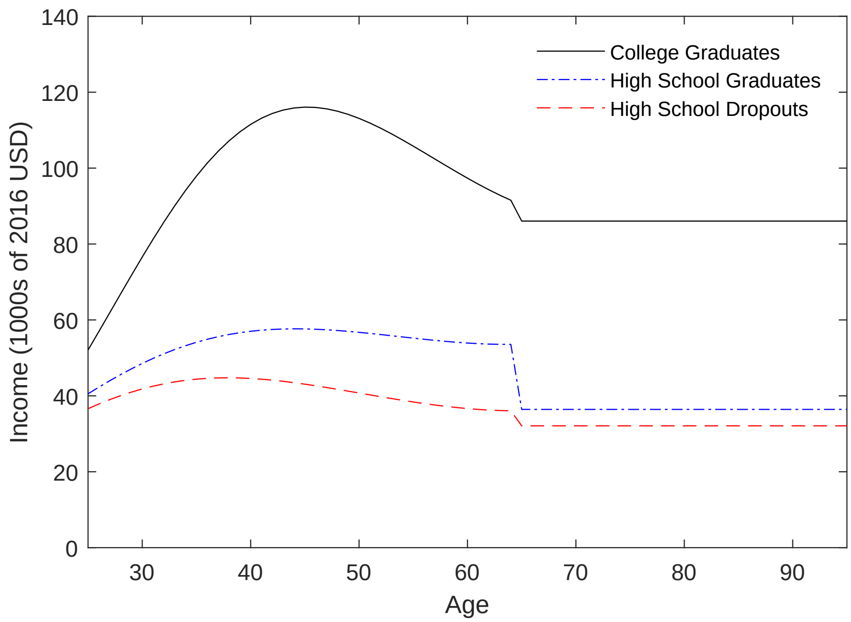


Figure 1: Deterministic age-earnings profile conditional on a household's education level. Source: Authors' calculations based on estimated reported by Cocco et al. (2005).

Interest Rates We set the interest rate on savings r_s equal to 3.5% following Park and Feigenbaum (2018) and we set the interest rate on debt r_d equal to 8.0% such that the wealth held by households at the 10th percentile of the wealth distribution matches the corresponding moment reported by Eggleston and Munk (2019).

3.2 Model Fit

Table 2 compares the wealth held by households in the model at various percentiles of the wealth distribution to the corresponding moments in the data. The model is calibrated to match the wealth held by households at the 10th percentile of the distribution. Although the model somewhat under-predicts the wealth held by households in the right tail of the distribution, we believe that it offers a plausible description of the distribution of wealth across households.

Table 3 reports median wealth held by households conditional on age and education in our calibrated model and in the 2019 SCF. Our model closely matches the median wealth held by households in the 55-64 age group, which are targets of our calibration exercise. The model also offers a reasonable fit to wealth over the life cycle for both high school dropouts and high school graduates. However, the model under-predicts the wealth held by college graduates in the 35-44 age group and over-predicts the wealth held by college graduates during retirement.

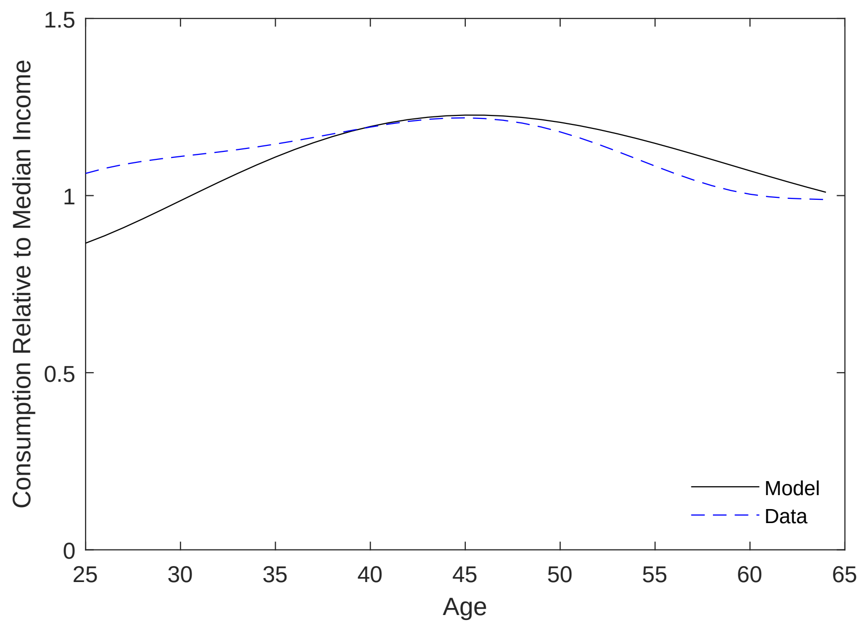


Figure 2: Average consumption over the life-cycle relative to median income in our baseline model compared to that estimated by Gourinchas and Parker (2002).

Table 2: Wealth by Percentile (1,000's of 2016 USD)

Percentile	Model	Data
10th	-2.8*	-3.5
25th	16.3	5.6
50th	74.1	94.7
75th	251.9	359.4
90th	828.6	952.3

Source: Calibrated model and Net Worth of Households: 2016, Eggleston and Munk, Current Population Reports. Moments in model which are targets of our calibration exercise are denoted with an asterisk.

Table 3: Median Wealth by Age and Education Group (1,000's of 2016 USD)

	High School Dropouts		High School Graduates		College Graduates	
Age Group	Model	Data	Model	Data	Model	Data
25–34	7.2	6.3	8.8	10.1	45.2	31.0
35–44	20.9	8.2	31.9	47.6	60.9	203.3
45–54	26.1	27.6	74.1	100.8	354.6	457.9
55–64	28.9*	30.0[1]	140.1*	138.2	667.0*	668.7
65–74	20.9	32.1	173.8	153.7	990.7	628.1
75 and over	16.3	125.3	173.8	200.2	1398.3	461.4

[1] Interpolated value due to small sample size in 2019 SCF.
Source: Calibrated model and authors' calculations using data from the 2019 Survey of Consumer Finances. Moments in model which are targets of our calibration exercise are denoted with an asterisk.

Figure 2 compares average consumption over the life-cycle relative to median income in our model to that estimated by Gourinchas and Parker (2002). Importantly, the age of peak consumption is not a targeted moment in our calibration exercise. Yet our model generates peak consumption at age 45, which is identical to that estimated by Gourinchas and Parker (2002). While the model under-predicts consumption at younger ages, it offers a plausible description of the decline in consumption later in a household's working life.

3.3 Planning, Consumption, and Wealth over the Life-Cycle

The optimal planning horizons chosen by the average household in our baseline model are shown in Figure 3 and are (weakly) decreasing over the life-cycle. Consistent with Proposition 2.2, the average household's choice of planning horizon is intimately related to the shape of their life-cycle income profile. During the early working years, the average household faces an increasing income profile, and chooses planning horizons that include the peak of their income profile while excluding retirement, when income is lower. This pattern continues through their 30s and 40s, with the average household planning less than 20 years into the future, ignoring retirement years. Starting in their 50s the average household includes a few retirement years in their planning window. The average household does not plan for their full remaining lifetime until very late in life, above age 90.

Figure 3 also depicts the planning horizons chosen by the average household when we set the disutility of planning A_j equal to zero for $j \in \{D, C, G\}$. In the absence of a planning cost, households in our model find it optimal to plan for their entire remaining lifetime each period. Note, however, that it is not *necessarily* the case that a household will choose to plan for their entire life-cycle if the cost of planning is set equal to zero. A household only chooses a horizon $h_t + 1$ over a horizon h_t if choosing the longer horizon results in a larger sum of planned utility within the horizon, as in Proposition 2.1. In our numerical analysis households always choose to plan for their full life-cycles when $A_j = 0$. This version of our model thus corresponds to a standard life-cycle model in which households plan, by default, for their entire remaining lifetime each period.

Figure 3 also depicts the planning horizon for case in which we exogenously impose that households choose a planning horizon equal to the minimum of 20 years or $(T_M - t + 1)$ years, where T_M is the maximum age a household can reach and t is the household's current age. This version of our model is similar (in spirit) to the exogenous (short) planning horizon model of Park and Feigenbaum (2018).[23] Consistent with the approach taken by Park and Feigenbaum (2018), the planning horizon of 20 years was selected such that the model generates a peak in average consumption at age 45 as has been documented empirically by Gourinchas and Parker (2002).

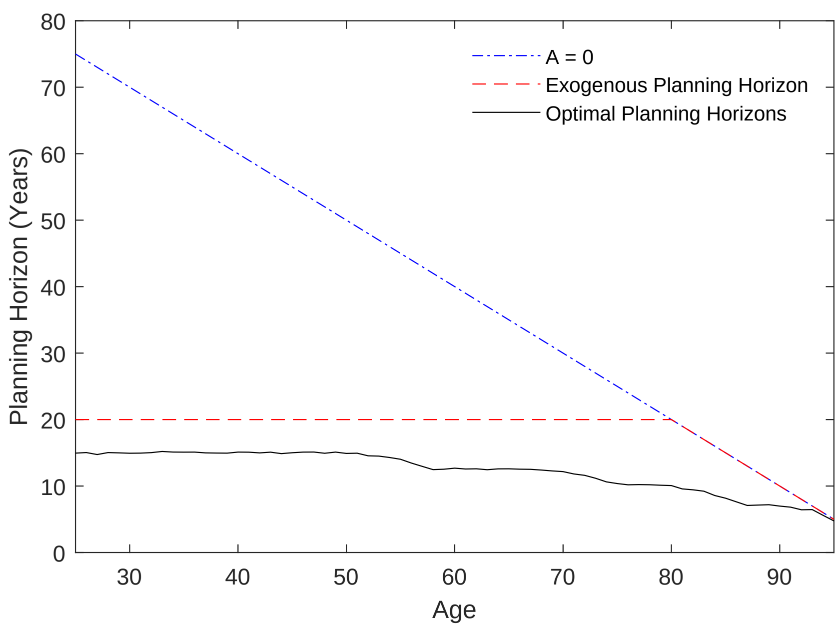


Figure 3: Average planning horizons over the life-cycle in our baseline model, the case in which the marginal disutility of planning A is set equal to 0, and the case in which households are forced to plan for 20 years each period.

[23] Park and Feigenbaum (2018) develops a general equilibrium, exogenous (short) planning horizon model in which households neither face mortality or income risk, nor do they have a bequest motive or make inter-generational transfers of wealth or education to their heirs.

The average consumption profile of households in our baseline model is depicted in Figure 4, along with that for the case in which A_j is set equal to zero for $j \in \{D, C, G\}$ and the case in which we impose an exogenous planning horizon of 20 years. The consumption hump in our model is driven by precautionary saving and survival uncertainty, as well as by the length of the planning horizon. Young households engage in precautionary saving to partially insure themselves against income risk. They are able to borrow to smooth consumption, but borrowing is expensive and so they choose to reduce their consumption while very young to build up a buffer stock of assets to smooth their consumption in the event of realizing an adverse transitory income shock. Retired households face mortality risk which means they might not live to the maximum possible age and enjoy consuming all of their assets. This incentivizes households to consume relatively more in middle age compared to retirement.[24]

The consumption hump in our model is also influenced by the endogenous planning horizon. Young households choose to only include their peak earning years in their planning window, excluding the years later in life when earnings fall at retirement. Households don't receive utility for periods outside their planning window, and so this reduces the incentive to save. These households consume more and save less than if they planned for their whole life-cycle. It is not until age 50, on average, that households include retirement in their planning window. As households choose to include retirement in their planning windows, this drives down their consumption as they devote more of their disposable income to saving. The way the planning horizon shapes consumption over the life-cycle is qualitatively similar to the mechanism in models of exogenous short planning horizons (e.g., Park and Feigenbaum (2018) and Caliendo and Aadland (2007)).

In the simplest version of an exogenous short planning horizon model, households do not face income or survival risk, and so the consumption hump is driven entirely by the shape of the income profile and the length of planning horizon. Consumption peaks as retirement enters the household's planning window. If the household exogenously plans for 20 years, consumption will peak 20 years before retirement as the household "sees" the decline in income they will experience in retirement and reduces their consumption to accumulate assets to fund old age consumption. This effect of the planning horizon on the consumption profile is visible in Figure 4. Households with an exogenous planning horizon of 20 years experience a decline in consumption as retirement enters their planning window after age 45. The decline in consumption is similar in our baseline optimal planning horizon model. Old age consumption declines the least for households who do not experience disutility of planning and choose to plan for the full life-cycle (the $A = 0$ case).

[24]The household's bequest motive reduces, but does not eliminate, the opportunity cost of holding assets at death.

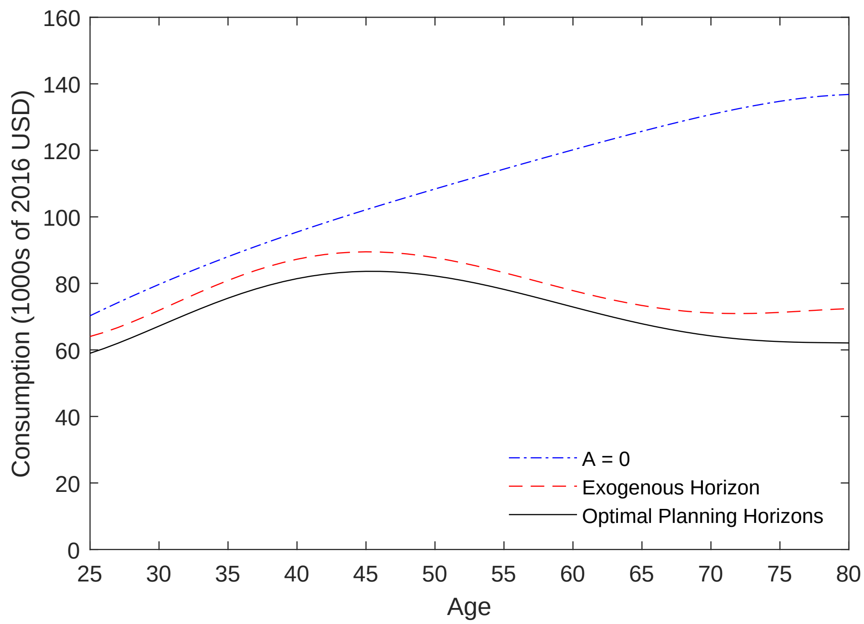


Figure 4: Average consumption over the life-cycle in our baseline model, the case in which the marginal disutility of planning A is set equal to 0, and the case in which households are forced to plan for 20 years each period.

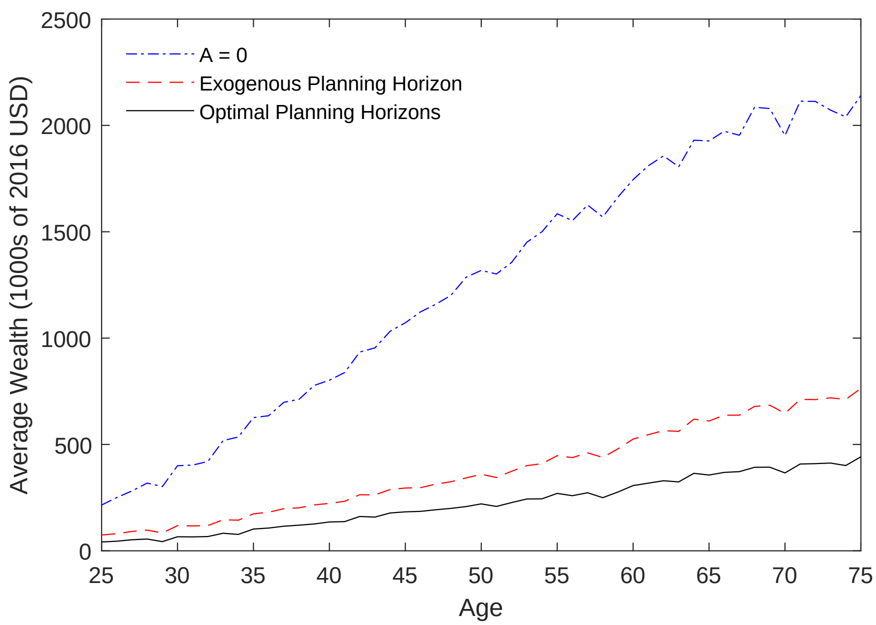


Figure 5: Average wealth over the life-cycle in our baseline model, the case in which the marginal disutility of planning A is set equal to 0, and the case in which households are forced to plan for 20 years each period.

Figure 5 depicts the average wealth profile for households in our baseline model. Initial assets are positive due to inter-generational transfers. Early in life, consumption closely tracks income and, as a result, the household neither saves nor borrows and wealth remains close to it's initial value. It is only once the household reaches their late 30's, and the decline in income prior to retirement enters their optimal planning horizon, that the household begins to save in earnest for retirement. Average wealth then continues to rise throughout the life-cycle, even beyond retirement, due to the presence of a bequest motive and a relatively high degree of wealth inequality (which skews the average wealth higher). Returning to Table 3, we see that median wealth also weakly increases throughout the life-cycle, but tends to level off during retirement.

The average wealth profile for the case in which households are forced to plan for 20 years is broadly similar to that in our baseline model with a few key differences. On average, households in our model choose planning horizons that are less than 20 years, and as result save less than households who exogenously plan for 20 years. For example, households that choose planning horizons of 15 years accumulate fewer assets because they do not include retirement in their planning window until they are age 50, while the households with exogenous 20-year horizons see retirement five years earlier beginning at age 45. In both cases, after age 50, although households include the first part of retirement within their planning horizon, they do not fully internalize how long retirement might last.

When the cost of planning is set equal to zero, households plan for their entire remaining lifetime and, as a result, they begin saving for retirement earlier and hold vastly more wealth at retirement than the average household in our baseline model. Indeed, when A_j is set equal to 0, the average household holds about five times more wealth at retirement than the average household in our baseline model. In this sense, our results suggest that the lack of planning for retirement is a quantitatively important factor in explaining why a large percentage of U.S. households arrive at retirement with little or no financial wealth.

3.4 Planning, Consumption, and Wealth Heterogeneity

Recall that our model economy is comprised of households with three different levels of education and corresponding labor income profiles and income shock parameters (see Table 1 and Figure 1). The average planning horizons selected by households with each education level are presented in Figure 6. College graduates have a steeper income profile when young and, as a result, they select longer planning horizons compared to high school graduates and high school dropouts. This positive relationship between education and planning is consistent with empirical findings reported by Ameriks et al. (2003) and Lusardi (2003), among many others.

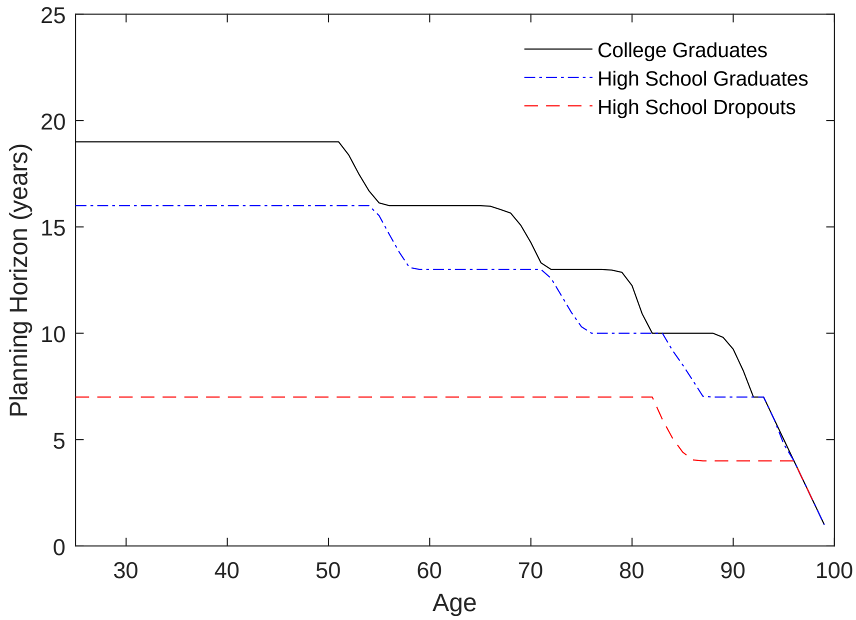


Figure 6: Average planning horizons over the life-cycle by education level in our baseline model.

Differences in planning horizons and income processes lead to differences in patterns of consumption over the life-cycle across education groups as depicted in Figure 7. The level of consumption is higher for households with higher income. The shape of the consumption profiles also differ. In particular, the consumption profile is steeper for college graduates. This is because the income profile is steeper for college graduates and because they choose longer planning horizons when young. Since college graduates include retirement in their planning window at a younger age than their lower income peers, they begin to consume less and save more for retirement at a younger age. In contrast, the income profiles of high school graduates and high school drop outs are both relatively flat, which leads to flatter consumption profiles. Consumption peaks at age 41 for high school dropouts and declines slowly thereafter. Consumption peaks at age 45 for high school graduates. Consumption peaks at age 47 for college graduates, declines until retirement, and then levels off, increasing slightly in old age.

Patterns of wealth accumulation over the life-cycle also differ markedly by education group, as depicted in Figure 8. College graduates receive a larger bequest and enter the model with more assets. They do not save or borrow much until around age 35, when they include the declining portion of their income profile in their planning window and being to accumulate

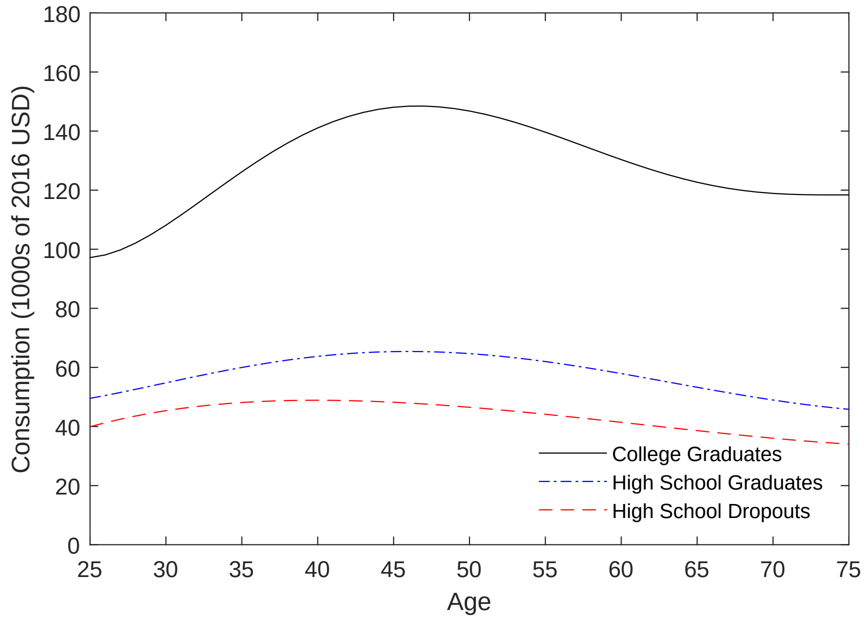


Figure 7: Average consumption over the life-cycle by education level in our baseline model.

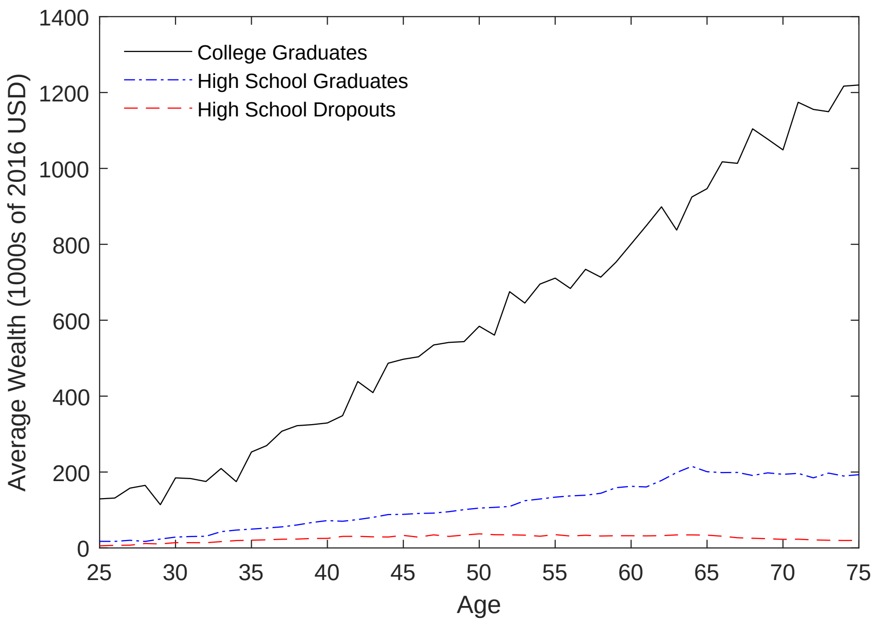


Figure 8: Average wealth over the life-cycle by education level in our baseline model.

assets. Average assets for college graduates continue to rise through retirement and remain elevated due to the presence of a bequest motive which disproportionately impacts high wealth, high income households. High school graduates and high school dropouts begin life with fewer assets and do not begin saving for retirement in a meaningful way until their late 50s when the first few years of retirement have entered their respective planning horizons. Lower income, combined with their decision to delay saving for retirement, leads high school graduates and high school dropouts to arrive at retirement with just 21% and 4%, respectively, of the wealth accumulated by college graduates.

High school graduates and dropouts arrive at retirement with less wealth than college graduates in part due to differences in income. In our model, the average earnings of high school dropouts and graduates are 50% and 41% of college graduates. The dispersion in wealth at retirement is larger than the dispersion in earnings for several life-cycle reasons. The income profile of college graduates declines more steeply in old age compared to high school graduates and dropouts. This incentivizes college graduates to accumulate more assets to smooth their retirement consumption. College graduates also leave larger bequests, as bequests are luxury goods. However, these factors alone do not fully explain the inequality in wealth at retirement in out baseline model. Wealth inequality is also driven in part by differences in planning horizons.

Comparing wealth at retirement by education group across different models illustrates some of the driving forces of wealth accumulation and inequality. Looking at the model with A_j set equal to 0 allows us to identify how much of these wealth differences are due to differences in life-cycle factors, and how much are due to differences in optimal planning horizons. Recall that in the model with A_j set equal to 0, all households plan for their entire remaining lifetime. As a result, differences in wealth at retirement are solely due to differences in life-cycle factors such as income and bequests. In this version of our model, high school graduates and high school dropouts to arrive at retirement with 34% and 18%, respectively, of the wealth accumulated by college graduates.

Looking at the exogenous short planning horizon model allows us to see how much wealth inequality at retirement would exist in the counterfactual setting where all households plan for 20 years. In that case, high school graduates and drop-outs arrive at retirement with 29% and 15% of the wealth of college graduates. The exogenous short planning horizon generates more wealth inequality than life-cycle factors alone.

Our optimal planning horizon model generates the most wealth inequality. Recall that high school graduates and dropouts choose shorter planning horizons than college graduates which amplifies the wealth inequality between groups. In this sense, endogenous planning horizons work to amplify the impact of life-cycle factors on differences in wealth at retirement.

3.5 Welfare Analysis

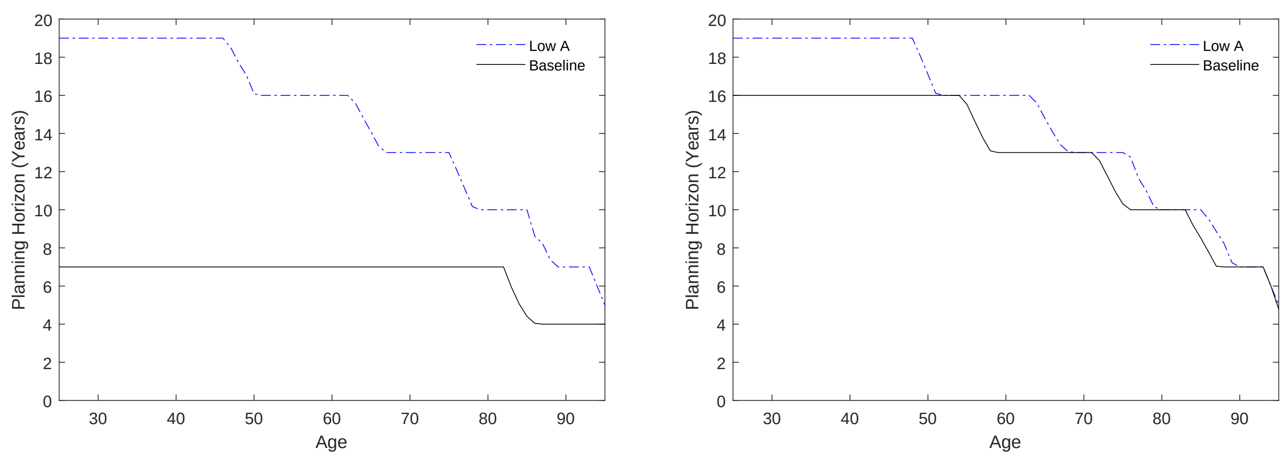
In our baseline model, households without a college degree plan less, accumulate less wealth, and enjoy lower levels of consumption over the life-cycle than their college-educated peers as indicated in Panel A of Table 4. This is due to the fact that households without a college degree both earn less income, on average, and face higher planning costs than their college-educated peers. To explore the role of optimal short planning horizons in contributing to lower lifetime consumption for non-college educated workers, we conduct several counterfactual experiments. First, we use our model to quantify the welfare costs associated with not having a college degree using a standard consumption equivalent–variation (EV) notion. Specifically, we compute the proportional increase in the stochastic optimal consumption profile that would be required to improve the lifetime well-being of the average household in our baseline model by as much as their well-being would increase if they had the same income process and faced the same planning costs as college-educated households. The results of this exercise are reported in Panel C of Table 4 and suggest that high school dropouts and high school graduates would be willing to give up 26.8% and 12.1%, respectively, of their average annual consumption to be college-educated.

Table 4: Planning, Wealth and Consumption by Education

	High School Dropouts (D)	High School Graduates (H)	College Graduates (C)
Panel A: Baseline Model			
Average planning horizon prior to retirement	7.0	15.4	18.1
Wealth at retirement	34.4	215.0	924.7
Average annual consumption	41.2	54.4	126.6
Panel B: Model with $A_j = A_C$, $j = \{D, H, C\}$			
Average planning horizon prior to retirement	17.7	17.9	18.1
Wealth at retirement	137.2	272.1	924.7
Average annual consumption	43.8	55.8	126.6
Panel C: Welfare Costs			
Not being college-educated	26.8%	12.1%	0.0%
Facing higher planning costs	17.3%	6.1%	0.0%
Lower and less smooth consumption only	4.1%	1.7%	0.0%

Average planning horizon is expressed in years. Wealth at retirement is the average wealth of households at age 65 expressed in 1000's of 2016 USD. Average annual consumption is based on households age 25 through 90 expressed in 1000's of 2016 USD. The welfare cost of planning is the proportional increase in (stochastic) consumption that would be utility-equivalent to setting the planning cost equal to that of college-educated households (equivalent-variation). Source: Authors' estimates using calibrated model.

The welfare costs associated with not being college-educated described above and reported in Panel C of Table 4 represent the combined effect of households without a college degree having less income and facing higher planning costs than their college-educated peers. We isolate the effect of facing higher planning costs by solving and simulating our model under the assumption that households without a college degree face the same planning cost as college-educated households (i.e., $A_j = A_C$ for $j = \{D, H, C\}$), but continue to earn lower income, as in the baseline model. The results of this counter-factual simulation are depicted in Figures 9–11 and summarized in Panel B of Table 4. Reducing the planning costs faced by households without a college degree leads to a significant increase in planning, wealth at retirement, and consumption over the life-cycle. The average planning horizon selected by households is still increasing in education, but the disparity between education groups is much smaller.

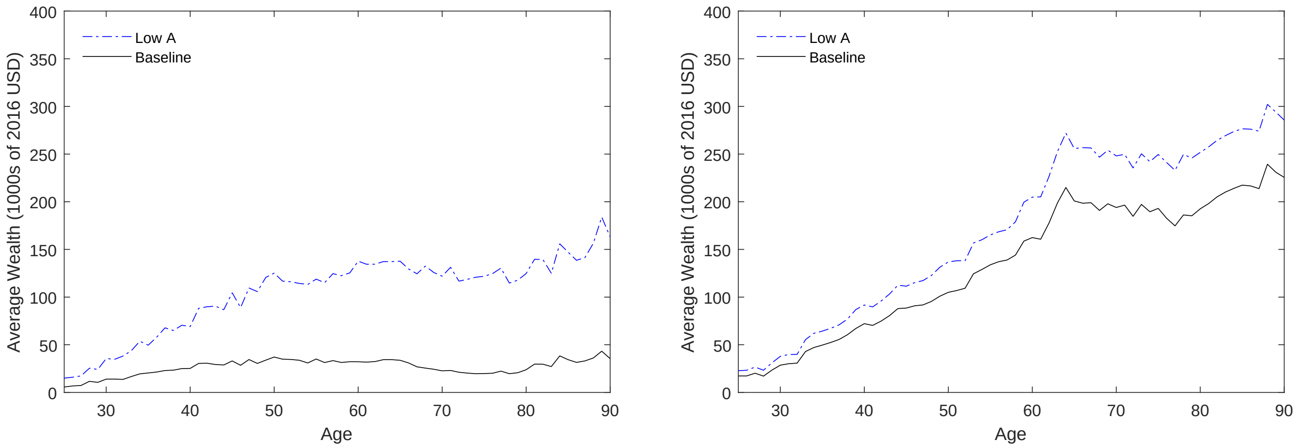


(a) High School Dropouts

(b) High School Graduates

Figure 9: Average planning horizons over the life-cycle by education in our baseline model and in our model with the planning cost set equal to that of college graduates.

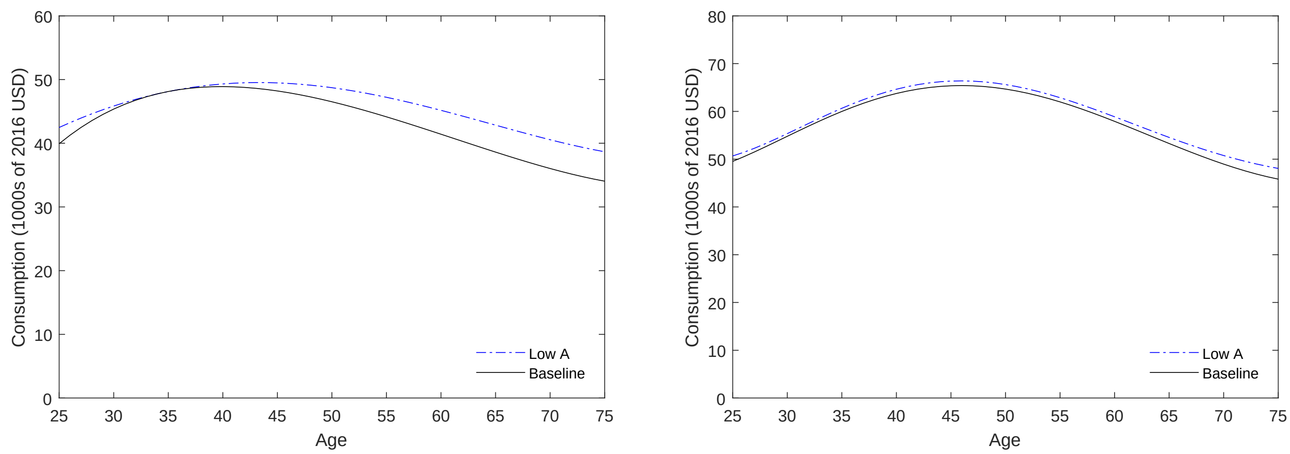
To quantify these effects, we compute the proportional increase in the stochastic optimal consumption profile that would be required to improve the lifetime well-being of the average household in our baseline model by as much as their well-being would increase if their cost to plan was equal to that of college-educated households while leaving their income process unchanged. The results of this exercise are reported in Panel C of Table 4 and suggest that facing higher planning costs accounts for between 50% and 65% of the overall welfare cost of not being college-educated. In other words, facing higher planning costs is at least as important to households without a college degree as having lower income relative to their college-educated peers.



(a) High School Dropouts

(b) High School Graduates

Figure 10: Average wealth over the life-cycle by education in our baseline model and in our model with the planning cost set equal to that of college graduates.



(a) High School Dropouts

(b) High School Graduates

Figure 11: Average consumption over the life-cycle by education in our baseline model and in our model with the planning cost set equal to that of college graduates.

From Figures 9–11, we know that reducing the planning cost that households without a college degree face leads them to plan further into the future and, as a result, realize a higher and smoother consumption profile throughout the life-cycle. While the latter is unambiguously welfare enhancing, the former may either increase or decrease welfare overall depending on the increase in planning relative to the reduction in marginal planning costs. To disentangle the effects of facing a lower planning cost on consumption versus overall planning costs, we again compute the proportional increase in the stochastic optimal consumption profile that would be required to improve the lifetime well-being of the average household in our baseline model by as much as their well-being would increase if their cost to plan was equal to that of college-educated households while leaving their income process unchanged, but this time ignore the disutility of planning when performing our calculations. This allows us to focus solely on measuring the welfare costs resulting from changes in the average consumption profile. The results of this exercise are reported in Panel C of Table 4 and suggest that changes in the average consumption profile account for between 24% and 27% of the total. The implication, of course, is that the increase in planning horizon length is more than offset by the reduction in marginal planning costs, thereby leading to large increases in welfare for households without a college degree.

To briefly summarize our analysis, our model suggests that much of the welfare cost of not being college-educated is due to facing higher planning costs than their college educated peers. In other words, if it were less costly for households without a college degree to plan, they would be much better off.[25] Moreover, only about one-quarter of the effect of facing these higher planning costs is due to realizing a lower and less smooth consumption profile. The majority of the welfare cost, roughly three-quarters or so, is explained by increased disutility of planning for the future.

Our welfare results are broadly consistent with the empirical literature on financial literacy and planning for retirement. Lusardi (2003) summarizes much of the empirical literature and concludes the planning costs "may even be sizable for some households, for example, those with little financial literacy (page 26)." Lusardi and Mitchell (2011) demonstrate that financial literacy is correlated with education and those with higher financial literacy scores are more likely to plan for retirement. In a similar vein, Ameriks et al. (2003) demonstrate that the propensity to plan is linked to wealth accumulation. Finally, Lusardi (2002) demonstrates that efforts to reduce the cost of planning improve retirement preparedness, particularly for those with low education or little wealth. Our theoretical model offers additional support to the idea that reducing the cost to plan could make households better off, particularly those with lower educational attainment.

Households in our baseline model have the option to plan for their entire remaining lifetime each period, as in a standard life-cycle model. However, the average planning horizons depicted in Figure 3 imply that the average household optimally elects to plan for less than

[25] Although it is beyond the scope of this paper, Feigenbaum et al. (2011) demonstrate that is is possible for the utility from consumption in a competitive equilibrium with bounded rationality to be higher than the utility from consumption in the rational competitive equilibrium when general equilibrium feedback effects are considered. Generally, this is possible if the boundedly rational behavior leads to higher savings, which increases the capital stock. Bounded rationality leads to lower savings in our setting. Additionally, we abstract from these general equilibrium feedback effects in our paper.

their remaining lifetime throughout the life-cycle. As a result of employing a short planning horizon, Figure 4 suggests that the average household realizes a consumption profile that is uniformly lower and less smooth than the consumption profile they otherwise would have obtained had they instead planned for their entire remaining lifetime each period, as in a standard life-cycle model. Given that the average household in our baseline model optimally elects not to replicate the planning and consumption paths that arise in a standard life-cycle model, it must be that the welfare cost of realizing a uniformly lower and less smooth consumption profile is more than offset by the increase in planning costs that would be required to plan for their entire remaining lifetime each period. In this section, we use our calibrated model to quantify these utility costs and benefits.

To proceed, we first collect the realized average consumption and planning life-cycle profiles depicted in Figures 3 and 4 for our baseline model and the model in which $A_j = 0$ for $j = \{D, H, C\}$ and denote these by $\{\bar{c}_t^{OP}, \bar{h}_t^{OP}\}_{t=T_0}^{T_M}$ and $\{\bar{c}_t^{PL}, \bar{h}_t^{PL}\}_{t=T_0}^{T_M}$, respectively, where OP stands for "Optimal Planner" and PL stands for "Proper Life-cycler". Next, we compute the present discounted utility from consumption and disutility from planning for each model $k = \{OP, PL\}$ as follows:

$$PV_{uc}^k = \sum_{t=T_0}^{T_M} \beta^{t-T_0} \Psi_t u\left(\bar{c}_t^k\right)$$

$$PV_{pc}^k = \sum_{t=T_0}^{T_M} \beta^{t-T_0} \Psi_t pc\left(\bar{h}_t^k\right).$$

Finally, we use the resulting estimates from the above expressions to compute the following ratio:

$$\frac{PV_{uc}^{PL} - PV_{uc}^{OP}}{PV_{pc}^{OP} - PV_{pc}^{PL}}.$$

The numerator represents the welfare cost incurred by the average optimal planner due to realizing a uniformly lower and less smooth consumption profile than the average proper life-cycler, while the denominator represents the welfare gained by the average optimal planner from choosing a short planning horizon versus planning for their entire remaining lifetime each period like the average proper life-cycler. A ratio equal to one would indicate the welfare cost of lower consumption from an optimal planning horizon is exactly offset by the welfare gain of experience lower disutility of planning. A ratio less than unity would indicate that the welfare gain of lower disuitlity of planning more than offsets the reduction in utility due to lower and less smooth consumption. The resulting value of this ratio is 0.006, which confirms that indeed, the welfare cost of realizing a uniformly lower and less smooth consumption profile is orders of magnitude smaller than the disutility avoided by selecting a short planning horizon rather than planning for their entire remaining lifetime each period.[26]

This result suggests that the implicit planning costs incurred by households in a standard life-cycle model are quite large relative to the utility derived from consumption. Indeed, our estimate of the present discounted disutility from planning PV_{pc}^{PL} is an order of magnitude larger than our estimate of the present discounted utility from consumption PV_{uc}^{PL}. To the extent that our model offers a plausible description of households' actual consumption, saving, and planning behavior, our welfare analysis suggests that it may not be reasonable to assume households are perfectly rational and plan for their entire remaining lifetime each period, as in a standard life-cycle model. Rather our results suggest that if given the choice, households in a standard life-cycle model would elect to use a short planning horizon in light of the relatively high implicit utility cost associated with planning for their entire remaining lifetime each period.

4 Conclusion

We propose an overlapping generations, life-cycle model in which households choose their planning horizon optimally each period. We show theoretically that optimal planning horizons and, by implication, the paths of consumption and wealth over the life-cycle, depend critically on the shape of households' income profile. In a calibrated version of our model, households choose weakly decreasing planning horizons over the life-cycle and avoid planning for retirement until well into their 40s. Average planning horizons in our model are increasing in education and income. As a result, households with higher levels of education and income end up accumulating more wealth at retirement relative to their income, consistent with empirical evidence. Our model is thus able to rationalize the empirical observation that a large number of household fail to plan and save for retirement, and that higher education and higher income households engage in more financial planning which, in turn, allows them to arrive at retirement more well-prepared than their less educated, lower income peers.

In a recent study, Park (2023) examines the interaction between short planning horizons, labor supply, and retirement. She finds that households with an exogenous short planning horizon adjust their labor supply and planned retirement age over the life-cycle as new information enters their planning window. In a related paper, Findley and Caliendo (2015) examine the interaction between saving for retirement and the decision of when to retire in

[26]We show in Appendix C that a similar result holds if we embed our optimal planning horizon mechanism into the exogenous short planning horizon model of Park and Feigenbaum (2018).

a model with hyperbolic discounters. They demonstrate that allowing naive agents to select their retirement date induces them to start saving for retirement earlier than they otherwise would. In future work, it might prove fruitful to study how allowing households to both plan optimally and decide when to retire affects planning and saving for retirement.

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Appendix

A Computational Solution

In our model, we assume that households pay a planning utility cost $pc(h_{i,j,t})$ that is an increasing function of their planning horizon $h_{i,j,t}$ when they *select* a planning horizon. If the household continues following the same plan from an earlier period, they do not experience any additional disutility of planning. However, if the household modifies their planning horizon choice before reaching the end of the previously selected horizon, they pay a marginal cost to adjust their horizon that is equal to the difference between the planning cost of the new horizon and the planning cost of the old horizon choice.

Given these assumptions, at each age, the household chooses to either follow the same plan they established in an earlier period, or they choose to re-optimize and select a different planning horizon. If they choose to re-optimize, they choose a new planning horizon $h_{i,j,t}$ and make a plan for consumption and saving $\{\hat{c}_{i,j,s}(h_{i,j,t}), \hat{b}_{i,j,s+1}(h_{i,j,t})\}_{s=t}^{t+h_{i,j,t}}$, for every age within the planning horizon. If they choose not to modify their planning horizon, they continue to follow the saving consumption plan they established when they selected their planning horizon.

Computationally, we implement this by assuming that the household chooses a planning horizon in *every* period, using a modified period utility function. Specially we assume the household makes decisions based on the period utility function

$$\tilde{u}(c_{i,j,s}, h_{i,j,t}) = \frac{\left(c_{i,j,s}(h_{i,j,t})\right)^{1-\gamma} - 1}{1-\gamma} - \tilde{A}(h_{i,j,t} + t - s), \tag{33}$$

where the subscript s indicates age, and the subscript t denotes time. Note the period utility function includes disutility associated with the planning horizon. The tilde notation $\tilde{u}(.)$ in equation (33) is to clarify that this is not the same utility function as (1) which excluded disutility of planning.

The household chooses their planning horizon and consumption optimally using a two-step process.

Step 1: Optimal Consumption and Saving: At every age t, given their education level j and current assets $b_{i,j,t}$, households choose the plan for consumption and saving, $\{\hat{c}_{i,j,s}(h_{i,j,t}), \hat{b}_{i,j,s+1}(h_{i,j,t})\}_{s=t}^{t+h_{i,j,t}}$, that maximizes their discounted utility realized within a given planning horizon $h_{i,j,t} \in H_t$:

$$\tilde{U}_{i,j,t}(b_{i,j,t};h_{i,j,t}) \equiv \max_{\{\hat{c}_{i,j,s}(h_{i,j,t}),\hat{b}_{i,j,s+1}(h_{i,j,t})\}_{s=t}^{t+h_{i,j,t}}} \sum_{s=t}^{t+h_{i,j,t}-1} \beta^{s-t}\left[\left(\frac{\Psi_s}{\Psi_t}\right)\tilde{u}\left(\hat{c}_{i,j,s}(h_{i,j,t}),h_{i,j,t}\right)\cdots \right. \tag{34}$$

$$\left. +(1-\left(\frac{\Psi_s}{\Psi_t}\right))v(\hat{b}_{i,j,s+1}(h_{i,j,t}))\right]$$

subject to the period budget constraints

$$\hat{c}_{i,j,s}(h_{i,j,t}) + \hat{b}_{i,j,s+1}(h_{i,j,t}) \leq y_{i,j,s} + R\hat{b}_{i,j,s}(h_{i,j,t}), \tag{35}$$

and the borrowing constraints

$$\hat{b}_{i,j,s+1}(h_{i,j,t}) \geq -\sum_{s=t}^{t+h_{i,j,t}-1} \frac{y_{i,j,s}}{R^{s-t}}, \tag{36}$$

for $s = t, ..., t + h_{i,j,t}$. Again, the tilde notation $\tilde{U}$ is to emphasize that equation (34) is not the same as equation (7) which excluded disutility of planning.

The planned consumption and savings path $\{\hat{c}_{i,j,s}(h_{i,j,t}), \hat{b}_{i,j,s+1}(h_{i,j,t})\}_{s=t}^{t+h_{i,j,t}}$ that solves equations 34-36 is identical to the path that solves 7-9 from the main text. The only difference between equations 34-36 and 7-9 is that the maximand in 34 includes disutility of planning $\tilde{A}(h_{i,j,t} + t - s)$ inside $\tilde{u}(.)$. These disuility terms act as a level shift of the maximand 34 compared to 7 and thus the solution to the maximization problem is identical.

Step 2: Optimal Planning Horizon: Each period, household i selects the planning horizon that maximizes their discounted lifetime utility given the corresponding optimal consumption and saving plan $\{\hat{c}_{i,j,s}(h_{i,j,t}), \hat{b}_{i,j,s+1}(h_{i,j,t})\}_{s=t}^{t+h_{i,j,t}}$ and the corresponding planning cost:

$$h^*_{i,j,t}(b_{i,j,t}) = \arg\max_{h_{i,j,t}\in H_t} \tilde{U}_{i,j,t}\big(b_{i,j,t}; h_{i,j,t}\big). \tag{37}$$

Computationally, we find $h^*_{i,j,t}(b_{i,j,t})$ by computing $\tilde{U}_{i,j,t}\big(b_{i,j,t}; h_{i,j,t}\big)$ for each possible horizon and choosing the horizon that maximizes utility.

We find the optimal planning horizon choices and consumption and saving policy rules for every age, education, current asset combination, by iterating backwards from age $t = T$ to age $t = 0$.

A.1 Equivalence of computational approach and main model

In our computational solution, household i optimally chooses a planning horizon $h_{i,j,t}$ over planning horizon $h_{i,j,t}-1$ if

$$\tilde{U}_{i,j,t}\big(b_{i,j,t}; h_{i,j,t-1}\big) > \tilde{U}_{i,j,t}\big(b_{i,j,t}; h_{i,j,t-1}-1\big). \tag{38}$$

If $\tilde{A} = A$, this is identical to the comparison households make the model described in the main text of the paper. Recall, household is only willing to choose a planning horizon $h_{i,j,t}$ over planning horizon $h_{i,j,t}-1$ if

$$U_{i,j,t}\big(b_{i,j,t}; h_{i,j,t}\big) - pc(h_{i,j,t}) > U_{i,j,t}\big(b_{i,j,t}; h_{i,j,t}-1\big) - pc(h_{i,j,t}-1). \tag{39}$$

The comparisons in equations 38 and 39 are identical because $\tilde{U}_{i,j,t}\big(b_{i,j,t}; h_{i,j,t-1}\big) = U_{i,j,t}\big(b_{i,j,t}; h_{i,j,t}\big) - pc(h_{i,j,t})$ if $\tilde{A} = A$ as shown below:

$$\tilde{U}_{i,j,t}\big(b_{i,j,t}; h_{i,j,t-1}\big) \tag{40}$$

$$= \sum_{s=t}^{t+h_{i,j,t}-1} \beta^{s-t}\left[\left(\frac{\Psi_s}{\Psi_t}\right)\tilde{u}\left(\hat{c}_{i,j,s}(h_{i,j,t}), h_{i,j,t}\right) + (1-\left(\frac{\Psi_s}{\Psi_t}\right))v(\hat{b}_{i,j,s+1}(h_{i,j,t}))\right] \tag{41}$$

$$= \sum_{s=t}^{t+h_{i,j,t}-1} \beta^{s-t}\left[\left(\frac{\Psi_s}{\Psi_t}\right)\left(\frac{\left(c_{i,j,s}(h_{i,j,t})\right)^{1-\gamma}-1}{1-\gamma} - \tilde{A}(h_{i,j,t}+t-s)\right) + (1-\left(\frac{\Psi_s}{\Psi_t}\right))v(\hat{b}_{i,j,s+1}(h_{i,j,t}))\right] \tag{42}$$

$$\begin{aligned} &= \sum_{s=t}^{t+h_{i,j,t}-1} \beta^{s-t}\left[\left(\frac{\Psi_s}{\Psi_t}\right)\left(\frac{\left(c_{i,j,s}(h_{i,j,t})\right)^{1-\gamma}-1}{1-\gamma}\right) + (1-\left(\frac{\Psi_s}{\Psi_t}\right))v(\hat{b}_{i,j,s+1}(h_{i,j,t}))\right] \\ &- \sum_{s=t}^{t+h_{i,j,t}-1} \beta^{s-t}\left(\frac{\Psi_s}{\Psi_t}\right)\tilde{A}(h_{i,j,t}+t-s) \end{aligned} \tag{43}$$

$$\begin{aligned} &= \sum_{s=t}^{t+h_{i,j,t}-1} \beta^{s-t}\left[\left(\frac{\Psi_s}{\Psi_t}\right)\left(\frac{\left(c_{i,j,s}(h_{i,j,t})\right)^{1-\gamma}-1}{1-\gamma}\right) + (1-\left(\frac{\Psi_s}{\Psi_t}\right))v(\hat{b}_{i,j,s+1}(h_{i,j,t}))\right] \\ &- \sum_{s=t}^{t+h_{i,j,t}-1} \beta^{s-t}\left(\frac{\Psi_s}{\Psi_t}\right)A(h_{i,j,t}+t-s) \end{aligned} \tag{44}$$

$$= U_{i,j,t}\big(b_{i,j,t}; h_{i,j,t}\big) - pc(h_{i,j,t}). \tag{45}$$

Our computational approach delivers the same optimal consumption, saving, and planning horizon choices as the theory described in the main text because of the particular functional form selected for the planning horizon cost.

B Impact of Borrowing Wedge, Bequest Motive, and Income Risk on Optimal Planning Horizons

The baseline model developed in Section 2 of the main text includes a number of features that are critically important for quantitatively matching patterns of consumption and savings documented in the data, as well as the distribution of wealth across households. In this section, we investigate the degree to which the presence of some of these features, namely the borrowing wedge, bequest motive, and income risk, impact the optimal planning horizons selected by households in our baseline model.

Our baseline model features a borrowing wedge and, as a result, the interest rate on debt r_d exceeds the interest rate on savings r_s. The optimal planning horizons chosen by the average household in our model with the borrowing wedge turned off (i.e., $r_s = r_d = 3.5\%$) are depicted in Figure 12, along with those in our baseline model which has the borrowing wedge turned on (i.e., $r_s = 3.5\%$, $r_d = 8.0\%$). The presence of the borrowing wedge appears to have no discernible impact on the optimal planning horizons chosen by the average household in our model. This is also true when we disaggregate households by education level as shown in Figure 13.

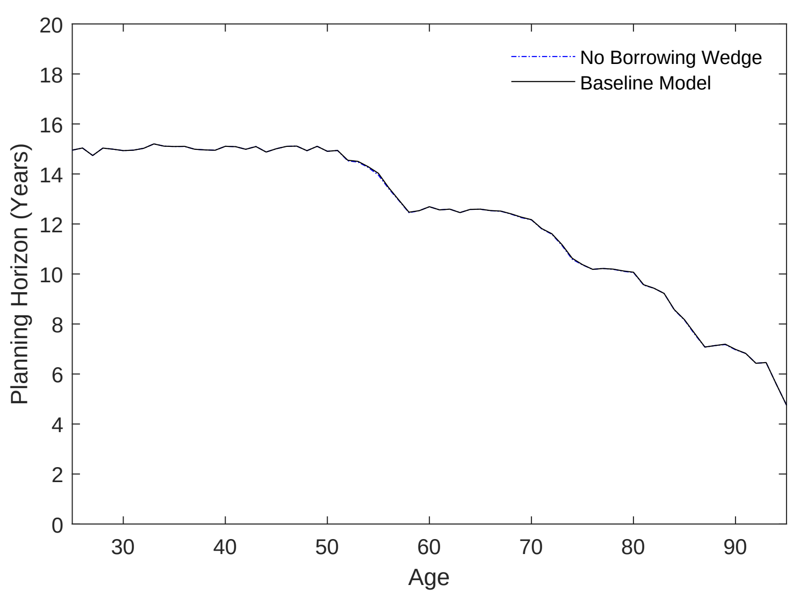
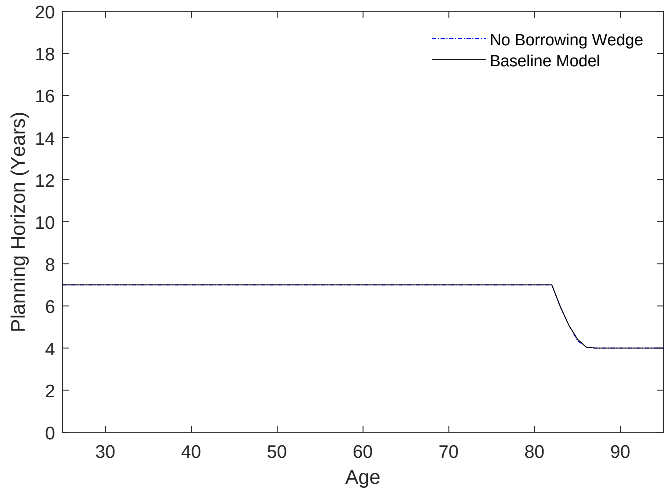
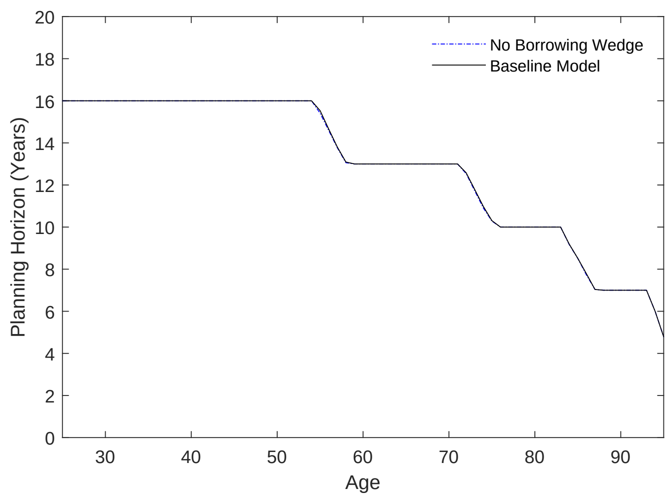


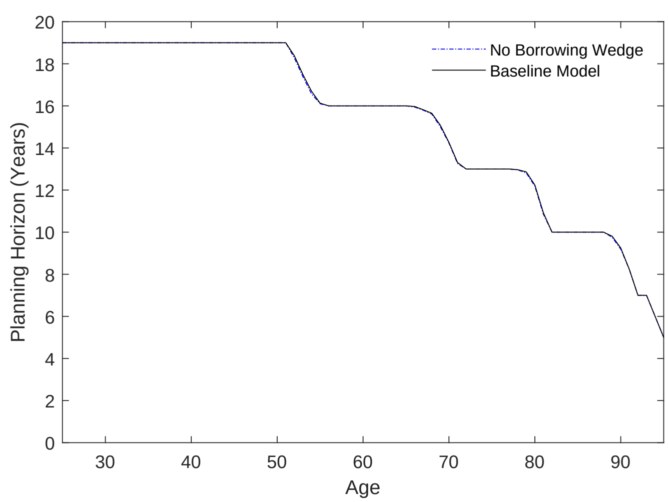
Figure 12: Average planning horizons over the life-cycle in our baseline model and in our baseline model with the borrowing wedge turned off (i.e., $r_s = r_d$).



(a) High School Dropouts



(b) High School Graduates



(c) College Graduates

Figure 13: Average planning horizons over the life-cycle by education in our baseline model and in our model with the borrowing wedge turned off (i.e., $r_s = r_d$).

In our baseline model, households are exposed to education-specific permanent and transitory income shocks prior to retirement, the volatilities of which are denoted by σ_{ξ_j} and σ_{e_j}, respectively, for $j = D, H, C$. The optimal planning horizons chosen by the average household in our model with these income shocks turned off (i.e., $\sigma_{\xi_j} = 0$ and $\sigma_{e_j} = 0$ for $j = D, H, C$) are depicted in Figure 14, along with those in our baseline model which features income risk. The presence of income risk appears to have little, if any, impact on the optimal planning horizons chosen by the average household in our model. This is also true when we disaggregate households by education level as shown in Figure 15.

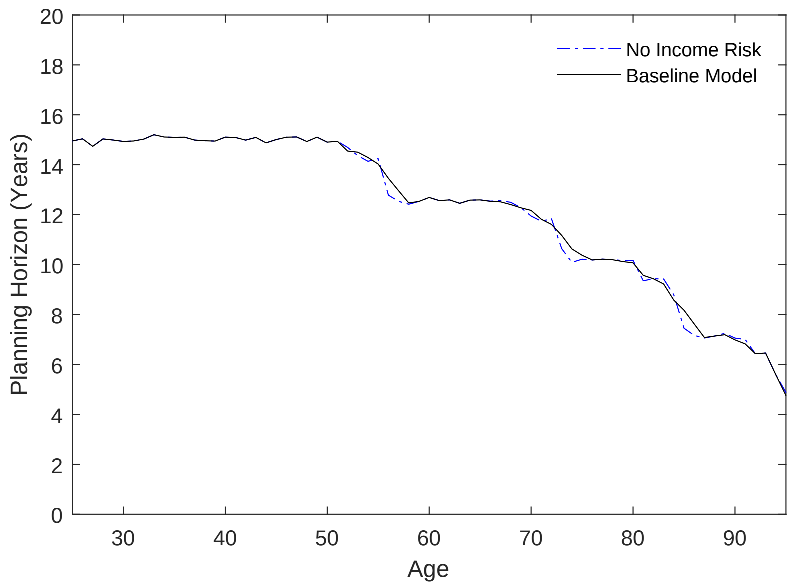
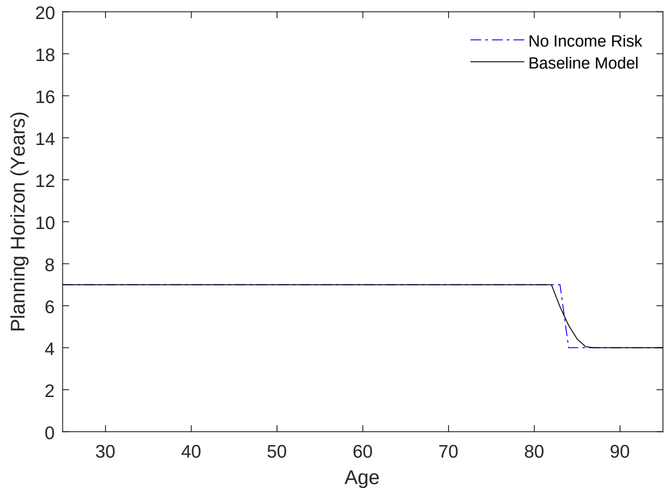
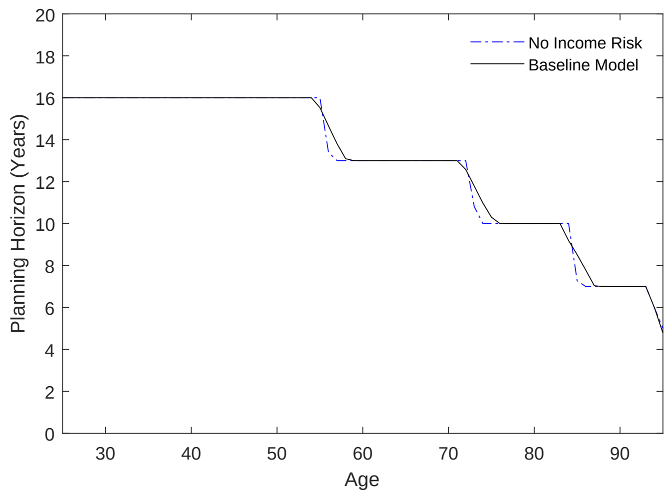


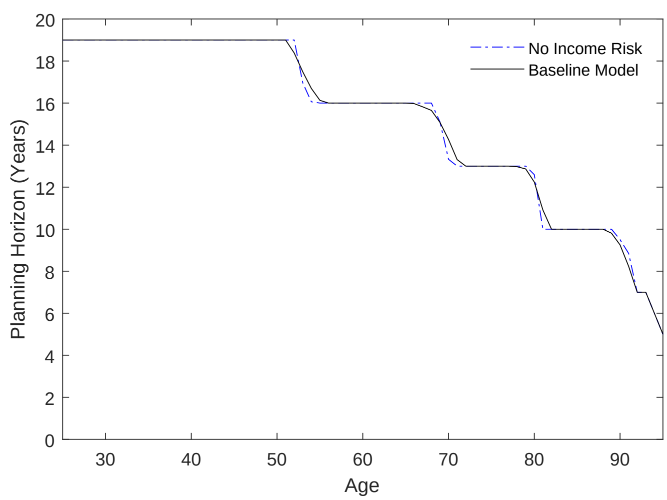
Figure 14: Average planning horizons over the life-cycle in our baseline model and in our model with the volatility of income shocks set equal to zero (i.e., $\sigma_{\xi_j} = 0$ and $\sigma_{e_j} = 0$ for $j = D, H, C$).



(a) High School Dropouts



(b) High School Graduates



(c) College Graduates

Figure 15: Average planning horizons over the life-cycle by education in our baseline model and in our model with the volatility of income shocks set equal to zero (i.e., $\sigma_{\xi_j} = 0$ and $\sigma_{e_j} = 0$ for $j = D, H, C$).

In our baseline model, households have a bequest motive, the strength of which is governed by the parameter ω. The optimal planning horizons chosen by the average household in our model with the bequest motive turned off (i.e., $\omega = 0$) are depicted in Figure 16, along with those in our baseline model. The presence of the bequest motive slightly increases the optimal planning horizons chosen by the average household in our model. When we disaggregate households by education level, as shown in Figure 17, we see that this modest increase in planning horizon length is driven mainly by College Graduates. Given that bequests in our baseline model are a luxury good, and since college graduates have more wealth, on average, than their less educated peers, it makes sense that these same households would respond by planning further into the future when the bequest motive is active since, on average, they derive a higher marginal utility from leaving resources to their descendants.

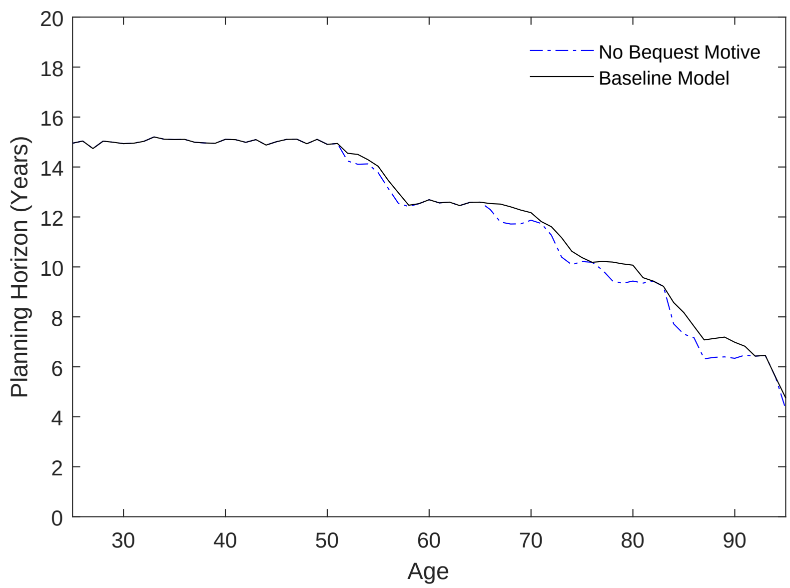
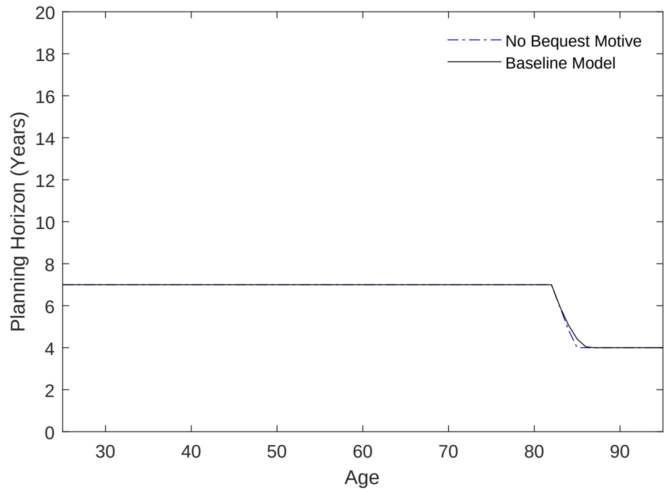
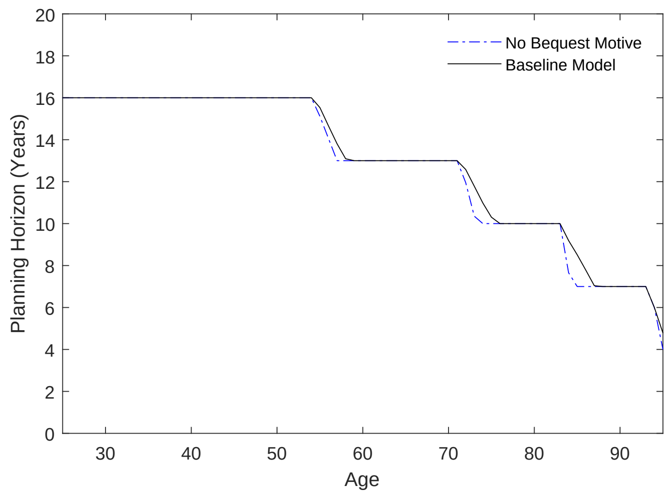


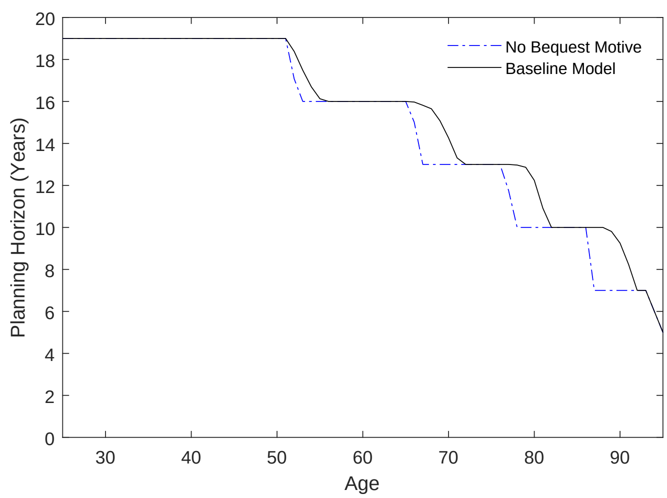
Figure 16: Average planning horizons over the life-cycle in our baseline model and in our model with the bequest motive turned off (i.e., $\omega = 0$).



(a) High School Dropouts



(b) High School Graduates



(c) College Graduates

Figure 17: Average planning horizons over the life-cycle by education in our baseline model and in our model with the bequest motive turned off (i.e., $\omega = 0$).

C Revisiting the Welfare Cost of Planning

In Section 3.5 of the main text, we use our calibrated model to estimate the welfare cost of realizing a uniformly lower and less smooth consumption profile relative to the welfare benefit of optimally choosing to employ a short planning horizon rather than planning for their entire remaining lifetime each period, as in a standard life-cycle model. Our results suggest that the implicit planning costs incurred by households in a standard life-cycle model are quite large relative to the utility derived from consumption.

In this section, we investigate whether this same conclusion holds up in an environment similar to that studied by Park and Feigenbaum (2018). To proceed, we embed our optimal planning horizon mechanism into their general equilibrium model. The only change that we make is to allow the representative household to select their planning horizon optimally each period subject to a constant marginal disutility of planning, as in our baseline model described in the main text. All other features of their model are left unchanged. Park and Feigenbaum (2018) select the length of the household's exogenous planning horizon to match the age at which consumption peaks and the discount factor to match the capital to output ratio. Similarly, we select the marginal disutility of planning to match the age at which consumption peaks and the discount factor to match the capital to output ratio.

Figure 18 compares the life-cycle profiles of consumption, planning, and wealth in a standard life-cycle model to those in the optimal planning horizon version of Park and Feigenbaum (2018) described above. Note that the standard life-cycle model simply corresponds to setting the marginal disutility of planning equal to zero and holding the interest rate and wage constant; we do not solve for a new general equilibrium here since the goal is to repeat the welfare analysis described in the main text in this alternative setting. For comparison purposes only, we have also depicted the life-cycle profile of consumption, planning, and wealth when the planning horizon is set equal to 19 years so that the model matches the age at which consumption peaks and the discount factor is chosen to match the capital to output ratio, as in Park and Feigenbaum (2018).

Next, we collect the realized average consumption and planning life-cycle profiles depicted in Figure 18 for the optimal planning horizon and standard life-cycle models and denote these by $\{\overline{c}_t^{OP}, \overline{h}_t^{OP}\}_{t=T_0}^{T_M}$ and $\{\overline{c}_t^{PL}, \overline{h}_t^{PL}\}_{t=T_0}^{T_M}$, respectively, where OP stands for "Optimal Planner" and PL stands for "Proper Life-cycler". Then, we compute the present discounted utility from consumption and disutility from planning for each model $k = \{OP, PL\}$ as follows:

$$PV_{uc}^{k} = \sum_{t=T_0}^{T_M} \beta^{t-T_0} \Psi_t u\left(\bar{c}_t^k\right)$$

$$PV_{pc}^{k} = \sum_{t=T_0}^{T_M} \beta^{t-T_0} \Psi_t pc\left(\bar{h}_t^k\right)$$

Finally, we use the resulting estimates from the above expressions to compute the following ratio:

$$\frac{PV_{uc}^{PL} - PV_{uc}^{OP}}{PV_{pc}^{OP} - PV_{pc}^{PL}}.$$

The numerator represents the welfare cost incurred by the average optimal planner due to realizing a uniformly lower and less smooth consumption profile than the average proper life-cycler, while the denominator represents the welfare gained by the average optimal planner from choosing a short planning horizon versus planning for their entire remaining lifetime each period like the average proper life-cycler. The resulting value of this ratio is 0.014, which is similar in magnitude to the value of 0.006 arrived at in the main text using our baseline model. Thus, even in an environment closely related to that studied by Park and Feigenbaum (2018), the welfare cost of realizing a uniformly lower and less smooth consumption profile is orders of magnitude smaller than the disutility avoided by selecting a short planning horizon rather than planning for their entire remaining lifetime each period.[27]

This result lends more support to our finding that the implicit planning costs incurred by households in a standard life-cycle model are quite large relative to the utility derived from consumption. Indeed, in this environment, as was true in our baseline model, our estimate of the present discounted disutility from planning PV_{pc}^{PL} is an order of magnitude larger than our estimate of the present discounted utility from consumption PV_{uc}^{PL}. This again suggests that it may not be reasonable to assume households are perfectly rational and plan for their entire remaining lifetime each period, as in a standard life-cycle model.

[27] The caveat being that we perform our welfare analysis, both here and in the main text, in partial equilibrium and therefore abstract from any potential general equilibrium feedback effects.

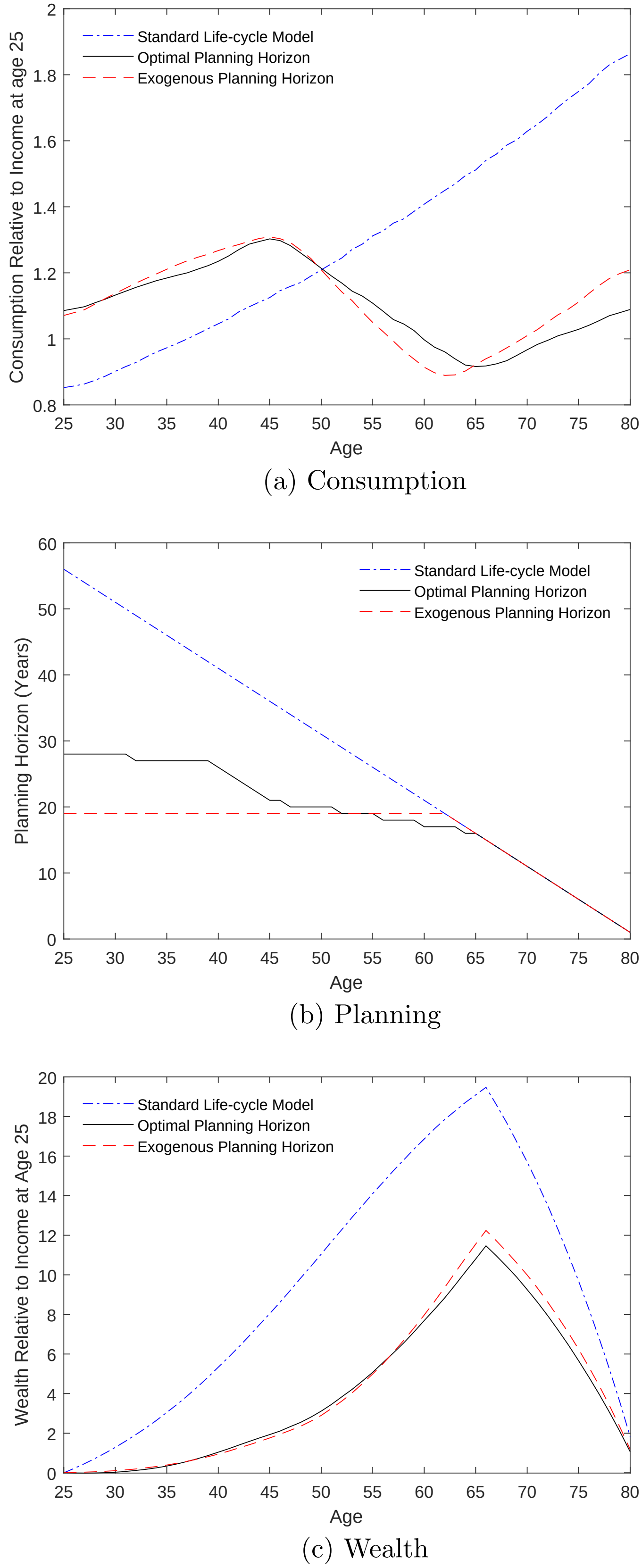


Figure 18: Consumption, planning, and wealth over the life-cycle in standard life-cycle model, exogenous planning horizon model, and optimal planning horizon model, all in an environment comparable to Park and Feigenbaum (2018).