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Time Discounting and Wealth Inequality†

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This paper documents a large association between individuals' time discounting in incentivized experiments and their positions in the real-life wealth distribution derived from Danish high-quality administrative data for a large sample of middle-aged individuals. The association is stable over time, exists through the wealth distribution and remains large after controlling for education, income profile, school grades, initial wealth, parental wealth, credit constraints, demographics, risk preferences, and additional behavioral parameters. Our results suggest that savings behavior is a driver of the observed association between patience and wealth inequality as predicted by standard savings theory. (*JEL* C91, D15, D31, E21)

Why some people are rich while others are poor is of fundamental interest in social science. Standard savings theory predicts that people who place a larger weight on future payoffs will be wealthier throughout the life cycle than more impatient people because of differences in savings behavior. Macroeconomic research suggests that this relationship between time discounting and wealth inequality can be quantitatively important and help explain why wealth inequality greatly exceeds

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income inequality (Krusell and Smith 1998, Quadrini and Ríos-Rull 2015, Carroll et al. 2017). In addition, heterogeneity in time discounting potentially plays an important role in the propagation of business cycles and the effects of stimulus policies because impatient individuals tend to run down wealth and, thereby, have limited opportunities to smooth consumption (Carroll, Slacalek, and Tokuoka 2014; Krueger, Mitman, and Perri 2016).

Rich experimental evidence, from the famous marshmallow experiments measuring delayed gratification in children in the 1960s to recent research on intertemporal choices to reveal discounting behavior of adults, points to pervasive heterogeneity in time discounting across individuals, but without linking this to wealth inequality (Mischel, Shoda, and Rodriguez 1989; Barsky et al. 1997; Frederick, Loewenstein, and O'Donoghue 2002; Harrison, Lau, and Williams 2002; Abdellaoui, Attema, and Bleichrodt 2010; Attema et al. 2010, 2016; Epper, Fehr-Duda, and Bruhin 2011; Andreoni and Sprenger 2012; Sutter et al. 2013; Augenblick, Niederle, and Sprenger 2015; Carvalho, Meier, and Wang 2016; Falk et al. 2018).

Our first main contribution is to document a large association between time discounting of individuals and their positions in the wealth distribution. This relationship between patience and wealth inequality is precisely estimated, stable over time, and exists through the wealth distribution. Secondly, we provide evidence suggesting that differences in savings behavior are a driver of the observed association as predicted by savings theory.

We obtain these results by combining data from preference-elicitation experiments with high-quality administrative data for a large sample of about 3,600 mid-life Danish individuals. We use established incentivized experimental elicitation methods to measure patience, defined as behaviorally revealed time discounting, and other behavioral parameters. The Danish administrative data provide longitudinal information about individuals' real-life wealth and income as well as detailed background information relevant for understanding wealth formation (Leth-Petersen 2010; Boserup, Kopczuk, and Kreiner 2016).

We provide different types of evidence on the association between patience and wealth inequality. We start by dividing the subjects into three equally sized groups according to their level of patience and plot the group averages of their percentile rank positions in the within-cohort wealth distribution from 2001 to 2015.[1] Over this 15-year period, the group average of the most patient individuals is persistently 6–7 percentiles higher in the wealth distribution than the average of the least patient individuals, and the medium patient individuals are, on average, in between the two other groups in the wealth distribution. The stability of the relationship between patience and wealth inequality over such a long period is consistent with the notion that it is shaped by deep and persistent underlying forces rather than income or wealth shocks appearing around the time when patience is elicited.

To assess the importance of the relationship between patience and wealth inequality, we compare it to how much the position in the wealth distribution is correlated with educational attainment and parental wealth. Arguably, educational attainment is one of the most important predictors of lifetime inequality (Huggett, Ventura,

[1] Throughout the paper, when we use the terms wealth rank or wealth position, we always mean the within-cohort percentile rank of individuals.

and Yaron 2011), and parental wealth is known to be one of the strongest predictors of individual wealth (Charles and Hurst 2003). We find that patience is as powerful as education in predicting a person's position in the wealth distribution and one-half as powerful as parental wealth.

We find that the average wealth level of the most patient individuals is DKK 215,000 higher than the average wealth level of the most impatient individuals in middle age, corresponding to about one-half of the median level in the overall wealth distribution.[2] Quantile regressions show that the association between patience and wealth is close to 0 at the bottom of the wealth distribution, consistent with the presence of credit constraints, and increases over the distribution such that the effect at percentile 95 is about three times as large as the average effect.

We show in the context of a simple life-cycle consumption model that patient individuals are wealthier than impatient individuals at all points in the life cycle due to differences in savings behavior.[3] Theoretically, wealth is also determined by permanent income, the timing of income, wealth transfers, initial wealth, and risk preferences. The association between patience and wealth could arise because patience is correlated with these wealth determinants. Identifying the impact of patience on wealth running through savings is a challenge because of the impossibility of randomly assigning preferences to people. We provide suggestive evidence on the role of the savings channel by collecting additional data to comprehensively control for the other wealth determinants. Arguably, the identified association between patience and wealth inequality operates through the savings channel if the analysis is successful in controlling for all other channels. In the baseline specification, including 70 controls motivated by the theory, we find a strongly significant relationship between patience and wealth inequality with an association equal to three-fourths in magnitude of the bivariate relationship. This suggests that the savings channel is a driver of the strong association between patience and wealth inequality.

We also include additional information about preferences and behavior from the experiment. This includes whether individuals are present biased or future biased, whether they make nonmonotonic choices in the experiment, and to what extent they are altruistic. The coefficients on these additional behavioral parameters are all small and insignificant at conventional levels in the wealth rank regressions.[4] The coefficient on patience becomes even larger and stands out when compared to the role of risk attitudes, altruism, and other behavioral parameters.

Theory predicts that relatively impatient people wish to borrow more and that they, therefore, impose a higher risk of being credit constrained on themselves. This potential effect is important for the propagation of business-cycle shocks and the

[2] At the time of the study, the exchange rate was about 6.5 Danish kroner (DKK) per US dollar. We also estimate discount rates structurally using random utility models and study the association between this patience measure and wealth. We find that a one standard deviation higher discount rate implies a decrease in wealth of DKK 38,700–46,900 across the different models.

[3] Note that this unambiguous effect of patience does not apply to the within-cohort variation in consumption, savings, and wealth accumulation even in a basic life-cycle savings model. The reason is that patient individuals consume less than impatient individuals early in life, but consume more later in life.

[4] The insignificance of present bias may reflect that the experiment is not ideal to identify this type of behavior. Individuals have, on average, stationary preferences in our experiment. This is similar to the results in the related convex time budget experiments of Andreoni and Sprenger (2012) and Augenblick, Niederle, and Sprenger (2015). The work by Augenblick, Niederle, and Sprenger (2015) and Andreoni et al. (2018) suggests that present bias is more prevalent in experiments in which individuals make intertemporal choices on "bads" (such as effort).

efficacy of stimulus policy (Carroll, Slacalek, and Tokuoka 2014; Krueger, Mitman, and Perri 2016) and, more generally, for the association between patience and wealth inequality. The association between patience and wealth rank may be muted because constrained individuals with relatively low, yet different, levels of patience are unable to run down wealth further and, therefore, end up with the same low level of wealth. We assess the impact of credit constraints by considering whether individuals have low levels of liquid assets relative to disposable income (e.g., Zeldes 1989; Johnson, Parker, and Souleles 2006; Leth-Petersen 2010). By splitting the sample into those likely and unlikely to be affected by credit constraints, we find the association between patience and wealth percentile rank to be small and insignificant for constrained individuals. In contrast, the association is large and highly significant for individuals unlikely to be affected by constraints. This evidence is consistent with the theoretical insight that the overall association between patience and wealth inequality is muted by credit constraints, and it explains why patience and wealth are unrelated at the bottom of the wealth distribution.

The credit constraint indicator is a crude measure. In reality, people can have differential access to credit and, therefore, effectively face constraints with varying intensity. The relevant slope of the intertemporal budget line is then the interest rate on marginal liquidity. To further account for credit constraints, we use account level data on debt, deposits, and interest payments during the year to measure the interest rate on marginal liquidity faced by the individuals (Kreiner, Lassen, and Leth-Petersen 2019). The slope of the budget line may also vary across savers because some individuals are better at obtaining high returns on financial assets, as indicated by recent evidence (Fagereng et al. forthcoming). Therefore, we also control for historical asset ownership and returns. After controlling for these additional financial variables, the association between patience and wealth inequality is still strong and precisely estimated.

We elicit the individuals' discounting behavior using state-of-the-art money-sooner-or-later choice experiments, which are well suited for large-scale implementation on an internet platform. A potential concern is that the elicited variation in time discounting across individuals may simply reflect variation in market interest rates and credit constraints (Frederick, Loewenstein, and O'Donoghue 2002; Dean and Sautmann forthcoming; Cohen et al. forthcoming) because of arbitrage or, more generally, that the patience-wealth rank association reflects wealth causing patience. Three pieces of evidence suggest that this concern is not critical. First, we find very stable relationships between patience and wealth inequality and between patience and the likelihood of being credit constrained over a 15-year period. This shows that the associations are not driven by short-term shocks or other temporary variation at business-cycle frequency (Dean and Sautmann forthcoming). Second, the strong association between patience and wealth rank remains after we control for market interest rates and credit constraints. This result is consistent with evidence of "narrow bracketing" whereby subjects do not integrate their choices in an experiment into their broader choice set. Recent evidence of narrow bracketing in the context of our experimental task is provided by Andreoni et al. (2018). Third, we exploit survey information about time discounting for a sample of 2,548 subjects from the 1952–1955 cohorts, collected when they were 18–21 years old. When using the crude measure of time discounting in the survey collected 30 years *before* we examine the wealth of the individuals, we also find a quantitatively important and stable relationship between patience and wealth inequality over the period 2001–2015.

Our study relates to the literature in public finance and macroeconomics documenting substantial wealth inequality and trying to understand its causes and consequences. This literature shows that wealth inequality is persistent and considerably larger than income inequality (Piketty and Saez 2014). Work on understanding the driving forces behind wealth inequality has mainly focused on differences across people in income processes, earnings capacity, wealth transfers, capital returns, and public policy (e.g., Heathcote, Storesletten, and Violante 2009; Piketty 2014; Hubmer, Krusell, and Smith 2016; Boserup, Kopczuk, and Kreiner 2016, 2018; De Nardi and Fella 2017; Benhabib, Bisin, and Luo 2017, 2019; Fagereng et al. forthcoming). A smaller literature on wealth inequality has studied the impact of preference heterogeneity in macro models (e.g., Krusell and Smith 1998; Krueger, Mitman, and Perri 2016; Carroll et al. 2017). These studies show that even a limited degree of heterogeneity in time discounting can potentially generate a significant increase in wealth inequality compared to the reference case with homogeneous preferences and that heterogeneous time discounting significantly improves the models' abilities to match the empirically observed wealth distribution. Our contribution relative to this literature is that we measure the actual time discounting of individuals independently and link it to their positions in the real-life wealth distribution. The large association between patience and wealth inequality provides support for models that incorporate heterogeneity in time discounting to explain wealth inequality and, more generally, consumption behavior (e.g., Alan, Browning, and Ejrnæs 2018).

Our paper also contributes to the experimental literature showing that elicited discount rates predict real-life outcomes (Chabris et al. 2008; Meier and Sprenger 2010; Lawless, Drichoutis, and Nayga 2013; Sutter et al. 2013; Backes-Gellner et al. 2018). Our study has the advantage that it is the first to combine data from a fully incentivized experiment with detailed, longitudinal register data on real-life outcomes for a large sample of individuals. This enables us to provide the new, compelling evidence on the relationship between patience and wealth inequality.

The next section derives theoretically the association between patience and wealth inequality within the context of a basic savings model. Section II presents the sampling scheme, the experimental design, and the register data. Section III presents the empirical results and Section IV features different robustness checks. Section V concludes.

I. Association between Time Discounting and Wealth Inequality in Theory

This section illustrates in a basic deterministic life-cycle savings model how heterogeneity in subjective discounting generates differences in savings behavior leading to permanent differences in wealth levels across individuals at all ages. It also points to other wealth determinants that might be correlated with individual discount rates. In the empirical analysis, we include controls for these other determinants in an attempt to isolate the effect operating through the savings channel.

Consider an individual choosing spending $c(a)$ over the life cycle $a \in (0,T)$ so as to maximize the discounted utility

$$U = \int_0^T e^{-\rho a} u\big(c(a)\big)\, da, \quad u\big(c(a)\big) \equiv \frac{c(a)^{1-\theta}}{1-\theta}, \tag{1}$$

where $u(\cdot)$ is instantaneous utility, θ is the coefficient of relative risk aversion (CRRA), and ρ is the rate of time preference. The flow budget constraint is

$$\dot{w}(a) = rw(a) + y(a) - c(a), \tag{2}$$

where $w(a)$ is wealth, $y(a)$ is income excluding capital income, and r is the market interest rate yielding capital income $rw(a)$. Utility (1) is maximized subject to the budget constraint (2), a given level of initial wealth $w(0)$ and the No Ponzi game condition, $w(T) \geq 0$. The solution is characterized by a standard Euler equation/Keynes-Ramsey rule, which may be used together with the budget constraint to derive the following closed-form wealth equation (see online Appendix A):

$$w(a) = Y\left(\gamma(a) - \frac{1 - e^{\frac{r(1-\theta)-\rho}{\theta}a}}{1 - e^{\frac{r(1-\theta)-\rho}{\theta}T}}\right)e^{ra}, \tag{3}$$

where Y is lifetime resources equal to the present value of income over the life cycle plus initial wealth, while $\gamma(a)$ is the share of lifetime resources received by the individual up to age a:

$$Y \equiv \int_0^T y(a)\, e^{-ra}\, da + w(0), \quad \gamma(a) \equiv \frac{\int_0^a y(\tau)\, e^{-r\tau}\, d\tau + w(0)}{Y}.$$

Wealth may both increase or decrease when going through the life cycle (higher a), and wealth may also be negative throughout the life cycle. The wealth equation (3) leads to the following prediction (see online Appendix A for a proof).

PREDICTION 1: *Differences in time discounting across people* (ρ) *generate differences in savings behavior* $(c(a)$ *profiles*$)$ *that generate inequality in wealth* $($*cross-sectional variation in* $w(a))$, *with patient people having more wealth at all points in the life cycle* (a) *conditional on the other wealth determinants* $(Y, \gamma(a), T, \theta)$.

This shows that the savings channel generates a positive association between patience and wealth at *all ages*. Note that the effect of patience on consumption and savings is ambiguous because patient individuals consume less than impatient individuals early in life, but consume more later in life.[5]

[5] Note also that the CRRA parameter has ambiguous effects on wealth. A higher θ reduces wealth if $r > \rho$ and increases wealth if $r < \rho$. Intuitively, a higher θ implies a stronger preference for consumption smoothing, which flattens the consumption profile. If the initial consumption profile is increasing (decreasing), occurring when $r > \rho$ $(r < \rho)$, then this increases (decreases) consumption in the first part of life leading to lower (higher) wealth over the life cycle.

Patience may also be correlated with the other wealth determinants. If, for example, patient individuals attain higher education levels and, therefore, higher permanent income Y, then this creates a positive relationship between patience and wealth beyond the savings mechanism. On the other hand, more education would normally also imply a steeper income profile, which in isolation reduces the level of wealth at all ages (due to lower values of $\gamma(a)$ in equation (3)). In the empirical analysis, we include a large set of controls for other wealth determinants in an attempt to isolate the relationship between patience and wealth running through the savings channel.

In the simple model, individuals borrow and lend at the market interest rate r. In reality, the slope of the budget constraint may also vary with patience. For example, a large literature has theoretically and empirically examined the role of credit constraints for savings behavior (Zeldes 1989; Leth-Petersen 2010; Krueger, Mitman, and Perri 2016). For illustration, consider the case where borrowing is possible only up to a certain limit. This credit constraint becomes binding for the most impatient individuals who wish to run down wealth further, but, conditional on being constrained, wealth does not vary with patience. In the empirical analysis, we use different measures of credit constraints to examine whether impatient individuals are more likely to be constrained, and we analyze whether time discounting is associated with wealth inequality after controlling for credit constraints and other factors measuring the slope of the budget constraint.

II. Experimental Design, Sample, and Data

Our empirical analysis combines experimental data and administrative register data linked together using social security numbers (Epper et al. 2020). This section describes the sampling scheme, the design and implementation of the experiment, and the register data.

A. *Sample and Recruitment for the Experiment*

Respondents were recruited by sampling individuals from the Danish population register satisfying the criteria that they were born in the period 1973–1983 and resided in the municipality of Copenhagen (which is the largest municipality in Denmark and includes the capital city) when they were seven years old. For people in mid-life, the timing of education and retirement should have the least influence on the wealth ranking compared to other phases of life and income is arguably a good proxy for permanent income (Haider and Solon 2006). A total of 27,613 individuals received a personal invitation letter in hard copy from the University of Copenhagen. The letter invites them to participate in the online experiment taking place in February 2015. The letter informs subjects about a unique username and password needed to log in to a website, the expected time to complete the experiment, the possibility of earning money in the experiment, and contact information for support (an English translation of the letter is available in online Appendix Section B.1). The analysis includes the 3,620 of the invitees, who successfully completed the experiment on the experimental platform and received a payment (13 percent of all invitees).[6] Participation rates at this level are common for similar experimental studies (e.g., Andersson et al. 2016 reports 11 percent). Sections IIC and IV analyze selection into the experiment.

The online experiment includes three preference elicitation tasks to measure time, risk, and social preferences. Each task is accompanied by short video instructions and comprehension questions. The three blocks appear in an individualized random order and, within each block, the set of choice situations is once again randomized. The elicitation tasks involve real monetary incentives. We use an experimental currency and inform the participants that 100 points correspond to DKK 25 in real money (US\$1 $\simeq$ DKK 6.5 at the time of the study). At the end of the experiment, the subject spins a wheel displayed on the screen in order to determine the choice situation relevant for payment. The random choice situation where the wheel stops is then displayed together with the subject's decision, and the points are exchanged into money. Payment is done via a direct bank transfer at the relevant date (details follow below). The possible payments considering all three tasks ranged from DKK 88 to 418. The average amount paid out was DKK 245.

B. *Measurement of Patience and Other Behavioral Parameters*

We use a state-of-the art experimental procedure to elicit patience, which is based on convex time budgets (Andreoni and Sprenger 2012).[7] In the experiment, subjects face a total of 15 independent budget allocation tasks that differ in terms of payment dates and interest payments. Each one of these tasks is displayed graphically on a separate screen.

Figure 1 depicts a screenshot of a typical allocation task. At the beginning of each choice situation, each subject is endowed with a budget of ten 100-point blocks. These ten blocks are allocated to the earlier of the two payment dates (8 weeks in Figure 1). The subject then has the possibility to move some or all of the ten blocks to the later date (16 weeks in Figure 1). When shifting a block into the future, the subject is compensated by a (situation-specific) interest payment. That is, each 100-point block's value increases once it is deferred to the later point in time. In the example depicted in the figure, each block allocated at the later point in time has a value of 105 points. The subject thus has to decide how many of the ten blocks to keep for earlier receipt and how many of the blocks to postpone for later receipt. In this example, the subject chooses to allocate four 100-point blocks for receipt in 8 weeks, and to save the remaining six 100-point blocks for receipt in 16 weeks. Deferring the receipt of six blocks leads to a total interest payment of $6 \times 5 = 30$ points. Choices are made by clicking on the respective block, after which a horizontal bar appears that can be moved up and down, or by using the keyboard.

[6] We also excluded 97 respondents without the required register data information (typically immigrants) or stating gender and/or year of birth that did not match the register data.

[7] We use money-sooner-or-later experiments because they are well suited for large-scale implementation on an internet platform. The experimental literature has also used experiments with real effort to elicit discounting behavior because they appear better able to measure present bias compared to convex time budget experiments (Augenblick, Niederle, and Sprenger 2015; Augenblick and Rabin 2019). More recently, Andreoni et al. (2018) shows that a sizable present bias also occurs if subjects allocate "bads," i.e., payments to the experimenter, in a convex time budget task, which suggests that it is not the convex time budget method per se that makes the detection of present bias difficult, but the framing of the task.

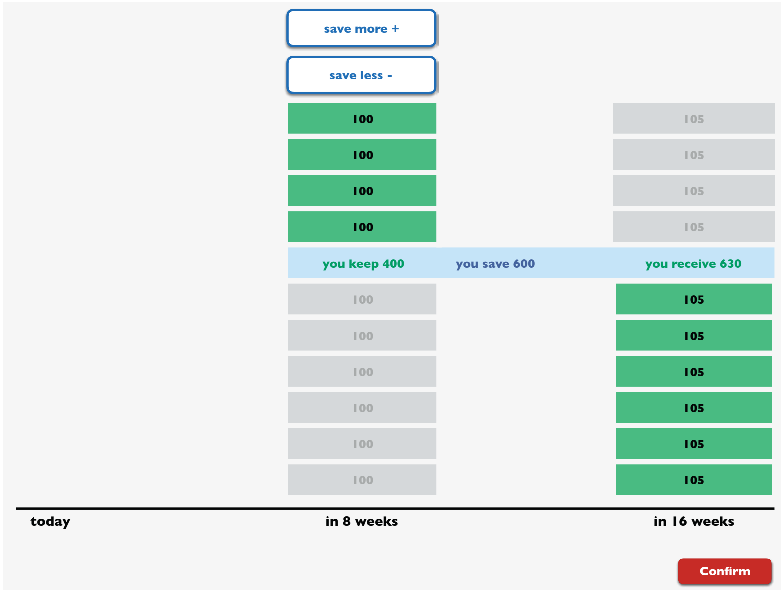

Figure 1. Example of a Choice Situation

Notes: The figure shows a screenshot of a typical choice situation. Each subject is endowed with ten colored 100-point blocks to be received in 8 weeks. The subject can move some or all of the ten blocks to be received in 16 weeks. Each block allocated at the later point in time has a value of 105 points. In the example, the subject chooses to allocate four 100-point blocks for receipt in 8 weeks, and save the remaining six 100-point blocks for receipt in 16 weeks. To avoid status quo bias, the user interface is designed such that the subject has to make an active choice. The subject is only able to confirm the decision and move on after actively choosing one of the allocations.

The choice situations involve three different payment dates, "today," "in 8 weeks," and "in 16 weeks," with combinations of all three payment dates (details are provided in online Appendix Section B.2). The compiled list of transactions are sent electronically to a bank for implementation of the payout. Subjects know that the payment is initiated either on the same day, or exactly 8 or 16 weeks later. Hence, the payment dates displayed on the screen refer to the points in time where the transactions are actually initiated. It takes one day to transfer the money to the subject's *NemKonto*, which is a publicly registered bank account that every Danish citizen possesses and which is typically used as the salary account (using this account implies that participants do not have to provide account information).

The applied interest rates vary across choice situations. For example, the five choice situations asking subjects to choose between receiving payments in 8 weeks or 16 weeks have rates of return in the interval 5–25 percent (amounting to annualized interest rates in the range of 32–145 percent). This range of offered interest rates is similar to those used in other studies. In online Appendix Section B.3, we show that the distribution of choices made by the participants in our internet experiment is very similar to the choice distribution in the original convex time budget study of Andreoni and Sprenger (2012) based on a lab experiment with students. We also display the distributions of structurally estimated individual discount rates based on four different specifications of a random utility model in online Appendix Section B.3. The distributions and individual ordering of the discount rates are very similar, with an average annual discount rate in the range 39 to 51 percent across the different models. This is in line with the previous literature, surveyed by Frederick, Loewenstein, and O'Donoghue (2002) and Cohen et al. (forthcoming). In our main analysis, we focus on the relationship between individuals' positions in the elicited patience distribution and their positions in the wealth distribution. This relationship is insensitive to the overall level of discounting and is robust to changes in the discount rates as long as the ordering of discount rates across individuals is unchanged.

We use a simple patience index based on the arithmetic mean of blocks saved for later receipt to measure an individual's degree of patience. This index is based on the five intertemporal choice situations with allocations between $t_1 = 8$ weeks and $t_2 = 16$ weeks:

$$\phi_{patience} = \text{mean}\left(\frac{z_1}{10}, \ldots, \frac{z_5}{10}\right), \tag{4}$$

where z_i denotes the number of blocks saved in situation i, and where we divide each choice by the total number of blocks so that $\phi_{patience} \in [0,1]$. We interpret this as an indicator of long-run discounting with higher values of $\phi_{patience}$ reflecting greater patience. Due to the discreteness of our measures (10 blocks to allocate in each of the 5 choice situations), our index can take values in steps of $1/50$.

For the patience measure defined in (4), censoring occurs at both ends of the scale by construction, making it impossible to detect lower and higher discount rates than those offered in the experiment. Figure 2 depicts the cumulative distribution of this patience index. It reveals substantial heterogeneity across the individuals in the sample with the exception of the top end of the distribution where 19 percent of the individuals saved all blocks in all five choice situations. Figure 2 also shows tertile cutoff points, which we use to split individuals into high, medium, and low patience groups in order to be able to illustrate the differences in outcomes across these groups graphically. As discussed further in Section IVB, our key results are robust to using other ways of measuring patience with the experimental data, e.g., using patience as measured by the allocations between $t_1 = 0$ weeks and $t_2 = 8$ or 16 weeks.

Individuals with the same long-run discount rate may accumulate different wealth levels because some individuals are present biased or have other nonconstant discounting behavior (Angeletos et al. 2001). To analyze the role of nonconstant discounting, we compute the difference in savings choices between 0–8 weeks (short run) and 8–16 weeks (long run) for each of the five interest rates offered in the experiment and take the average of these differences for each individual. According to this measure, individuals have, on average, stationary preferences. About one-third of the individuals display no bias, a little less than one-third save more in the long-run decisions than in the short-run decisions (present biased), and a little more than one-third save more in the short-run decisions than in the long-run decisions (future biased).[8] We include this information in the empirical analysis.

The distribution of individuals' differences between short-run and long-run decisions is bell-shaped around 0 (see online Appendix Section B.4) suggesting that

[8] Our finding of no systematic present bias based on the nonparametric measure is confirmed when we estimate structural β-δ models, cf. online Appendix Section B.3.

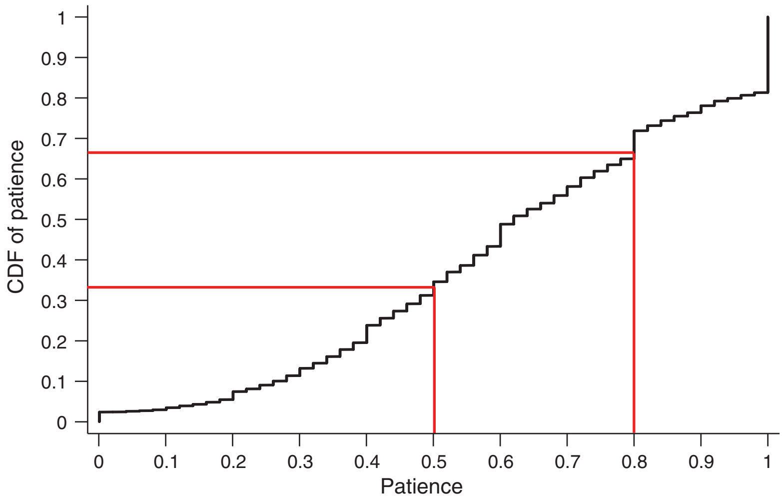

Figure 2. Distribution of the Patience Index

Notes: The figure shows the cumulative distribution of the patience index computed from expression (4) using the experimental data with allocations between $t_1 = 8$ weeks and $t_2 = 16$ weeks. The vertical lines indicate tertile cutoff points.

this measure could reflect choice errors in the experiment rather than systematic behavioral biases. Choi et al. (2014) documents a correlation between choice inconsistencies and savings. In the empirical analysis, we therefore also include an indicator variable for individuals who violate monotonicity by saving more in a choice situation offering a low interest rate compared to a similar choice situation offering a high interest rate.

In some of the analyses, we include information about individuals' risk aversion and altruism elicited in the experiment. The types of tasks involved in the elicitation of these measures and the visualization on the screen were made as similar as possible to the ones used for elicitation of patience, resulting in a risk aversion index and an altruism index going from 0 to 1, as in the case of patience. Online Appendix Sections B.5 and B.6 provide additional information about the elicitation of risk aversion and altruism.

C. *Register Data Information on Wealth and Other Characteristics*

The choice data from the experiment are linked at the individual level with administrative register data at Statistics Denmark. The register data contain demographic characteristics and longitudinal information about annual income and values of assets and liabilities at the end of each year for each individual.[9] The income and wealth information is based on third-party reports to the Danish tax authorities who use them for tax assessment and selection for audit (Kleven et al. 2011). For instance, employers report earnings, government institutions report transfer

[9] In online Appendix Section D.2, we show that results are unchanged when we consider household-level wealth.

payments, and banks, mortgage institutions, mutual funds, and pension companies report values of assets and liabilities. The value of assets includes bank deposits, market value of listed stocks, bonds and mortgage deeds in deposit, and value of property assessed by the tax authorities using land and real estate registries. The value of liabilities includes all debt except debt to private persons. The data contain information about adult individuals (age ≥ 18) over the period 1980–2015. Wealth accumulated in pension accounts and estimated car values are available as of 2014. Our results are robust to the inclusion of these components: see the robustness analysis in Section IVB.

The Danish wealth data have been used previously for research on wealth inequality (Boserup, Kopczuk, and Kreiner 2016), retirement savings (Chetty et al. 2014a), impact of credit constraints (Leth-Petersen 2010; Kreiner, Lassen, and Leth-Petersen 2019), effects of wealth taxation (Jakobsen et al. forthcoming), and accuracy of survey responses (Browning and Leth-Petersen 2003; Kreiner, Lassen, and Leth-Petersen 2015). Wealth inequality has been reasonably stable in Denmark over the 35-year observation period, with the top 10 percent richest owning between 50 and 80 percent of wealth depending on the definition of wealth and the sample considered (Boserup, Kopczuk, and Kreiner 2016; Jakobsen et al. forthcoming).

Table 1 provides summary statistics for our respondents (column 1) and compares their characteristics to those of a 10 percent random sample of the full population of this age group (columns 2–3).[10] The respondents' median wealth level is somewhat higher than the median of their annual gross income, while the variance of wealth is considerably higher. People in the bottom 10 percent of the distribution have negative net wealth. Percentile 95 of the wealth distribution is about five times the median. The corresponding ratio for the income distribution is less than two, showing that wealth is more unequally distributed than income. The respondents are slightly more likely to have children and are slightly more educated compared to the random sample. The distributions of income and wealth are statistically significantly different from the random sample, but the differences are not large. For example, the differences in the median levels of income and wealth are 6–7 percent. Income is slightly higher for the respondents throughout the income distribution, while the wealth distribution of respondents is somewhat more dispersed. Section IV provides evidence suggesting that our main results are not very sensitive to the differences in sample composition shown in Table 1.

III. Empirical Results

We start this section by presenting evidence on the overall association between time discounting and wealth inequality. Informed by basic savings theory, we then introduce a large number of control variables in an attempt to isolate an association between patience and wealth inequality operating through the savings channel. We also analyze the role of present bias, risk preferences, and altruism elicited in the

[10] The differences in the table between the sample of respondents and the 10 percent random sample consist of differences between respondents and nonrespondents as well as differences between the individuals invited for the experiment and the population. Respondents and nonrespondents are compared in online Appendix Section B.7.

TABLE 1—MEANS OF SELECTED CHARACTERISTICS: RESPONDENTS VERSUS 10 PERCENT OF THE POPULATION

	Respondents (1)	Population (2)	(1) − (2) (3)	
Age	37.32	37.31	0.01	(0.82)
Woman (= 1)	0.50	0.50	−0.01	(0.44)
Single (= 1)	0.28	0.28	−0.01	(0.23)
Dependent children (= 1)	0.70	0.68	0.02	(0.00)
Years of education	14.90	14.70	0.20	(0.00)
Gross income distribution				
5th percentile	135,745	113,992	21,753	
25th percentile	287,472	263,532	23,941	
50th percentile	382,997	355,896	27,101	(0.00)
75th percentile	484,463	453,367	31,096	
95th percentile	719,754	698,786	20,968	
Wealth distribution				
5th percentile	−337,615	−234,125	−103,490	
25th percentile	93,899	124,101	−30,202	
50th percentile	486,006	458,345	27,661	(0.00)
75th percentile	1,066,468	947,205	119,263	
95th percentile	2,395,664	2,215,063	180,601	
Observations	3,620	70,756	74,376	

Notes: Variables are based on 2015 values. The random 10 percent sample of the Danish population is drawn from individuals born in the same period (1973–1983) and not included in the gross sample. *p*-values from unconditional *t*-tests of equality of means in parentheses. The reported *p*-values for the gross income distribution and the wealth distribution are from two-sample Kolmogorov-Smirnov tests for equality of distribution functions. (= 1) indicates a dummy variable taking the value 1 for individuals who satisfy the description given by the variable name. Wealth denotes the value of real estate, deposits, stocks, bonds, mortgage deeds in deposit, cars, and pension accounts minus all debt except debt to private persons. The tax assessed values of housing is adjusted by the average ratio of market prices to tax assessed values among traded houses of the same property class and in the same location and price range. Gross income refers to annual income and excludes capital income. Wealth and income are measured in Danish kroner (DKK). The table includes individuals for whom a full set of register variables is available.

experiment. Finally, we analyze the role of credit constraints using administrative data with detailed financial information at the individual level.

A. *Association between Time Discounting and Wealth Inequality*

Figure 3 presents graphical evidence of the association between the elicited time discounting of the individuals and their positions in the wealth distribution, measured by the individual's percentile rank in the within cohort $\times$ time distribution of the sample (e.g., Chetty et al. 2014b). This measure has several advantages: by construction it controls for life-cycle and time trends in wealth; it works well with zero and negative values that are common in wealth data; and it is robust to outliers and unaffected by monotone transformations of the underlying data. In panel A of Figure 3, we split the sample into three equally sized groups according to the degree of patience in the experiment and plot the average position in the wealth distribution of each group of individuals over the period 2001–2015. The group average of the most patient individuals is persistently at the highest position in the wealth distribution, followed by the group with medium patience, and with the most impatient individuals on average attaining the lowest position in the wealth distribution. The difference between the most patient group and the most impatient group is about 6–7 wealth percentiles throughout the 15-year period spanned by the data. This stability

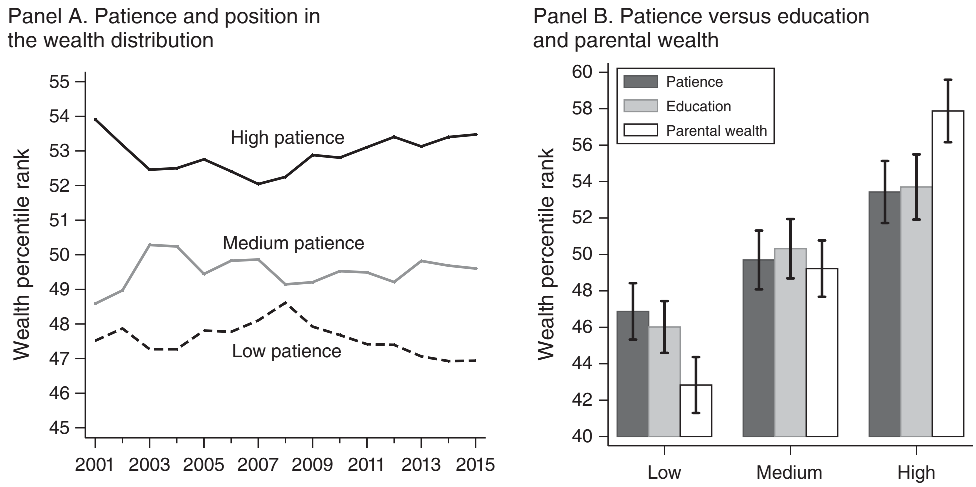

Figure 3. Association between Time Discounting and Wealth Inequality

Notes: Panel A shows the association between elicited patience and the position in the wealth distribution in the period 2001–2015. The position in the distribution is computed as the within cohort × time percentile rank. The sample is split into three equally sized groups according to the tertiles of the patience measure such that *High patience* includes the 33 percent most patient individuals in the sample, *Low patience* the 33 percent most impatient individuals, and *Medium patience* the group in between the *High patience* and *Low patience* groups. Cutoffs for the patience groups are: Low $[0.0, 0.5]$; Medium $[0.5, 0.8]$; High $[0.8, 1.0]$. Panel B compares the patience-wealth association to the education-wealth association and to the parental wealth-wealth association. The subject's wealth and educational attainment are measured in 2015, where educational attainment equals years of completed education. Parental wealth is measured when the subject was 18 years old. The individuals in the sample are split into three equally sized groups according to patience, years of education, and parents' position in their wealth distribution, respectively. Cutoffs for the education groups (years) are: Low $[8, 14]$; Medium $[14, 16.5]$; High $[16.5, 21]$ where the numbers refer to years of completed education. Whiskers represent 95 percent confidence intervals.

of the association between patience and position in the wealth distribution shows that it is not driven by wealth shocks appearing around the same time as patience is elicited and that the relationship persists beyond temporary variations in wealth at business-cycle frequencies.

To assess the magnitude of the association between patience and wealth inequality, we compare it to the association between educational attainment levels and wealth inequality. Huggett, Ventura, and Yaron (2011) argues that educational attainment is one of the most important factors contributing to lifetime inequality. Panel B of Figure 3 splits the sample into three equally sized groups according to educational attainment as measured by the number of years of completed education, which range from 8 to 21 years. As is clear from the graph, the differences between the most educated group and the least educated group and between the most patient group and the least patient group are almost the same and equal to 7–8 percentiles. We also compare the patience-wealth association to the relationship between parental wealth and child wealth. It is well known from the intergenerational literature that parental wealth is a very strong predictor of child wealth (Charles and Hurst 2003; Clark and Cummins 2015; Adermon, Lindahl, and Waldenström 2018). Panel B of Figure 3 shows that individuals with parents in the top one-third of the parental wealth distribution are positioned 15 percentiles higher in the child wealth distribution than individuals with parents in the lowest third of the parental wealth distribution. In other words, heterogeneity in time discounting and in education are roughly equally important for individuals' position in the wealth distribution, whereas parental wealth is roughly twice as important.

A regression of wealth in amounts (DKK) on the patience index, including age dummy variables to control for life-cycle patterns, gives a coefficient of DKK 215,000. This coefficient measures the average effect of moving from the lowest to the highest level of patience in the sample. The increase in wealth corresponds to about half of the median wealth level reported in Table 1.[11]

Figure 4 provides evidence on the association between patience and wealth measured throughout the wealth distribution. The graph shows coefficients from quantile regressions of wealth on patience and their 95 percent confidence intervals. The average effect of DKK 215,000 is illustrated by the horizontal dotted line. The association between patience and wealth is close to 0 in the bottom 10 percent of the wealth distribution. This is consistent with the presence of credit constraints, as described theoretically in Section I and documented empirically in Section IIID. The association between patience and wealth increases as we move up in the wealth distribution with a point estimate at percentile 95 of DKK 615,000, which is about three times as large as the average effect.

In summary, the overall association between patience and the position in the wealth distribution is strongly significant, quantitatively important, stable across 15 years and exists through the entire wealth distribution except at the very bottom.

B. *Isolating the Savings Channel by Controlling for Other Wealth Determinants*

The bivariate association between patience and wealth inequality in Figure 4 is potentially caused by higher savings propensities of patient individuals in accordance with standard savings theory, but it could also exist because of a correlation between patience and other wealth determinants as described theoretically in Section I. Identifying the long-run impact of differences in preferences is a challenge because it is impossible in practice to randomly assign type characteristics to people. In this section, we provide suggestive evidence on the savings channel by employing a selection-on-observables strategy. We do this by measuring the strength of the association between patience and wealth in multivariate regressions with a large set of controls for the other potential wealth determinants. Recognizing that other covariates could matter and that variables may be measured with error, this evidence on the savings channel can only be suggestive. Section IV reports results from a large number of sensitivity analyses.

Theoretically, differences across individuals in the level of permanent income and in the time profiles of income are important for the cross-sectional variance in wealth. In addition, these wealth determinants are likely correlated with patience

[11] In online Appendix Section C.1, we report results from regressing wealth in amounts on individual discount rates. The individual discount rates are estimated using four different random utility models as described in Section IIB and online Appendix Section B.3. The association between wealth levels and discount rates is in the range DKK −918 to DKK −720 per percentage point across the different models. In line with previous experimental studies, we find large variation in individual discount rates. Accordingly, a one standard deviation higher discount rate is associated with a DKK 38,700–46,900 lower level of wealth.

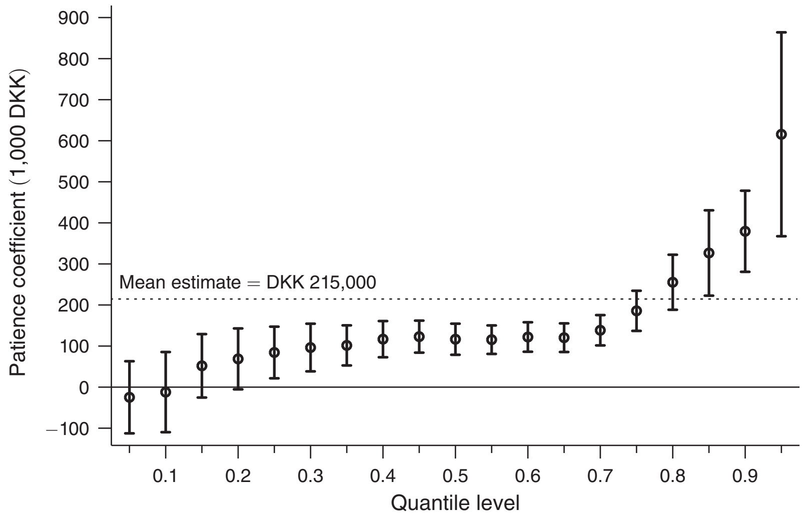

Figure 4. Relationship between Patience and Wealth throughout the Wealth Distribution

Notes: The figure plots patience coefficients from quantile regressions of wealth measured in DKK on the patience index and age indicators to account for life-cycle patterns. Whiskers represent 95 percent confidence intervals. The dotted line indicates the patience coefficient from an OLS regression with the same variables.

since patient individuals are more prone to make educational investments. Figure 5 shows how the position in the labor income distribution differs across the three patience groups defined in Figure 3. Panel A of Figure 5 plots for each age of the individuals the coefficients from a regression of the percentile rank in the income distribution on the patience group indicators, where *Low patience* is the reference group. The panel shows that the most patient group on average has a steeper income profile over the age interval 18–40. They start out being lower in the income distribution than the less patient groups, but at age 40 they are positioned about seven percentiles higher than the low patience group, suggesting that individuals in the most patient group have higher levels of permanent income. It turns out that controls for educational attainment capture these income differences very well. Panel B plots the patience coefficients from the same regressions when we include 11 dummy indicators for years of completed education. The patience coefficients are now close to 0. This suggests that inclusion of educational attainment indicators in the wealth rank regressions adequately controls for differences in permanent income and in timing of income.

Table 2 shows the impact on the patience-wealth inequality association of including the 11 educational attainment controls. Column 1 in panel A reports the result from a bivariate regression of the wealth rank percentile in 2015 on the patience measure.[12] The estimate shows that moving from the lowest to the highest level of

[12] We focus on the wealth positions at the end of the observation period because at this point in the life cycle, individuals have completed their education and income is arguably a good proxy for permanent income (Haider and Solon 2006). Online Appendix Section D.2 shows that the results are robust to using a longer time period for measuring the position in the wealth distribution.

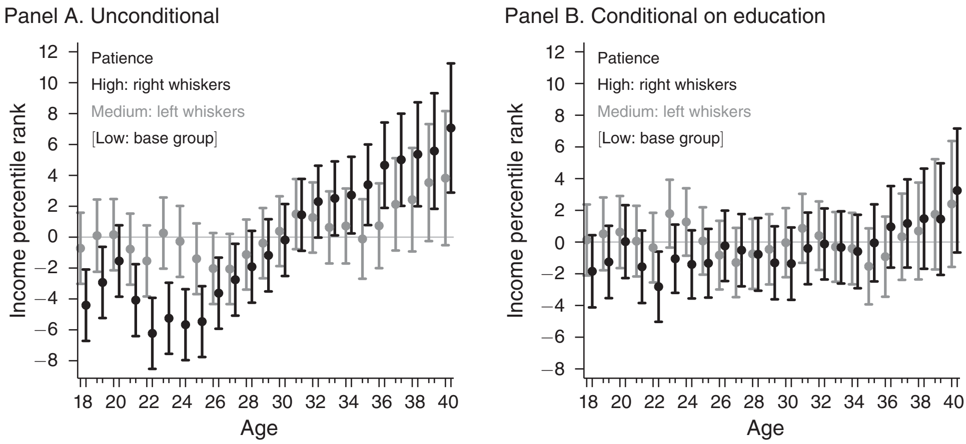

FIGURE 5. RELATIONSHIP BETWEEN DISCOUNTING BEHAVIOR AND INCOME OVER THE LIFE CYCLE

Notes: Panel A plots coefficients from regressions of "within-age-group-and-year labor income percentile rank" on two patience group indicators (*High patience* and *Middle patience*). The base group is *Low patience*. The definition of the three groups is described in the Notes for Figure 3. Panel B plots patience group coefficients from the same type of regressions, but this time including 11 dummy indicators for years of completed education. Panel B shows that the patience coefficients are insignificant, suggesting that educational attainment dummies adequately control for differences in permanent income and in timing of income. Whiskers represent 95 percent confidence intervals in both panels.

patience in the sample is associated with a difference of 11.4 wealth percentiles. The association is precisely estimated with a standard error of 1.73, corresponding to a p-value of significance equal to 6.1×10^{-11}. When including the educational attainment indicators in column 2, the coefficient on patience decreases somewhat, but it is still large with a value of 9.6 percentiles.

In column 3, we include 59 additional control variables in the regression. We control for differences in income path by including decile indicator variables for the position in the within-cohort income distribution in 2015 (gross income excluding capital income), for the observed income growth from age 25–27 to age 30–32, and for the expected income growth from 2014 to 2016 obtained from survey information accompanying the experiment. We also include decile indicators for school grades motivated by the fact that cognitive ability is relevant for individuals' income potential and also correlated with time discounting (Dohmen et al. 2010).

We include decile dummies for the within-cohort wealth rank at age 18 to capture the potential role of differences in initial wealth across individuals when entering into adulthood. Wealth accumulation may also be influenced by transfer payments from parents during adulthood (De Nardi 2004; Boserup, Kopczuk, and Kreiner 2016). Under the assumption that the variation in family transfer payments across individuals is a function of parental wealth, we control for this source of variation in wealth by including decile indicators for parental wealth measured when individuals are 18 years old.[13]

[13] We obtain the same result if we confine the sample to individuals where both parents are alive in 2015, see online Appendix Section D.2. This rules out that wealth differences are driven by inheritance from parents.

Table 2—Patience and Wealth Inequality

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Panel A. Dependent variable: wealth, rank							
Patience	11.37	9.59	8.45	9.45	−1.44	11.14	7.72
	(1.73)	(1.75)	(1.75)	(1.92)	(2.29)	(2.41)	(2.25)
Risk aversion			2.53	2.45	−2.81	5.31	3.18
			(2.04)	(2.04)	(2.84)	(2.70)	(2.54)
Present bias (= 1)				1.23			
				(1.33)			
Future bias (= 1)				2.58			
				(1.32)			
Nonmonotonic choices in time task (= 1)				−1.99			
				(1.07)			
Altruism				−3.67			
				(2.16)			
Interest rate on liquidity							−1.63
							(0.10)
Owned stocks, 2008–2014 (= 1)							6.21
							(1.56)
Rate of return on stocks, 2008–2014							0.36
							(0.54)
Educational attainment	No	Yes	Yes	Yes	Yes	Yes	Yes
Additional controls	No	No	Yes	Yes	Yes	Yes	Yes
Observations	3,620	3,620	3,552	3,552	1,353	2,157	2,157
Adjusted R^2	0.01	0.02	0.08	0.08	0.03	0.08	0.19
Panel B. Dependent variable: wealth, amounts (1,000 DKK)							
Patience	215	171	147	168	2	192	134
	(44)	(40)	(40)	(40)	(36)	(62)	(60)
Same controls as in panel A	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Age dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3,620	3,620	3,552	3,552	1,353	2,157	2,157
Adjusted R^2	0.02	0.03	0.08	0.09	0.01	0.09	0.14

Notes: OLS regressions of wealth inequality on patience. The measurement of patience is described in expression (4). Robust standard errors in parentheses. Panel A uses percentile ranks in the wealth distribution computed within cohorts in 2015 as the dependent variable. The interest rate on liquidity and the rate of return on stocks are measured in percent. The rate of return on stocks is winsorized at 5th percentile and 95th percentile. Column 5 reports estimation results on the subsample of respondents who are recorded holding liquid assets worth less than one month's disposable income in 2014. Columns 6 and 7 report estimation results on the subsample holding liquid assets worth more than one month's disposable income in 2014. The controls for educational attainment include indicator variables for 12 lengths of education measured in years in the Danish education system. The additional controls include income decile indicators based on the position in the within-cohort gross income (excluding capital income) distribution in 2015, decile indicators based on the observed income growth from age 25–27 to age 30–32, decile indicators for the expected income growth from 2014 to 2016 obtained from survey information accompanying the experiment, school performance decile indicators based on self-reported school grades, initial wealth decile indicators based on the position in the within-cohort wealth distribution at age 18, parental wealth decile indicators based on the position of parents in the parental wealth distribution measured within the cohort of the respondent when the respondent was 18 years old, a gender dummy, a dummy for being single, and a dummy for having dependent children. Furthermore, all regressions include constant terms (not reported). Panel B uses wealth measured in amounts (1,000 DKK) in 2015 as the dependent variable. The table format of panel B follows the format of panel A with the same sample restrictions and control variables. However, panel B also includes age indicators to account for life-cycle patterns and only reports the estimation output for the patience variable.

Additionally, we include risk aversion elicited in the experiment among the controls. It is well known that risk aversion and patience are correlated (e.g., Leigh 1986; Anderhub et al. 2000; Eckel, Johnson, and Montmarquette 2005), and risk aversion is theoretically a potential wealth determinant, although its effect on wealth is ambiguous (see footnote 5). Finally, we also include demographic controls for gender, marital status, and the presence of dependent children.

After including all 70 controls in column 3, the patience-wealth inequality association is 8.5 percentiles, which is equal to three-fourths of the bivariate association in column 1, and it is precisely estimated with a standard error of 1.75. We arrive at the same conclusion when we look at wealth amounts in panel B. The estimated coefficient on patience with all controls in column 3 shows a DKK 147,000 difference between the lowest and the highest level of patience, which is approximately three-fourths of the bivariate association of DKK 215,000 reported in column 1. These results suggest that the savings channel is a driver behind the large observed association between patience and wealth inequality. Online Appendix Section C.2 provides supplementary evidence supporting this conclusion by showing that the gap in wealth between patient individuals and less patient individuals increases gradually over the life cycle from age 18 to 40, and by demonstrating a positive association between patience and savings propensities over this life-span.

C. *Present Bias*, *Choice Inconsistency*, *and Altruism*

In column 4 of Table 2, we include additional information from the experiment about preferences and behavior as described in Section IIB. We include indicator variables for whether individuals display present-biased behavior or future-biased behavior and for making nonmonotonic choices in the experiment. We also include the altruism index in the regression. When adding these variables, the patience coefficient increases from 8.5 percentiles to 9.5 percentiles. The additional behavioral coefficients are all small and insignificant at conventional levels. As discussed in Section IIB, the fact that present bias is insignificant could reflect that the experimental design used in this study is not ideal for detecting such behavior. Nevertheless, the results show that the elicited long-run patience level strongly predicts wealth inequality, while risk preferences and social preferences elicited in the experiment play little or no role for wealth inequality.

D. *The Role of Financial Markets*

Theory predicts that relatively impatient people wish to borrow more. As a consequence, they impose, on themselves, a higher risk of being credit constrained. This can be important for propagation of business-cycle shocks and the efficacy of stimulus policy (Carroll, Slacalek, and Tokuoka 2014; Krueger, Mitman, and Perri 2016) and also for the association between patience and wealth inequality that we study. This association may be muted because constrained individuals with differing levels of patience are unable to run down wealth further and, therefore, end up with the same level of wealth, as is described theoretically in Section I.

To measure credit constraints, we follow the previous literature and construct a dummy indicator for respondents holding liquid assets corresponding to less than one month of disposable income (e.g., Zeldes 1989; Johnson, Parker, and Souleles 2006; Leth-Petersen 2010). Using this measure, we find a remarkably stable and quantitatively important association between the individuals' degrees of patience and their propensities to be credit constrained over the period 2001–2015 (see online Appendix Section C.3). The stable relationship over such a long period is consistent with the notion of self-imposed credit constraints.

In columns 5 and 6 of Table 2, we analyze the relationship between patience and wealth inequality for credit constrained individuals and unconstrained individuals, respectively. For this exercise, we split the sample based on the credit constraint indicator measured in 2014, i.e., the year before we measure the wealth rank, and estimate the baseline specification in column 3 for the two subsamples. The association between elicited patience and wealth percentile rank turns out to be small and insignificant at conventional levels for the credit constrained individuals (column 5). In contrast, the association for the unconstrained individuals is 11.1 percentiles (column 6) and thus considerably larger than the 8.5 percentiles obtained for the full sample (column 3). This evidence is consistent with the theoretical insight that the overall association between patience and wealth inequality is muted by credit constraints and can explain why patience and wealth are unrelated in the bottom of the wealth distribution (cf. Figure 4).

The assumption underlying the credit constraint indicator is that some individuals may borrow at a fixed interest rate, while others cannot borrow at all. Arguably, this does not capture the entire effect of credit constraints as people can have different access to credit and, therefore, effectively face constraints with varying intensity. The relevant slope of the budget line is the interest rate on marginal liquidity, which may vary across individuals. To further account for credit constraints, we compute a measure of this "marginal interest rate" and include it among the controls in column 7 of Table 2. The marginal interest rate is derived from account-level data with information about debt, deposits, and interest payments during the year. We impute the interest rate for each account of an individual from yearly interest payments and end-of-year balances. For people with debt accounts, we select the highest interest rate among debt accounts as the marginal interest rate. For people without debt, we select the lowest interest rate among their deposit accounts based on the logic that this is the cheapest source of liquidity. Kreiner, Lassen, and Leth-Petersen (2019) shows that the computed interest rates match actual interest rates set by banks well and that this measure of credit constraint tightness improves the ability to predict spending responses to a stimulus policy. Details about the construction of the marginal interest rate, its distribution, and validation of the imputation are presented in online Appendix Section C.4 and in Kreiner, Lassen, and Leth-Petersen (2019).

Recent evidence also suggests that some individuals are better at obtaining high returns on financial assets (Fagereng et al. forthcoming), which create variation in the slope of the budget line of savers. To account for this type of variation, we compute stock market returns for each individual by dividing the sum of dividend income and realized capital gains/losses during the year with the market value of stocks. As returns and ownership fluctuates somewhat from year to year, we calculate the average value over the period 2008–2014. Besides the stock market returns, we also include an indicator variable for owning stocks during the period.

In Table 2, column 7, we expand the specification of column 6, for the subsample of individuals who are not likely to be affected by (hard) credit constraints and include the interest rate on marginal liquidity, the financial asset ownership indicator, and the rate of return on financial assets. The coefficient on the marginal interest rate is precisely estimated and has the expected negative sign. People who own stocks are, as expected, more likely to be placed higher in the wealth distribution. Given the other covariates, the return on assets turns out not to be important for the wealth rank. The inclusion of the financial variables mutes the association between patience and the wealth rank compared to column 6, but the association is still strong, precisely estimated, and comparable in magnitude to the baseline specification in column 3. Since patient individuals are likely to face low interest rates on loans because they have accumulated a high level of wealth, the estimate in column 7 may be a lower bound for the relevant association between patience and wealth inequality.

The empirical findings in this section are also relevant for concerns about whether differences in elicited time discounting simply reflect variation in real-life market interest rates facing the individuals participating in the experiment rather than their time references (Frederick, Loewenstein, and O'Donoghue 2002; Krupka and Stephens 2013; Dean and Sautmann forthcoming). For example, Dean and Sautmann (forthcoming) suggests that shocks to income in a developing-country context can affect the intertemporal marginal rate of substitution elicited experimentally, implying that an experimental measure may not uncover differences in inherent discounting behavior of the participants. Our findings of stable relationships between patience and wealth inequality and patience and credit constraint propensity over a 15-year period are, however, difficult to reconcile with explanations based on shocks or other temporary variation in income and wealth at business-cycle frequency.

Likewise, the fact that patience significantly predicts the wealth percentile rank after controlling for market interest rates and asset returns suggests that the patience-wealth rank relationship is not simply driven by arbitrage. This finding is consistent with the view that experimentally elicited discount rates contain, due to narrow bracketing, relevant information about individuals' subjective time discounting. This complements other evidence about narrow bracketing in the experimental literature showing that subjects do not integrate their choices in the experiment into their broader choice sets. For example, recent evidence by Andreoni et al. (2018) shows that subjects do not arbitrage against market interest rates when making intertemporal allocations of cash in experiments.

IV. Importance of Reverse Causality, Selection, and Measurement

This section presents a series of robustness checks. First, we reproduce the association between patience and wealth inequality using survey information about time discounting for individuals surveyed in the 1970s. This addresses the pertinent question of whether it is important for our key results that individual time discounting in the experiment is measured at the end of the observation period for the wealth data obtained from the administrative registries. Second, we show that the results are robust to the measurement of patience and wealth and to selection into participating in the experiment.

A. *Association between a Survey Measure of Patience in Early Adulthood and Wealth Inequality Three Decades Later*

This section uses data from the Danish Longitudinal Survey of Youth (DLSY). The DLSY survey contains a crude measure of time discounting collected in 1973 for a sample consisting of 2,548 individuals from the 1952–1955 cohorts.[14] The survey data are merged with administrative records covering the same period as the core analysis. In this way, we examine whether an alternative measure of time discounting, collected when individuals in the survey are 18–21 years old, is predictive of future inequality in wealth when they are about 45–60 years old. The respondents in the 1973 survey were asked, among other things, the following question: *If given the offer between the three following jobs, which one would you choose?* (*i*) *A job with an average salary from the start.* (*ii*) *A job with low salary the first two years but high salary later.* (*iii*) *A job with very low salary the first four years but later very high salary.* We interpret this question about the preference over the timing of income streams as a proxy for time discounting, where respondents answering (iii) are the most patient and respondents answering (i) are the least patient. This aligns with the interpretation of the money-sooner-or-later experiments to elicit time discounting. We also asked this survey question to a subsample of the participants in the experiment. For this group, we observe a strong correlation between the survey-based measure of patience and patience elicited in the incentivized experiment (see online Appendix Section D.1).

Figure 6 replicates Figure 3 for the DLSY sample. Panel A shows the average position in the wealth distribution in the period 2001–2015 for each of the three patience groups defined by the three answers to the survey question in the DLSY sample in 1973. The most patient group of individuals is consistently at the highest position in the wealth distribution, followed by the group with medium patience and with the least patient individuals on average attaining the lowest position. The difference in the average wealth rank position of the most patient and the least patient is about 7–8 wealth percentiles. Panel B compares the predictive power of the early-adulthood survey measure of patience and the education level of the individuals observed in the register data.[15] It shows that the association between patience and wealth inequality is about the same size as the association between education and wealth inequality. The persistence, magnitude, and size relative to education resemble the pattern observed in Figure 3.

Table 3 presents regressions of wealth percentile ranks on dummy variables for the DLSY patience groups. Column 1 shows results from a regression without control variables included, corresponding to the association between patience and wealth inequality reported in panel B of Figure 6. The standard errors of the regression estimates show that the differences between the low patience group and the medium and high patience groups are significant at the 1 percent level. Column 2 includes dummy indicators for the number of years of completed education, income decile

[14] For details, see https://dlsy.sfi.dk/dlsy-in-english/. Eighty-two percent of the sample belongs to the 1954 cohort, while the rest are recruited from the 1952, 1953, and 1955 cohorts.

[15] We cannot compare the patience-wealth rank association to the association between parental wealth position and child wealth position as in panel B of Figure 3 for the DLSY survey sample because the respondents are born before 1960 when the identity of most parents is missing in the register data. The link between parents and children exists for all cohorts born in 1960 and later.

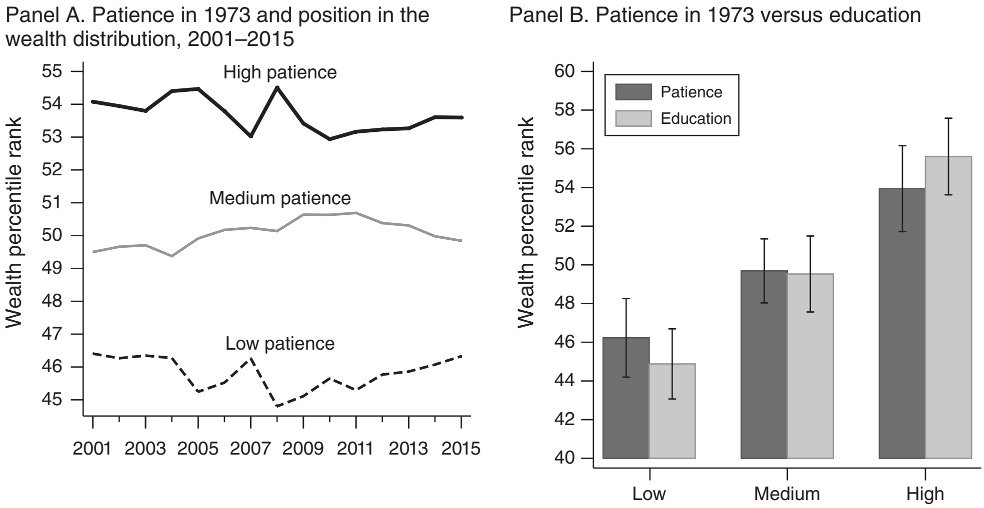

Figure 6. Patience in 1973, Educational Attainment, and Wealth Inequality

Notes: Panel A shows the association between time discounting elicited in the Danish Longitudinal Survey of Youth (DLSY) in 1973 and the position in the wealth distribution in the period 2001–2015. The position in the wealth distribution is computed as the percentile rank in the sample. The three groups are defined based on the answers to the question: *If given the offer between the three following jobs*, *which one would you choose?* (*i*) *A job with an average salary from the start.* (*ii*) *A job with low salary the first two years but high salary later.* (*iii*) *A job with very low salary the first four years but later very high salary.* 664 respondents preferred a flat income profile *Low patience*, 1,157 preferred a steeper profile *Medium patience*, and 727 preferred the steepest profile *High patience*. Panel B compares the patience-wealth association to the education-wealth association. The subject's wealth and educational attainment is measured in 2001. Educational attainment equals years of completed education. The individuals in the sample are split into three groups according to patience and years of education. The division by patience is the same as in panel A. For education, three equally sized groups are defined based on years of education. Cutoffs for the education groups (years): low [8, 13]; medium [13, 14.5]; high [14.5, 22] where the numbers refer to years of completed education. Whiskers represent 95 percent confidence intervals.

Table 3—Patience in 1973 and Position in the Wealth Distribution, 2001

Dependent variable: wealth	Rank (1)	Rank (2)	1,000 DKK (3)	1,000 DKK (4)
High patience	7.71	3.24	194	112
	(1.54)	(1.51)	(46)	(45)
Medium patience	3.49	1.54	93	55
	(1.34)	(1.30)	(71)	(58)
Controls	No	Yes	No	Yes
Observations	2,546	2,546	2,546	2,546
Adjusted R^2	0.01	0.13	0.00	0.03

Notes: OLS regressions. Robust standard errors in parentheses. The regressions are based on 2001, which is the first year in panel A of Figure 6. By then, the individuals in the DLSY sample (born 1952–1955) were in their midlifes such that it is comparable to the scenario in our core analysis. The dependent variable in columns 1–2 is the percentile rank in the wealth distribution, whereas the dependent variable in columns 3–4 is wealth measured in amounts (1,000 DKK). Dummies for medium and high patience are included in the regressions, low patience is the reference group. The patience groups are based on the time discounting question in DLSY, see notes to Figure 6. The controls include year indicators for educational attainment, income decile indicators based on the position in the gross income (excluding capital income) distribution, initial wealth decile indicators based on the position in the wealth distribution in 1983, a gender dummy, a dummy for being single, and a dummy for having dependent children. Furthermore, all regressions include constant terms (not reported). Two observations are dropped because of missing wealth data in 1983.

indicators, decile indicators for initial wealth measured in 1983 (first occurrence of individual-level wealth data), and demographic controls. Including the controls mutes the patience coefficients, but the high patience group parameter is still sizable and significant at a five percent level. Columns 3 and 4 report the result from running the same regressions with the level of wealth in amounts as outcome variable. The results show that the most patient individuals in the survey have close to DKK 200,000 more wealth than the impatient individuals and about DKK 110,000 more wealth when we condition on all the control variables. These associations are of the same magnitude as the findings in columns 1 and 3 of panel B in Table 2.

In summary, the results from using a measure of patience elicited early in the life cycle confirms the findings from the core analysis based on experimental elicitation of time discounting that relatively patient individuals are consistently positioned higher in the wealth distribution. This suggests that the patience-wealth rank association is not driven by a causal relationship going from wealth to patience or driven by shocks, affecting both patience and wealth, appearing around the time when patience is elicited.

B. *Measurement and Selection*

Online Appendix Section D.2 provides a large number of robustness analyses showing that the results are robust to different ways of measuring patience in the experiment, various ways of controlling for shocks and education, different specifications of wealth, and selection into participating in the experiment. The results are described below.

Our patience measure is based on the subset of choice situations where the subjects are asked to choose between payouts 8 and 16 weeks from the experiment date. As described in Section II, we also confronted subjects with trade-offs that involved payouts made as soon as possible after the experiment, where the delay only pertained to the time required to administer the transfer to the participant's account (one day). It is possible from the experiment to construct patience measures based on all combinations of the payment dates that we exposed subjects to ("today," "in 8 weeks," and "in 16 weeks"). It turns out that the parameter estimates on patience are very similar across the different combinations of payment dates.

About 19 percent of the sample consistently postpone payments in the intertemporal choice situations, cf. Figure 2. In order to verify that individuals who always postpone payments do not drive our main result, we re-estimate the association between patience and wealth with and without controls on a subsample omitting these individuals. The association becomes somewhat smaller, but it is still quantitatively important and strongly significant. Finally, we estimate discount rates structurally using a random utility model. In order to make the scale comparable to our patience index, we rank the estimated discount rates and use the discount rate rank as a regressor. With this measure, moving from the least patient to the most patient individual in the sample is associated with an increase of close to 11 rank points in the wealth distribution, which is similar to the association reported in column 1 of Table 2.

The tax-assessed values of houses used to compute individual wealth may be somewhat below market values. To account for this potential bias, we adjust the values by the average ratio of market prices to tax-assessed values among traded houses of the same property class and in the same location and price range following Leth-Petersen (2010). The overall association between patience and wealth inequality is nearly unchanged after this adjustment. The wealth data including housing and financial wealth are consistently third-party reported for a long period of time. However, they lack two components of wealth that are potentially important for assessing wealth inequality, namely the value of cars and the value of wealth accumulated in pension accounts. Data documenting these two components have recently become available, but only from 2014 onward. The inclusion of car values has almost no effect, while the inclusion of pension wealth slightly mutes the association between patience and wealth inequality. However, in all cases, the estimates are within two standard errors of the estimate obtained with the baseline specification in Table 2. Measuring wealth at the household level instead of at the individual level also leaves the association between patience and position in the wealth distribution almost unchanged. We also examine differences in financial wealth. For this narrower wealth concept, we find a larger association with patience compared to the broad wealth measure.

To explore the potential role of shocks and other transitory variations in the measurement of wealth and income, we compute three-, five-, and seven-year averages for each of these variables and re-estimate the wealth rank regressions. The coefficient on patience is essentially identical across these cases. We obtain the same conclusion if we, as an alternative way to reduce the importance of shocks, consider subsamples of subjects who have lived in stable relationships (no spouse or same spouse) and not experienced unemployment shocks or health shocks for a long period before the elicitation of patience. We reach the same conclusion in another sensitivity analysis where we confine the sample to individuals where both parents are alive in 2015, thereby ruling out that wealth differences are driven by inheritance from parents.

In the control set, we include 11 dummy variables for years of educational attainment. To allow for the possibility of variation in returns across educations with the same length, for example comparative literature studies, economics, and physics, we conduct sensitivity analyses where we include more detailed education controls. The expanded educational control set did not change the estimated effect of patience on wealth in any important way.

Only a fraction of the subjects whom we invited to participate in the experiment accepted the invitation. This potentially implies that our sample is selected and not representative of the population at large. To address this issue, we re-estimate the key associations between patience and wealth inequality using propensity score weighting, where the propensity scores are estimated using register data information about participants and the population at large: year indicators for educational attainment, decile indicators for income, observed income growth, parental wealth and wealth at age 18 as well as age indicators, a gender dummy, a dummy for being single, and a dummy for having dependent children. We find no important deviations from the baseline estimates.

V. Conclusion

According to standard savings theory, differences in how much people discount the future generate differences in savings behavior and thereby wealth inequality. We provide a direct empirical link between time discounting and wealth inequality by combining data on individuals' time discounting collected from a large-scale, incentivized experiment with administrative data revealing the positions of individuals in the real-world wealth distribution. We document a quantitatively important association between patience and wealth inequality, which is of the same magnitude as the association between educational attainment and wealth inequality. The association is stable over time and exists throughout the wealth distribution except at the very bottom. We find that three-quarters of the association exists after controlling for a large number of variables capturing other wealth determinants. This suggests that the savings channel is a driver of the observed association between patience and wealth inequality, consistent with savings theory.

Taken together, our results suggest that differences in time discounting across individuals play a significant role for wealth differences and, more generally, point to the potential importance of incorporating heterogeneous time discounting into models of consumption and savings behavior as originally suggested by Krusell and Smith (1998) and recently applied by Cooper and Zhu (2016); Hubmer, Krusell, and Smith (2016); Krueger, Mitman, and Perri (2016); Carroll et al. (2017); De Nardi and Fella (2017); and Alan, Browning, and Ejrnæs (2018).

Our results indicate that elicited patience contains relevant information about the cross-sectional ordering of subjects' time discounting which is predictive of their positions in the wealth distribution. Therefore, making a direct link between experimentally elicited discounting behavior and the discount rates entering models of aggregate savings behavior would appear to be a natural next step. However, taking this step is likely to be a challenge in practice. As is well known in the experimental literature (Frederick, Loewenstein, and O'Donoghue 2002), discount rates elicited under relatively small stakes are typically much larger than discount rates that are implied by aggregate models of discounting. However, insofar as the ordering of patience derived from small stake choice tasks is the same as it would be in a setting with large stakes, the experiments can credibly elicit the ordering of individuals in terms of their discounting behavior, as done in our analyses.

Our study also contributes to inequality research at a broader level. Most studies aiming at explaining inequality assume homogeneous preferences/behavior and focus on differences across people in innate abilities, realization of income shocks, transfer payments, and related components entering the budget constraint. Our finding that elicited time discounting predicts large, systematic differences in income profiles and wealth accumulation across people suggests that heterogeneity in preferences also has a role to play in the formation of inequality.

REFERENCES

Abdellaoui, Mohammed, Arthur E. Attema, and Han Bleichrodt. 2010. "Intertemporal Tradeoffs for Gains and Losses: An Experimental Measurement of Discounted Utility." *Economic Journal* 120 (545): 845–66.

Adermon, Adrian, Mikael Lindahl, and Daniel Waldenström. 2018. "Intergenerational Wealth Mobility and the Role of Inheritance: Evidence from Multiple Generations." *Economic Journal* 128 (612): F482–513.

Alan, Sule, Martin Browning, and Mette Ejrnæs. 2018. "Income and Consumption: A Micro Semistructural Analysis with Pervasive Heterogeneity." *Journal of Political Economy* 126 (5): 1827–64.

Anderhub, Vital, Werner Güth, Wieland Müller, and Martin Strobel. 2000. "An Experimental Analysis of Intertemporal Allocation Behavior." *Experimental Economics* 3 (2): 137–52.

Andersson, Ola, Håkan J. Holm, Jean-Robert Tyran, and Erik Wengström. 2016. "Risk Aversion Relates to Cognitive Ability: Preferences or Noise?" *Journal of the European Economic Association* 14 (5): 1129–54.

Andreoni, James, Christina Gravert, Michael A. Kuhn, Silvia Saccardo, and Yang Yang. 2018. "Arbitrage Or Narrow Bracketing? On Using Money to Measure Intertemporal Preferences." NBER Working Paper 25232.

Andreoni, James, and Charles Sprenger. 2012. "Estimating Time Preferences from Convex Budgets." *American Economic Review* 102 (7): 3333–56.

Angeletos, George-Marios, David Laibson, Andrea Repetto, Jeremy Tobacman, and Stephen Weinberg. 2001. "The Hyperbolic Consumption Model: Calibration, Simulation, and Empirical Evaluation." *Journal of Economic Perspectives* 15 (3): 47–68.

Attema, Arthur E., Han Bleichrodt, Yu Gao, Zhenxing Huang, and Peter P. Wakker. 2016. "Measuring Discounting without Measuring Utility." *American Economic Review* 106 (6): 1476–94.

Attema, Arthur E., Han Bleichrodt, Kirsten I. M. Rohde, and Peter P. Wakker. 2010. "Time-Tradeoff Sequences for Analyzing Discounting and Time Inconsistency." *Management Science* 56 (11): 2015–30.

Augenblick, Ned, Muriel Niederle, and Charles Sprenger. 2015. "Working over Time: Dynamic Inconsistency in Real Effort Tasks." *Quarterly Journal of Economics* 130 (3): 1067–1115.

Augenblick, Ned, and Matthew Rabin. 2019. "An Experiment on Time Preference and Misprediction in Unpleasant Tasks." *Review of Economic Studies* 86 (3): 941–75.

Backes-Gellner, Uschi, Holger Herz, Michael Kosfeld, and Yvonne Oswald. 2018. "Do Preferences and Biases Predict Life Outcomes? Evidence from Education and Labor Market Entry Decisions." CESifo Working Paper 6863.

Barsky, Robert B., F. Thomas Juster, Miles S. Kimball, and Matthew D. Shapiro. 1997. "Preference Parameters and Behavioral Heterogeneity: An Experimental Approach in the Health and Retirement Study." *Quarterly Journal of Economics* 112 (2): 537–79.

Benhabib, Jess, Alberto Bisin, and Mi Luo. 2017. "Earnings Inequality and Other Determinants of Wealth Inequality." *American Economic Review* 107 (5): 593–97.

Benhabib, Jess, Alberto Bisin, and Mi Luo. 2019. "Wealth Distribution and Social Mobility in the US: A Quantitative Approach." *American Economic Review* 109 (5): 1623–47.

Boserup, Simon H., Wojciech Kopczuk, and Claus T. Kreiner. 2016. "The Role of Bequests in Shaping Wealth Inequality: Evidence from Danish Wealth Records." *American Economic Review* 106 (5): 656–61.

Boserup, Simon H., Wojciech Kopczuk, and Claus T. Kreiner. 2018. "Born with a Silver Spoon? Danish Evidence on Wealth Inequality in Childhood." *Economic Journal* 128 (612): F514–44.

Browning, Martin, and Søren Leth-Petersen. 2003. "Imputing Consumption from Income and Wealth Information." *Economic Journal* 113 (488): F282–301.

Carroll, Christopher, Jiri Slacalek, and Kiichi Tokuoka. 2014. "The Distribution of Wealth and the MPC: Implications of New European Data." *American Economic Review* 104 (5): 107–11.

Carroll, Christopher, Jiri Slacalek, Kiichi Tokuoka, and Matthew N. White. 2017. "The Distribution of Wealth and the Marginal Propensity to Consume." *Quantitative Economics* 8 (3): 977–1020.

Carvalho, Leandro S., Stephan Meier, and Stephanie W. Wang. 2016. "Poverty and Economic Decision-Making: Evidence from Changes in Financial Resources at Payday." *American Economic Review* 106 (2): 260–84.

Chabris, Christopher F., David Laibson, Carrie L. Morris, Jonathon P. Schuldt, and Dmitry Taubinsky. 2008. "Individual Laboratory-Measured Discount Rates Predict Field Behavior." *Journal of Risk and Uncertainty* 37 (2–3): 237–69.

Charles, Kerwin K., and Erik Hurst. 2003. "The Correlation of Wealth across Generations." *Journal of Political Economy* 111 (6): 1155–82.

Chetty, Raj, John N. Friedman, Søren Leth-Petersen, Torben Heien Nielsen, and Tore Olsen. 2014a. "Active vs. Passive Decisions and Crowd-Out in Retirement Savings Accounts: Evidence from Denmark." *Quarterly Journal of Economics* 129 (3): 1141–1219.

Chetty, Raj, Nathaniel Hendren, Patrick Kline, and Emmanuel Saez. 2014b. "Where Is the Land of Opportunity? The Geography of Intergenerational Mobility in the United States." *Quarterly Journal of Economics* 129 (4): 1553–1623.

Choi, Syngjoo, Shachar Kariv, Wieland Müller, and Dan Silverman. 2014. "Who Is (More) Rational?" *American Economic Review* 104 (6): 1518–50.

Clark, Gregory, and Neil Cummins. 2015. "Intergenerational Wealth Mobility in England, 1858–2012. Surnames and Social Mobility." *Economic Journal* 125: 61–85.

Cohen, Jonathan, Keith Marzilli Ericson, David Laibson, and John Myles White. Forthcoming. "Measuring Time Preferences." *Journal of Economic Literature.*

Cooper, Russell, and Guozhong Zhu. 2016. "Household Finance over the Life-Cycle: What Does Education Contribute?" *Review of Economic Dynamics* 20: 63–89.

Dean, Mark, and Anja Sautmann. Forthcoming. "Credit Constraints and the Measurement of Time Preferences." *Review of Economic and Statistics*.

De Nardi, Mariacristina. 2004. "Wealth Inequality and Intergenerational Links." *Review of Economic Studies* 71 (3): 743–68.

De Nardi, Mariacristina, and Giulio Fella. 2017. "Saving and Wealth Inequality." *Review of Economic Dynamics* 26: 280–300.

Dohmen, Thomas, Armin Falk, David Huffman, and Uwe Sunde. 2010. "Are Risk Aversion and Impatience Related to Cognitive Ability?" *American Economic Review* 100 (3): 1238–60.

Eckel, Catherine, Cathleen Johnson, and Claude Montmarquette. 2005. "Saving Decisions of the Working Poor: Short- and Long-Term Horizons." In *Field Experiments in Economics* (*Research in Experimental Economics*), Vol. 10, edited by Glenn W. Harrison, Jeffrey Carpenter, and John A. List, 219–60. Bingley, UK: Emerald Group Publishing Limited.

Epper, Thomas, Ernst Fehr, Helga Fehr-Duda, Claus Thustrup Kreiner, David Dreyer Lassen, Søren Leth-Petersen, and Gregers Nytoft Rasmussen. 2020. "Time Discounting and Wealth Inequality: Dataset." Statistics Denmark.

Epper, Thomas, Helga Fehr-Duda, and Adrian Bruhin. 2011. "Viewing the Future through a Warped Lens: Why Uncertainty Generates Hyperbolic Discounting." *Journal of Risk and Uncertainty* 43 (3): 169–203.

Fagereng, Andreas, Luigi Guiso, Davide Malacrino, and Luigi Pistaferri. Forthcoming. "Heterogeneity and Persistence in Returns to Wealth." *Econometrica*.

Falk, Armin, Anke Becker, Thomas Dohmen, Benjamin Enke, David Huffman, and Uwe Sunde. 2018. "Global Evidence on Economic Preferences." *Quarterly Journal of Economics* 133 (4): 1645–92.

Frederick, Shane, George Loewenstein, and Ted O'Donoghue. 2002. "Time Discounting and Time Preference: A Critical Review." *Journal of Economic Literature* 40 (2): 351–401.

Haider, Steven, and Gary Solon. 2006. "Life-Cycle Variation in the Association between Current and Lifetime Earnings." *American Economic Review* 96 (4): 1308–20.

Harrison, Glenn W., Morten I. Lau, and Melonie B. Williams. 2002. "Estimating Individual Discount Rates in Denmark: A Field Experiment." *American Economic Review* 92 (5): 1606–17.

Heathcote, Jonathan, Kjetil Storesletten, and Giovanni L. Violante. 2009. "Quantitative Macroeconomics with Heterogeneous Households." *Annual Review of Economics* 1 : 319–54.

Hubmer, Joachim, Per Krusell, and Anthony A. Smith Jr. 2016. "The Historical Evolution of the Wealth Distribution: A Quantitative-Theoretic Investigation." NBER Working Paper 23011.

Huggett, Mark, Gustavo Ventura, and Amir Yaron. 2011. "Sources of Lifetime Inequality." *American Economic Review* 101 (7): 2923–54.

Jakobsen, Katrine, Kristian Jakobsen, Henrik Kleven, and Gabriel Zucman. Forthcoming. "Wealth Taxation and Wealth Accumulation: Theory and Evidence from Denmark." *Quarterly Journal of Economics*.

Johnson, David S., Jonathan A. Parker, and Nicholas S. Souleles. 2006. "Household Expenditure and the Income Tax Rebates of 2001." *American Economic Review* 96 (5): 1589–1610.

Kleven, Henrik Jacobsen, Martin B. Knudsen, Claus Thustrup Kreiner, Søren Pedersen, and Emmanuel Saez. 2011. "Unwilling or Unable to Cheat? Evidence from a Tax Audit Experiment in Denmark." *Econometrica* 79 (3): 651–92.

Kreiner, Claus Thustrup, David Dreyer Lassen, and Søren Leth-Petersen. 2015. "Measuring the Accuracy of Survey Responses Using Administrative Register Data: Evidence from Denmark." In *Improving the Measurement of Consumer Expenditures*, edited by Christopher D. Carroll, Thomas F. Crosley, and John Sabelhaus. Chicago: University of Chicago Press.

Kreiner, Claus Thustrup, David Dreyer Lassen, and Søren Leth-Petersen. 2019. "Liquidity Constraint Tightness and Consumer Responses to Fiscal Stimulus Policy." *American Economic Journal: Economic Policy* 11 (1): 351–79.

Krueger, Dirk, Kurt Mitman, and Fabrizio Perri. 2016. "Macroeconomics and Household Heterogeneity." In *Handbook of Macroeconomics*, Vol. 2, edited by John B. Taylor and Harald Uhlig, 843–921. Amsterdam: Elsevier.

Krupka, Erin L., and Melvin Stephens, Jr. 2013. "The Stability of Measured Time Preferences." *Journal of Economic Behavior & Organization* 85: 11–19.

Krusell, Per, and Anthony A. Smith, Jr. 1998. "Income and Wealth Heterogeneity in the Macroeconomy." *Journal of Political Economy* 106 (5): 867–96.

Laibson, David. 1997. "Golden Eggs and Hyperbolic Discounting." *Quarterly Journal of Economics* 112 (2): 443–78.

Lawless, Lydia, Andreas C. Drichoutis, and Rodolfo M. Nayga, Jr.. 2013. "Time Preferences and Health Behaviour: A Review." *Agricultural and Food Economics* 1: Article 17.

Leigh, J. Paul. 1986. "Accounting for Tastes: Correlates of Risk and Time Preferences." *Journal of Post Keynesian Economics* 9 (1): 17–31.

Leth-Petersen, Søren. 2010. "Intertemporal Consumption and Credit Constraints: Does Total Expenditure Respond to an Exogenous Shock to Credit?" *American Economic Review* 100 (3): 1080–1103.

Meier, Stephan, and Charles Sprenger. 2010. "Present-Biased Preferences and Credit Card Borrowing." *American Economic Journal: Applied Economics* 2 (1): 193–210.

Mischel, Walter, Yuichi Shoda, and Monica L. Rodriguez. 1989. "Delay of Gratification in Children." *Science* 244 (4907): 933–38.

Piketty, Thomas. 2014. *Capital in the Twenty-First Century.* Cambridge, MA: Harvard University Press.

Piketty, Thomas, and Emmanuel Saez. 2014. "Inequality in the Long Run." *Science* 344 (6186): 838–43.

Quadrini, Vincenzo, and José-Víctor Ríos-Rull. 2015. "Inequality in Macroeconomics." In *Handbook of Income Distribution*, Vol. 2B, edited by Anthony B. Atkinson and François Bourguignon, 1229–1302. Elsevier.

Sutter, Matthias, Martin G. Kocher, Daniela Glätzle-Rützler, and Stefan T. Trautmann. 2013. "Impatience and Uncertainty: Experimental Decisions Predict Adolescents' Field Behavior." *American Economic Review* 103 (1): 510–31.

Zeldes, Stephen P. 1989. "Consumption and Liquidity Constraints: An Empirical Investigation." J*ournal of Political Economy* 97 (2): 305–46.