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When you need it or when I die?

Timing of monetary transfers from parents to children

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Abstract The standard overlapping generations model assumes the ability to borrow against bequests. If this assumption is not met, it may happen that not all generations smooth their consumption over time. We prove that by allowing for inter vivos transfers in this latter situation, all generations smooth consumption, i.e. the first best solution is restored. Next, using a combination of Dutch survey and administrative data, we provide empirical support for the model's implication that parents transfer wealth when their children need to borrow out of future resources. Our findings suggest an instrumental role for inter vivos transfers as a device that generations can resort to for smoothing their consumption over time.

JEL Classification: D12, D13, D91

Keywords: inter vivos transfers, credit constraints, overlapping generations

1 Introduction

Intergenerational wealth transfers can occur at the parent's death via bequests or during their lifetime via inter vivos transfers. Hence, conditional on having decided to transfer wealth to their children, parents face the choice of the timing of the transfer. If the only mechanism driving

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transfers is altruism and capital markets are perfect, once legal constraints on end-of-life transfers are considered, bequests and inter vivos should be perfect substitutes. An extensive body of literature identifies good reasons to postpone transfers such as, for instance, self-insurance against longevity or health risks (Carroll, 1997). Still, empirical evidence suggests inter vivos are not ruled out by the need of precautionary savings. Boserup et al. (2016), using Danish registry data, find a positive correlation between parental wealth and child wealth early in life, and stress that such evidence is consistent with a standard model of human capital investment and consumption smoothing over the lifecycle only by significant parental transfers early in life. The same authors, and others, also argue that inter vivos can be a response to different taxation schemes for monetary gifts and end-of-life transfers (Page, 2003, Nishiyama, 2002, McGarry, 2000, Bernheim et al., 2004, Joulfaian, 2004, Boserup et al., 2018) but the empirical evidence does not always support this argument (Joulfaian and McGarry, 2004, Poterba, 2001). Another strand of literature suggests that inter vivos are needed when children face binding credit constraints because of adverse unexpected shocks to earnings (McGarry, 1999, McGarry, 2000, Cox and Jappelli, 1990, Cox, 1990, Altonji et al., 1997, Barczyk and Kredler, 2014).

We contribute to the existing literature on the timing of financial transfers from (altruistic) parents to children, i.e. inter vivos or bequest, by providing an economic theoretical model that shows inter vivos transfers can take place when children cannot borrow against future bequests. This result is obtained without resorting to income uncertainty, tax differentials or financial market frictions. In addition, we provide further empirical evidence on the prediction of our economic theoretical model that inter vivos are more likely to take place when children become homeowners and are, arguably, credit constrained.

To be more specific, we first show that when inter vivos transfers are included in an

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Overlapping Generations Model (OLG) where households can borrow against future income but not against future bequests, they serve as a device by which each generation can reach the first best solution (i.e. consumption smoothing). In order to do so, we first point out that in a standard OLG model without any liquidity constraints (i.e. borrowing against future bequests is allowed), one does not need to rely on inter vivos transfers to guarantee consumption smoothing for all generations (Blanchard and Fischer, 1989). Next, we follow Altig and Davis (1989) and Cox (1990) to justify the relevance of inter vivos with the inability to borrow against future bequests and without resorting to uncertainty or tax differentials. An important advantage of our approach is that the resulting life cycle model can be harmlessly integrated into any model that embeds an OLG model for household behavior and it is, therefore, fully compatible with the existing macroeconomic literature on wealth transmission.

Second, we present empirical evidence in favor of parents transferring wealth to their children when the latter need to borrow from future resources. We show that when children are more likely to buy their first home and, arguably, are more likely to be credit constrained, the more likely it is that their parents (plan to) carry out an inter vivos transfer. We follow Engelhardt and Mayer (1998) and Guiso and Jappelli (2002) who use survey data on US and Italy, respectively, and make use of survey questions on inter vivos. They find that inter vivos transfers reduce the time children need to save before becoming homeowners, and both studies motivate this evidence as a means for children to make up for insurance or credit market failures. In this paper we instead focus on the parent decision to transfer rather than on the saving pattern of children, i.e., we look at the transfer from the opposite perspective. We find that as the children approaches the age at which it is likely they want to buy a house, the parent is more likely to transfer.

More recently, Kolodziejczyk and Leth-Petersen (2013) and Halvorsen and Lindquist

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(2017) using administrative data on Denmark and Sweden, respectively, find no evidence of inter vivos at the time of home purchase. Differently from the previous two studies, they have no direct information on inter vivos and their analyses consist of comparisons of the wealth accumulation trajectories of parents and children. Their conclusion is that children are not in need of an inter vivos transfer because credit markets are frictionless in Denmark and Sweden.

In our empirical analysis we study transfer behavior in the Netherlands covering the period 2001-2008. The Dutch pension system is rather generous and the public health system includes long-term care insurance which makes precautionary saving less necessary (Van Ooijen et al., 2015). Nevertheless, the elderly, on average, keep large amounts of assets even at a very old age. Van Ooijen et al. (2015) also shows that there are substantial bequests and transfers after the death of the first spouse. Furthermore, they show that housing equity typically forms a substantial part of net worth. The Dutch mortgage market is rather liberal compared to other developed countries. This is reflected in a relatively high levels of mortgage debt-GDP ratio (Scanlon and Elsinga, 2014a). The Dutch mortgage market was deregulated during the 1990s. For instance, households could borrow up to 110 percent of the value of the home and up to six times their household income. After 2011, the Dutch financial regulators imposed tighter constraints on mortgage borrowing (Scanlon and Elsinga, 2014a); this is outside our sample period (2001-2008). Most importantly, borrowers needed a stable financial situation to get a mortgage. This typically meant having a permanent labor contract, which mostly affected the young people. This rule is relevant for our study and the parents could step in either to guarantee the loan or make an inter vivos transfer. Concerning the latter, parents can make each year tax-exempted transfers to their children up to about 4,500 euros (see for details on gift and inheritance tax rates, Suari et al. (2023)). Moreover, parents could make a more substantial, tax-free transfer once (about 23,000 euro) which

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children could use to finance the acquisition of a home. Finally, the tax regime provides incentives for estate planning, i.e. for making inter vivos transfers.

For our empirical analysis we combine Dutch survey and administrative data. We use the Dutch DNB Household Survey that includes questions on inter vivos intentions and combine it with the Income Panel Study of the Netherlands, an administrative dataset that allows to construct an exogenous proxy for the probability that one of the children will become first time homeowners in the subsequent year. In addition, our data allow to control for other determinants of inter vivos transfers, next to controlling for fixed effects, in our empirical models. Our main empirical finding is that it is more likely inter vivos take place when children become first time homeowners. This finding complements previous empirical evidence on the role of tax incentives and unexpected income shocks on children's resources as drivers of inter vivos transfers (e.g. Joulfaian & McGarry, 2004; Barczyk & Kredler, 2014).

The paper is organized as follows. Section 2 outlines the theoretical model and section 3 describes the survey and administrative data. Section 4 details the empirical analysis and discusses the baseline results, after which section 5 explains our robustness checks. Section 6 concludes the paper by summarizing our main findings and their contribution to the literature.

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2 AN ECONOMIC MODEL FOR TRANSFER TIMING

Our starting point is an OLG model with a Becker (1974) type downward altruism; that is, each generation's utility depends on that of the next. Each generation lives for two periods. The utility function of a generation born at time t, (V_t) is

$$V_t = u(c_{1t}) + u(c_{2t+1}) + \alpha V_{t+1}, \tag{1}$$

where an individual born at time t consumes c_{1t} in period 1 of his life and c_{2t+1} in period 2 (at time $t+1$). The per period utility $u(.)$ is an increasing and strictly concave function of consumption, while $\alpha > 0$ measures the degree of altruism. In order to model intergenerational transfers we follow Constantinides et al. (2002) by using a representative agent model free of heterogeneous preferences, and by abstracting from the labor-leisure trade-off. Moreover, the model is fully deterministic (Auerbach and Kotlikoff, 1987), and earnings (y_{1t}, y_{2t}) are known to each generation and greater than or equal to zero in each period. We further assume that both the interest rate (r_t) and the rate of time preference (θ) are equal to zero.[2]

The model's timing structure is outlined in Table 1, where the first period of generation t's lifetime occurs at time t, in which it receives earnings (y_{1t}) and inter vivos (R_{t-1}) transferred by the previous generation $t-1$. During period 1, therefore, generation t consumes c_{1t}, saves A_t for period 2, and allocates R_t to inter vivos transfers for the next generation $t+1$. These inter vivos transfers occur at the end of the first lifetime period of each generation. In period 2, generation t has savings from period 1 (A_t) and receives earnings (y_{2t+1}) and a bequest (b_t) transferred by generation $t-1$. During this same period, generation t consumes c_{2t+1} and allocates resources to bequeath b_{t+1} to generation $t+1$. In line with the literature on bequests, we rule out intergenerational transfers from children to parents and assume that inter vivos and bequests cannot be negative (i.e., $R_s, b_s \geq 0, \forall s$). In addition, because the initial values R_0 and b_1 are exogenously given in period 1 of the first generation (i.e., there is no previous generation from which to receive transfers), we assume that R_0 and b_1 are both equal to zero. We start with solving the model in its 'textbook' version: there are no inter vivos (i.e., $R_s = 0\ \forall s$) and each generation faces no credit

[2] The drawback of this latter simplifying assumption is that all the comparisons between amounts over time are amplified due to the absence of an intertemporal discount.

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constraints, i.e. each generation can borrow against future earnings and bequests. The well-known result is that in this setting each generation smooths consumption.[3]

Next, we assume that each generation cannot borrow in its first period against future bequest to be received in its second period and show that in this setting not all generations smooth consumption. It is important to note that we are not introducing any market friction: each generation can still freely borrow against its own future earnings. Generation t maximizes its utility V_t with respect to its choice variables c_{1t}, c_{2t+1}, A_t and b_{t+1}:

$$\max_{c_{1t}, c_{2t+1}, A_t, b_{t+1}} u(c_{1t}) + u(c_{2t+1}) + \alpha V_{t+1}, \tag{2a}$$

subject to the following constraints:

$$c_{1t} = y_{1t} - A_t, \tag{2b}$$

$$c_{2t+1} = y_{2t+1} + A_t + b_t - b_{t+1}, \tag{2c}$$

$$A_t \geq -y_{2t+1}, \tag{2d}$$

$$b_{t+1} \geq 0. \tag{2e}$$

Equation (2d) imposes that younger generations can borrow up to their future income y_{2t+1}, but not against future bequest b_{t+1}. We solved the model via backward induction.[4] Conditional on generation $t+1$'s optimal bequest to the next generation (b_{t+2}), generation t faces the following optimization problem:

$$V_t(b_t) = \max_{A_t, A_{t+1}, b_{t+1}} u(c_{1t}) + u(c_{2t+1}) + \alpha[u(c_{1t+1}) + u(c_{2t+2}) + \alpha V_{t+2}(b_{t+2})], \tag{3a}$$

[3] The maximization problem is solved by backward induction, assuming a transversality condition and ruling out corner solutions at zero consumption. Detailed derivations are given in the appendix.

[4] We followed exactly the same steps as in the "textbook" case detailed in the appendix, assuming a transversality condition and ruling out corner solutions.

subject to the following constraints

$$c_{1t} = y_{1t} - A_t, \tag{3b}$$

$$c_{2t+1} = y_{2t+1} + A_t + b_t - b_{t+1}, \tag{3c}$$

$$c_{1t+1} = y_{1t+1} - A_{t+1}, \tag{3d}$$

$$c_{2t+2} = y_{2t+2} + A_{t+1} + b_{t+1} - b_{t+2}, \tag{3e}$$

$$b_{t+1} \geq 0, \tag{3f}$$

$$A_\tau \geq -y_{2\tau+1}, \tau = t, t+1. \tag{3g}$$

The credit constraint (3g) implies

$$A_t = \frac{y_{1t}+b_{t+1}-y_{2t+1}-b_t}{2} \geq -y_{2t+1}, \tag{4}$$

which can be written as

$$b_t \leq y_{1t} + y_{2t+1} + b_{t+1}. \tag{5}$$

Based on the above, generation t smooths consumption (i.e., $c_{1t} = c_{2t+1} = \frac{y_{1t}+y_{2t+1}+b_t-b_{t+1}}{2}$) if the bequest received, b_t, is relatively small. On the other hand, (5) also implies that if b_t is large enough, generation t will be credit constrained. In this case, the optimal consumption path is $c_{1t} = y_{1t} + y_{2t+1}$; $c_{2t+1} = b_t - b_{t+1}$; $c_{1t} < c_{2t+1}$. The crucial point is that if borrowing against the bequest is not possible, then there can be generations who do not smooth consumption.

Finally, we introduce inter vivos transfers: besides bequest, generation t can receive a transfer R_{t-1} from the previous generation at the beginning of period 1 of its life and can make an inter vivos transfer to the next generation $t+1$ at the end of period 1 (R_t). The full maximization problem can then be written conditional on generation $t+1$'s choice variables, R_{t+1} and b_{t+2} and evaluated at their optimum:

$$V_t(R_{t-1}, b_t) = \max_{A_t, A_{t+1}, R_t, b_{t+1}} \begin{array}{c} u(c_{1t}) + u(c_{2t+1}) \\ +\alpha[u(c_{1t+1}) + u(c_{2t+2}) + \alpha V_{t+2}(R_{t+1}, b_{t+2})] \end{array} \tag{6a}$$

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subject to the following constraints

$$c_{1t} = y_{1t} - A_t + R_{t-1} - R_t, \tag{6b}$$

$$c_{2t+1} = y_{2t+1} + A_t + b_t - b_{t+1}, \tag{6c}$$

$$c_{1t+1} = y_{1t+1} - A_{t+1} + R_t - R_{t+1}, \tag{6d}$$

$$c_{2t+2} = y_{2t+2} + A_{t+1} + b_{t+1} - b_{t+2}, \tag{6e}$$

$$b_{t+1} \geq 0, \tag{6f}$$

$$R_t \geq 0, \tag{6g}$$

$$A_\tau \geq -y_{2\tau+1}, \tau = t, t+1. \tag{6h}$$

As before, the model is solved backwards with the assumption that transfers to the last generation (in this case, R_{T-1} and b_T) are optimal. If generation t is not credit constrained, then

$$c_{1t} = c_{2t+1} = \frac{y_{1t}+R_{t-1}-R_t+y_{2t+1}+b_t-b_{t+1}}{2},$$

and from (6h)

$$b_t - R_{t-1} \leq y_{1t} + y_{2t+1} + b_{t+1} - R_t. \tag{7a}$$

Here, the transfer received by generation t in period 2 in excess of the transfer received in period 1, $b_t - R_{t-1}$, must be relatively small. If generation $t+1$ is also free of credit constraint and smooths consumption, then

$$b_{t+1} - R_t \leq y_{1t+1} + y_{2t+2} + b_{t+2} - R_{t+1}. \tag{7b}$$

Based on comparative statics and holding total transfers from generation t to generation $t+1$ ($R_t + b_{t+1}$) constant, the transfer timing affects the chances that generations t and $t+1$ are credit constrained. If generation t postpones the transfer – i.e. b_{t+1} is relatively large compared to R_t – then it is more likely that generation t will not be credit constrained (cf. (7a)) but generation $t+1$ will be: a higher transfer late in generation t's lifetime will reduce this latter's borrowing needs while increasing those of generation $t+1$ (cf. (7b)). We can now prove that in equilibrium, each

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generation will set R_t in such a way that the credit constraint is not binding for generation $t+1$; that is inter vivos offset the credit constraints and each generation smooths consumption and achieves the first best solution.

Theorem: *(Inter vivos transfers restore the first best solution) If each generation faces the optimization problem (6a) under constraints (6b) to (6h) so that generations cannot borrow against bequests but can transfer money via both bequests and inter vivos, then when* $b_1 = R_0 = 0$*, the credit constraint will not be binding for any generation, and all generations will smooth consumption. (Proof is reported in the Appendix).*

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The theorem implies that either there are both inter vivos and bequest, or none of them and that each generation smooths consumption. To guarantee smoothing for the next generation, the inter vivos transfer (if any) must take place at the time when the child needs to consume out of future resources, or earlier in time, for the credit constraint not to be binding (cf. (7a) and (7b)). The child counts both on own future earnings and on the resources the parent will transfer. Since it is possible to borrow against future earnings, but it is not possible to borrow against a bequest, the parent makes part of the transfer as inter vivos. Further, the parent can as well transfer to the child to help subsequent generations smooth consumption. The implication tested in our empirical analysis is that children who need to borrow from future resources are more likely to receive an inter vivos.

Finally, a noteworthy advantage of our theoretical model is that although its equilibrium characteristics are the same as those of a standard OLG model, unlike the extant research on inter vivos transfers, it does not invoke heterogeneous preferences, market frictions, or uncertainty to justify the transfers' existence. Our model is thus fully compatible with the existing macroeconomic literature on wealth transmission and can be harmlessly integrated into a standard OLG framework.

3 DATA

The DNB Household Survey (DHS), launched in 1993, includes information on work, pensions, housing, mortgages, income, assets, loans, health, economic and psychological concepts, and personal characteristics. The DHS panel data cover a representative sample of around 2,000 Dutch-speaking households per year (see Teppa and Vis (2012), for more detail). For our main analysis we use data for the period 2001–2008 as in 2001 there was a major resampling in order to keep the DHS representative, and after 2008 our analysis could have been influenced by the economic crisis and by the accompanied changes in mortgage lending rules (Kerste et al., 2011, Scanlon and Elsinga, 2014b). Nevertheless, we check in section 5 the validity of this choice by replicating the analysis on an extended sample but find no changes to our main findings.

Of particular importance for our analysis is the questionnaire section on "economic and psychological concepts," which asks all household members about their intentions to make inter vivos transfers with only one answer allowed:

(PLAN) Do you give substantial amounts of money to your children in order to transfer part of your capital to them, or are you planning to do so in the future, e.g. every year?

1. *no*
2. *yes, I already give substantial amounts now*
3. *yes, I am planning to give substantial amounts in the future*

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4. *don't know*

This question is asked only to respondents with children, and no multiple answers are allowed. If both parents are in the sample, then both are asked for a response. Figure 1 shows that, as parents become older, they first start planning future transfers (bottom left graph) and then gradually reduce such planning in favor of actually transferring (top right graph).

The DHS also contains questions about within-family monetary transfers, especially whether respondents gave money to any family member in the year prior to interview (*IN38*), and if so, the total amount transferred (*IN39*). *IN38* and *IN39* differ from *PLAN* in that they capture transfers to any family member not just children. In particular, respondents may transfer money to their parents rather than their offspring and, based on a cross tabulation of *IN38* and *PLAN*, only about half of the respondents that report an amount transferred to family members declare they are transferring or planning to transfer a substantial amount to children. Moreover, *IN38* and *IN39* refer to the year prior to the interview while *PLAN* asks about current or planned inter vivos. While the availability of the PLAN question allows us to analyse inter vivos, the way *IN38* and *IN39* are formulated prevent from accounting in a precise way for the size of the transfer. Unfortunately, this is a limitation of the paper we cannot overcome given the data at hand.

The dataset for 2001–2008 contains 7,152 individuals and 26,198 year-person observations. Although the DHS is administered to all household members over 16, given our focus on inter vivos transfers, we restrict the sample to household heads and their spouses or cohabiting partners with at least one child. Removing observations with missing values on key variables reduces the sample to 1,892 individuals (6,648 year-person observations), after which limiting it to homeowners further reduces it to 1,465 individuals (5,053 year-person observations). We make

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this latter reduction because accurately assessing the main empirical implication of our theoretical model requires relatively wealthy parents who may face a trade-off between relieving a child's credit constraint and postponing a transfer to smooth their own consumption. Finally, for the baseline specification we restrict the sample to household heads (3,238 year-person observations). Descriptive statistics are in Table 2.

We use also data from the Income Panel Study of the Netherlands (IPO; (Centraal Bureau voor de Statistiek, 2009)) to compute a proxy of the need to borrow out of future resources and likely to be being credit constrained. As an administrative database of individual incomes collected by Statistics Netherlands from official sources such as tax records, population registry and benefit-issuing institutions (e.g., for rent subsidies), the IPO is a representative sample of the Dutch population covering an average of about 95,000 individuals per year from 1995 onward. Most important for our paper is that the IPO contains data on the demographic composition of respondents' households and notes whether they (or their partners) are homeowners. Individuals remain in the sample for as long as they are alive and residing in the Netherlands.

We use the IPO data to compute the hazard rate by age of becoming a homeowner (i.e., the probability of buying a house conditional on not yet owning one) and the hazard rate by age of having a first child in the subsequent year (i.e., the probability of giving birth conditional on not yet having children). Over the 1995–2010 period, the hazard rate of becoming a homeowner peaks right before age 30, while the hazard rate of having a first child rises to age 33 and then declines more quickly than that of buying a first home (Figure 2).[5] Because these events often mark a period in which households are in need of borrowing from future resources, we use these hazard rates to

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[5] Hazard rates cannot be computed by year because of low frequency; however, computing them over subperiods shows only very limited and gradual changes over time.

compute proxies of the likelihood of facing a credit constraint. We link the hazard rates to the DHS data using the age of each child of the respondent and sum them up by household and year. In this way we construct for each survey respondent a time varying measure of the probability of having at least one child who buys its first home in the subsequent year, and a measure of the probability that at least one of the children gives birth to his/her first child.[6] As for almost all households the purchase of a house is typically financed through a mortgage (i.e. borrowing from future resources), the former measure is our preferred proxy for the likelihood that at least one of the respondent's children is credit constrained (*PCC*) and in need of a transfer, while the latter will be used as a robustness check (see Figure 3 for the distribution by parent age of these measures and Table 2 for descriptive statistics).

4 EMPIRICAL RESULTS

In this section, we test whether children who are credit constrained and in need of borrowing from future resources are more likely to receive an inter vivos. We first define a binary indicator for the presence of, or intention to make, an inter vivos transfer based on the *PLAN* variable and then regress it on the probability that at least one child is credit constrained and in need of a transfer (*PCC*). To do so, we estimate the following linear probability model:

$$DPLAN_{it} = \beta_0 + \beta_1 PCC_{it} + \mathbf{X}'_{\mathbf{it}}\boldsymbol{\beta} + \theta_i + \mu_t + u_{it}, \qquad (8)$$

Where θ is an individual-specific fixed effect, μ is a year-specific effect that captures macro shocks, $\mathbf{X}$ contains control variables and u is an idiosyncratic error term. The dependent variable *DPLAN* takes the value 0 if the *PLAN* response is 1 (the respondent is neither transferring nor

[6] We are implicitly assuming that each child's fertility and homeownership choices are independent of those of their brothers and sisters.

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planning to transfer in the future), 3 (the respondent is planning to transfer in the future), or 4 (the respondent is still undecided whether to transfer in the future). *DPLAN* takes the value 1 if the *PLAN* response is 2 (the respondent is currently transferring). θ captures the effects of time-invariant individual characteristics such as the degree of altruism, permanent income and birth cohort. Equation (8) is estimated using a fixed effects estimator to allow θ to be correlated with $\mathbf{X}$ and PCC, and standard errors are clustered at the individual level. If there were no such correlations, a random effects estimator would be more efficient, but we reject a random effects specification for each of the models estimated below.[7]

As already mentioned, our preferred measure of *PCC* is the probability that at least one of the children buys a home for the first time. In this analysis, we assume that the higher *PCC*, the more likely it is that at least one of the children is credit constrained and in need of a transfer. This assumption relies on the observation that when an individual buys their first home, they is more likely than at other ages to be in need of borrowing out of future resources, i.e. at that time they will apply for a mortgage (against his future earnings) and is more likely than at other ages to receive an inter vivos transfer. Other studies, e.g. McGarry (2016), use children characteristics reported by their parents, including whether or not they buy a first home, as proxy of being in need of a transfer. The DHS data on respondents' children is, however, limited to age and gender and we have built *PCC* based only on the ages of the children and external information on age-specific

[7] These test results are not reported in the tables. Since standard errors are clustered, the test statistic is obtained by means of an artificial regression along the lines of MUNDLAK, Y. 1978. On the pooling of time series and cross section data. *Econometrica: journal of the Econometric Society*, 69-85.. That is, we estimate a RE linear probability model using the same set of regressors as the corresponding FE specification, plus all their time averages. An *F*-test of the joint significance of the set of time averages is asymptotically equivalent to a Hausman test.

hazards of a first home purchase obtained from the administrative IPO panel. An advantage of using this external statistic is that PCC is exogenous in equation (8) once confounding factors are controlled for. Under these assumptions, a positive effect of PCC on $DPLAN$ would provide empirical evidence in support of our theoretically derived claim that inter vivos transfers are a device by which parents can relieve their children's credit constraints.

In all specifications $\mathbf{X}$ includes respondent age-squared (age is omitted as we include individual and time fixed effects), a dummy for the presence of a partner, a quadratic polynomial in the number of children, the age of the oldest child, and the number of grandchildren. These latter variables have been shown to be correlated with inter vivos transfers (McGarry, 2016). The richer specification controls also for individual income and household wealth. We add the extra controls for the following reasons: first, tax differentials between inter vivos and bequests might induce parental anticipation or postponement of a transfer, and tax considerations are likely to be relevant for relatively wealthier households. Second, and related to the assumed exogeneity of PCC, the age profile of PCC resembles parent's lifecycle trajectory of income or wealth (Kapteyn et al., 2005). Therefore, parental income and wealth are likely candidates for inclusion as to control for possible confounding effects of PCC.

Furthermore, inter vivos may be reduced or bequest plans changed by parental precautionary savings against unforeseen income or wealth shocks like unemployment, health conditions, or longevity (Carroll, 1997). In the Netherlands, however, the pervasive welfare system tends to reduce the incentives for such postponement and precautionary savings play a limited role in portfolio decisions (Hochguertel (2003); also based on DHS data). Nevertheless, we control for precautionary savings using subjective information on the propensity to save for unforeseen

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expenses,[8] labor market status (dummies for employment or self-employment, unemployment and being out of the labor force), and self-reported health, which may also be related to an exchange motive for inter vivos transfer (Cox, 1987, Alessie et al., 2014, Almås et al., 2020).

In Table 3 we report the estimation results for two specifications of equation (47), which differ with respect to the set of control variables included in **X**. We focus on parents who are likely to be in the position of transferring wealth to their offspring by restricting the sample to homeowners. In column (1) we include in **X** only household composition variables and the age of the oldest child. The effect of PCC is positive and statistically significant: a one percentage point increase in the probability of at least one child being credit constrained increases the probability of a planned or current transfer by about 1 percentage point. The magnitude of the PCC coefficient and its standard error hardly change when the set of controls is in column (2) enlarged with other potential drivers of inter vivos transfers. Concerning these latter controls, the only statistically significant regressor is net real wealth of the parents , which suggests a role for taxes.

All in all, our empirical findings support the theoretical prediction that when the next generation (children) needs to borrow from future resources, the current generation (parents) is more likely to transfer or plan to transfer part of its wealth during its own lifetime.

5 ROBUSTNESS CHECKS

The key implication of the theorem of section 2 is that either parents transfer both via bequest and inter vivos, or they do not transfer. Therefore, in Table 4, column (1), we augment the model

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[8] Specifically, respondents are asked to rate the importance of putting aside "some savings to cover unforeseen expenses" on a scale from 1, "very unimportant," to 7, "very important."

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with a dummy variable taking on the value one if the respondent reported that they already planned to leave a substantial bequest to their children, and its interaction with *PCC*. In accordance with the theoretical implication, parents who planned a bequest were also more likely to make an inter vivos transfer. The interaction term instead is not significant. In Table 4, column (2), we extend the baseline specification by including an interaction term between *PCC* and (the hyperbolic sine of) net financial wealth. Again the interaction is not significant, suggesting that wealthier parents are not more likely to make inter vivos transfers to their credit constrained children than less wealthy parents.

The last column of Table 4 then reports estimates for including years from 1993 until 2012 rather than only 2001–2008.[9] The *PCC* parameter estimate is now smaller in magnitude than those reported in Table 3, corresponding to a 0.6 percentage points increase (rather than a 1 percentage point increase) in the probability of transferring when the children are credit constrained. This specification is clearly run on a larger sample, and a few controls turn now significant. The higher the number of children the more likely it is to observe inter vivos and being in poor health positively impacts the probability of an inter vivos which may indicate the importance of an exchange motive.

In order to allow for planned transfers to take place long after the respondent declares willingness for a future transfer, we redefine the dependent variable in column (1) of Table 5 to take the value of one also for respondent declarations of a planned future transfer. The estimated

[9] Although DHS data are also available for 2013 to 2019, we exclude these years from the sensitivity analysis because certain transitory arrangements were in place during that period that allowed parents to make very large tax-free inter vivos transfers (over 20,000 euros). Including observations from this period could therefore complicate the interpretation of the regressions.

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PCC effect obtained with this definition is very similar to the estimates in column (2), or column (1) for that matter, of Table 3. In column (2) of Table 5, in contrast, the dependent variable takes a value of one if respondents declare currently being in the act of transferring and report in *IN39* a transfer of at least 10,000 euros to family members (not limited to children) in the current year. This specification allows us to focus on substantial transfers and rule out small gifts. Here, although the *PCC* effect is still positive and statistically significant, its magnitude is somewhat smaller.

In column (3) we look at the amount transferred rather than on the probability to transfer. The dependent variable is equal to the transfer to family member (*IN39;* in thousands of euros), conditional on reporting of being currently transferring to children (*PLAN=2*). We find no significant effect of *PCC* on the amount of the inter vivos transfers. As described in Section 3, the amounts reported for this question can include transfers to friends and family members rather than only to children.

Finally, in Table 6, we consider alternative proxies for the likelihood that at least one child needs a transfer to smooth consumption, i.e. different proxies for *PCC*. In column (2) *PCC* is proxied with the hazard rate for at least one offspring having a first child *and* at least one buying a first home. The estimate coefficient is positive and significant. Because this requirement is much tighter than that used in the baseline specification (the mean probability that the joint event occurs is 0.2%, while the mean of the baseline proxy for *PCC* is 6.2%), it is reasonable to expect a higher chance of financial distress when the two events occur in the same year. Next, in columns (3) and (4), respectively, we use as our proxies the probability of at least one offspring buying a first home *or* at least one offspring having a first child in the following year and the probability of at least one having a first child in the following year. Both variables have again a positive and significant

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effect.

6 SUMMARY AND CONCLUSIONS

The very strong, albeit veiled, assumption by standard overlapping generations (OLG) models that younger generations can borrow against bequests is arguably undesirable because it means that banks lend money to dynasties rather than to individuals or that children borrow from their parents at the market interest rate. In this paper, therefore, we relax this assumption by having each generation live for two periods with earnings in both, but unable to spend out of a bequest from the previous generation until the second period. This restriction means that in its first period, each generation can borrow only up to its own second period earnings. As a result, some generations may not be able to smooth consumption, making the first best solution unattainable. Next, we allow a generation to make inter vivos transfers. This yields our main theoretical result that by allowing for inter vivos when children are not allowed to borrow against future bequest, the first best solution of the standard OLG model is restored and each generation smooths consumption.

One important implication of our economic theoretical model is that parents are likely to make inter vivos transfers to their children when these latter are credit constrained and in need of borrowing from future resources. We empirically test this implication by combining Dutch survey data on respondents' inter vivos intentions with administrative records that allow us to construct an exogenous proxy for at least one offspring being credit constrained and needing a transfer. The empirical results support the implication: the higher the probability that at least one child is credit constrained, the more likely that the parent carries out, or plans to carry out, an inter vivos transfer. This empirical outcome remains robust to a wide range of specifications and complements previous empirical evidence on tax incentives and unexpected income shocks as drivers of inter

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vivos transfers.

Altogether, our theoretical and empirical findings provide evidence for the importance of inter vivos transfers between generations as a mean for consumption smoothing within generations.

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DECLARATIONS OF INTEREST

None

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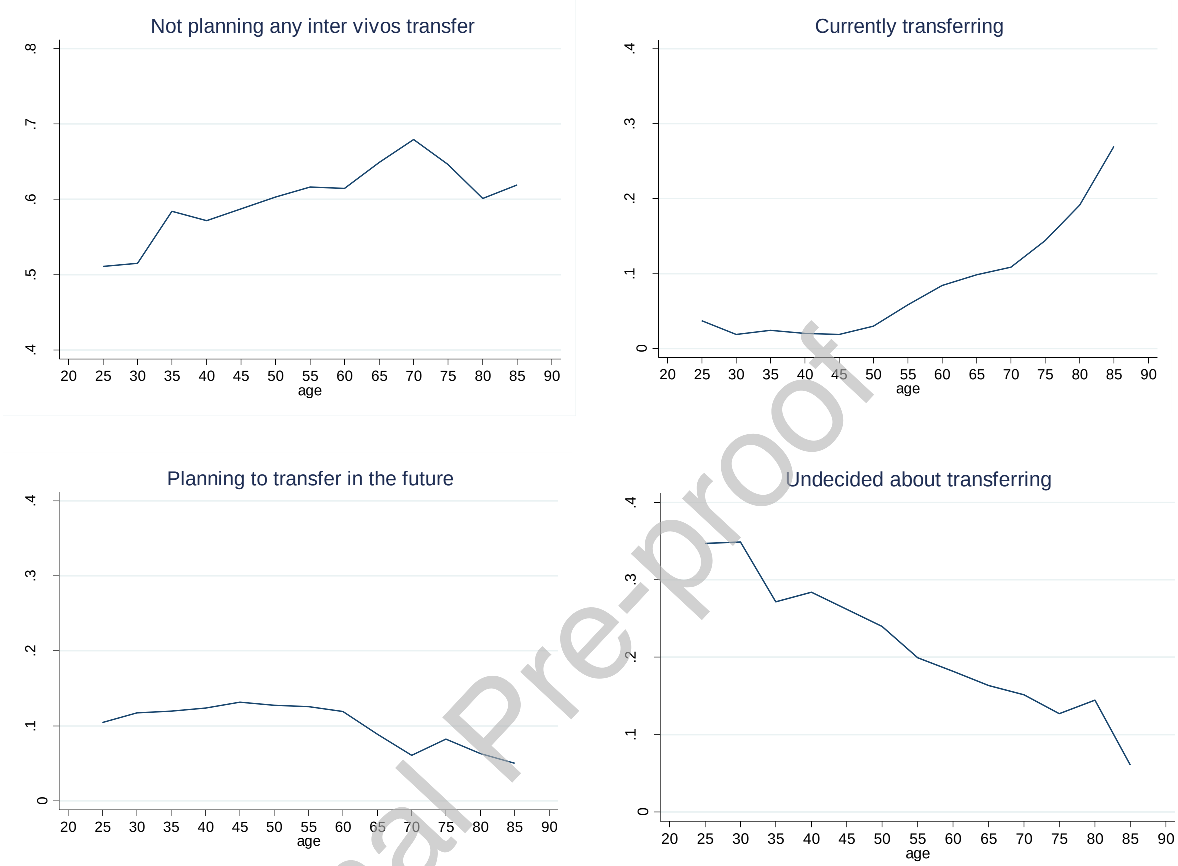
Figure 1 Sample proportions of the four possible responses on an intended inter vivos transfer (*PLAN*), by age and birth cohort.



Notes: These profiles are based on weighted sample averages, with those based on fewer than five observations set to missing, and the age range restricted to 20–80 years to avoid peaks from low response frequency.

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Figure 2 Hazard rates of buying a first house and having a first child, by age

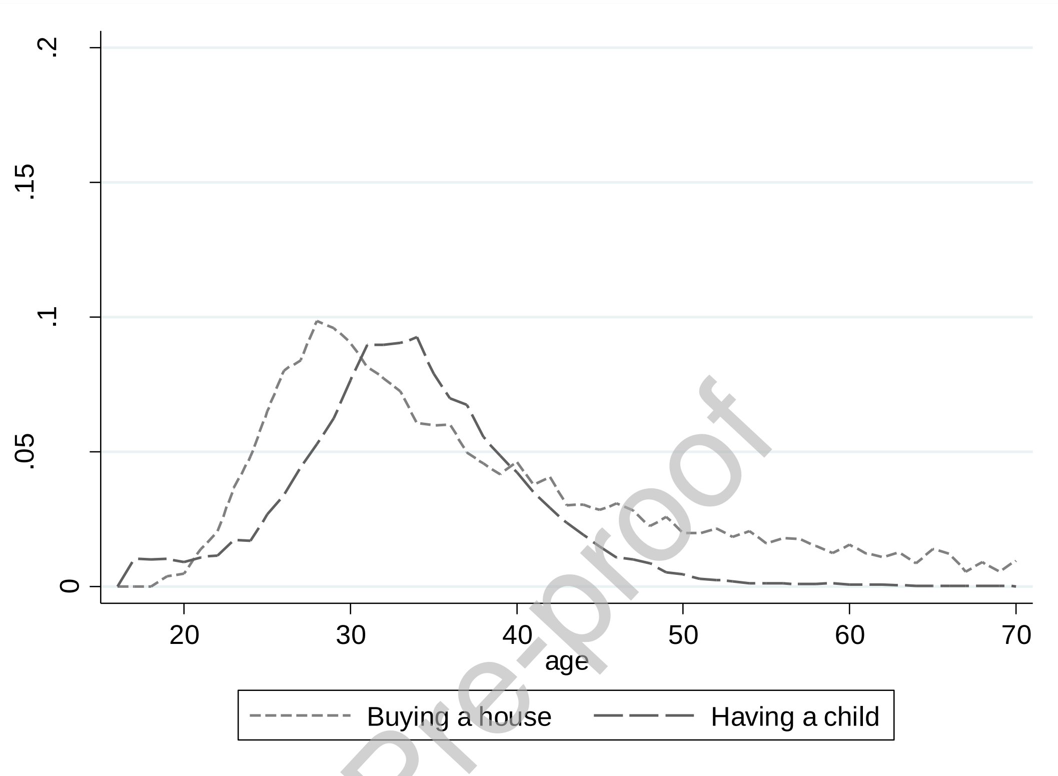

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Figure 3 Proxies of at least one offspring being credit constrained, by parent age

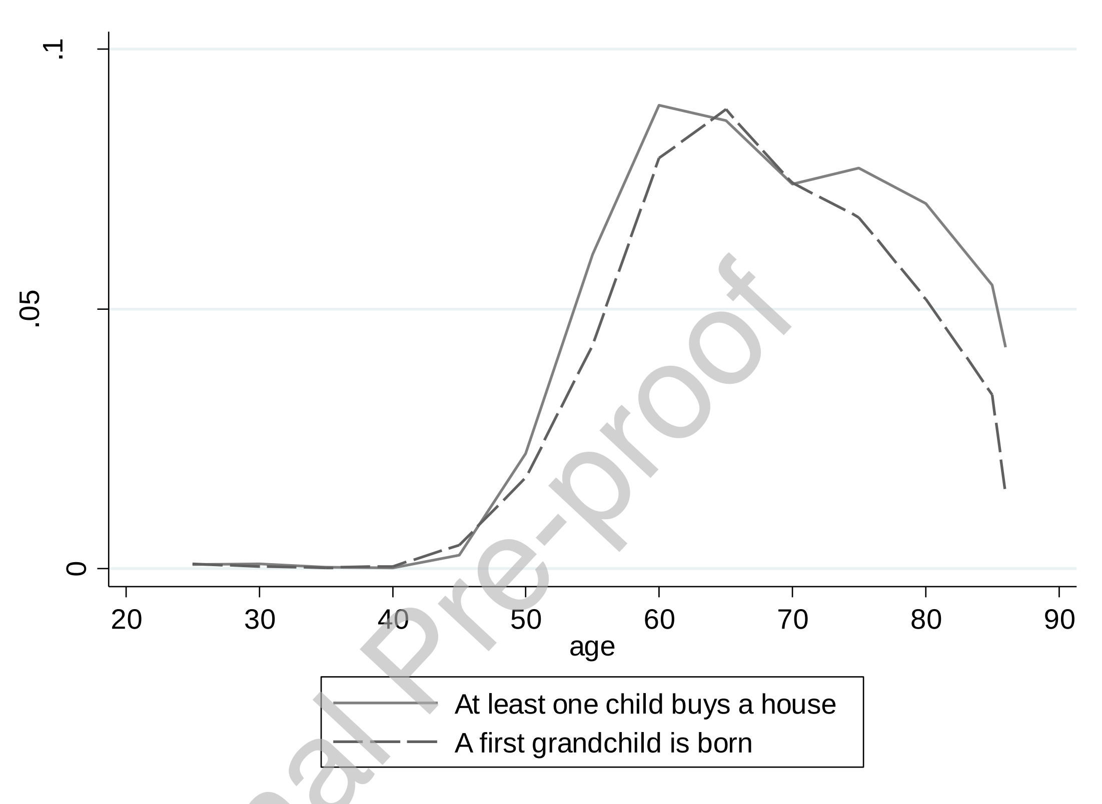

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Table 1: Model structure

		time t		time $t+1$		time $t+2$	
		beginning	end	beginning	end	beginning	end
Generation t	Money IN	y_{1t}, R_{t-1}		A_t, y_{2t+1}, b_t			
	Money OUT	c_{1t}	A_t, R_t	c_{2t+1}	b_{t+1}		
Generation $t+1$	Money IN			y_{1t+1}, R_t		$A_{t+1}, y_{2t+2}, b_{t+1}$	
	Money OUT			c_{1t+1}	A_{t+1}, R_{t+1}	c_{2t+1}	b_{t+2}
⋮							
	...	time $T-2$		time $T-1$		time T	
		beginning	end	beginning	end	beginning	end
Generation $T-2$	Money IN	y_{1T-2}, R_{T-3}		$A_{T-2}, y_{2T-1}, b_{T-2}$			
	Money OUT	c_{1T-2}	A_{T-2}, R_{T-2}	c_{2T-2}	b_{T-1}		
Generation $T-1$	Money IN			y_{1T-1}, R_{T-2}		A_{T-1}, y_{2T}, b_{T-1}	
	Money OUT			c_{1T-1}	A_{T-1}	c_{2T}	

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Table 2: Descriptive statistics

	Mean	Median	std dev	min	max
PLAN: I don't know	0.209	0	0.406	0	1
PLAN: no	0.593	1	0.491	0	1
PLAN: yes, I am currently transferring	0.077	0	0.266	0	1
PLAN: yes, I am planning to transfer	0.121	0	0.326	0	1
Probability offspring buys first home	0.039	0.005	0.054	0	0.497
Probability offspring has first child	0.034	0.01	0.049	0	0.415
Probability offspring has first child *or* buys a first home	0.069	0.022	0.093	0	0.764
Probability offspring has first child *and* buys a first home	0.002	0	0.004	0	0.037
Age	48.852	48	15.062	19	101
Number of children	1.309	1	1.366	0	9
Number of grandchildren	1.076	0	2.524	0	60
Partner present in the household	0.703	1	0.457	0	1
Age of the oldest child	22.029	20	14.397	0	67
In poor health (self-reported)	0.216	0	0.411	0	1
IHS total earnings	9.61	10.867	3.907	-11.885	14.802
IHS net financial wealth	7.982	10.277	6.523	-14.748	15.763
IHS net real wealth (includes housing wealth)	9.103	11.726	5.792	-14.763	16.159
Employed or self-employed	0.652	1	0.476	0	1
Unemployed and looking for work	0.017	0	0.128	0	1
Out of the labor force	0.331	0	0.471	0	1
Save to cover unforeseen expenses	5.609	6	1.257	1	7
IN38 (1=transfer)	1.951	2	0.217	1	2
IN39 (amount transferred in €1000, conditional on IN38=1)	7,133.321	3034.033	15,723.935	0	165,283.613

Notes: Reported statistics refer to the main estimation sample: 3,239 observations over the period 2001-2008. IHS = inverse hyperbolic sine transformation: $IHS(x) = \ln(x + \sqrt{x^2 + 1})$

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Table 3: Fixed effects estimates with making or planning an inter vivos transfer (*DPLAN*) as the dependent variable

	(1) p.e. (s.e.)	(2) p.e. (s.e.)
Probability that at least one child is credit constrained *(PCC)*	1.016***	1.040***
	(0.362)	(0.365)
Number of children	0.041	0.043
	(0.038)	(0.038)
Number of children squared	-0.005	-0.005
	(0.006)	(0.006)
Number of grandchildren	0.002	0.002
	(0.003)	(0.003)
Partner present in the household	-0.075	-0.076
	(0.063)	(0.062)
Age of the oldest child	-0.005	-0.005
	(0.006)	(0.006)
In poor health (self-reported)		-0.013
		(0.020)
IHS total earnings		-0.000
		(0.002)
IHS net financial wealth		0.001
		(0.001)
IHS net real wealth (includes housing wealth)		0.002**
		(0.001)
Employed or self-employed		-0.033
		(0.032)
Unemployed and looking for work		-0.025
		(0.029)
Save to cover unforeseen expenses		0.002
		(0.005)
Number of observations	3,239	3,239
Number of individuals	939	939

Notes: PCC=Probability offspring buys first home. All specifications include a full set of year dummies, regional dummies, and a quadratic term in age to account for nonlinear age effects. Out of the labor force is the reference category for the employed and the unemployed dummies. IHS = inverse hyperbolic sine transformation: $IHS(x) = \ln(x + \sqrt{x^2 + 1})$; p.e. = parameter estimates; s.e. = robust standard errors. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

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Table 4: Alternative specifications

	(1) Interaction PCC & bequest p.e. (s.e.)	(2) Interaction PCC & wealth p.e. (s.e.)	(3) Longer panel (1993-2012) p.e. (s.e.)
Probability that at least one child is credit constrained *(PCC)*	1.021***	1.063***	0.664***
	(0.365)	(0.370)	(0.192)
Interaction PCC with planned bequest	0.285		
	(0.347)		
Interaction PCC with financial wealth		0.029	
		(0.018)	
Planned bequest (0-1 variable)	0.078***		
	(0.021)		
Number of children	0.044	0.038	0.035**
	(0.038)	(0.038)	(0.017)
Number of children squared	-0.005	-0.005	-0.006**
	(0.006)	(0.006)	(0.002)
Number of grandchildren	0.001	0.002	0.002
	(0.003)	(0.003)	(0.002)
Partner present in the household	-0.082	-0.077	-0.004
	(0.063)	(0.062)	(0.029)
Age of the oldest child	-0.005	-0.005	-0.002
	(0.006)	(0.006)	(0.002)
In poor health (self-reported)	-0.013	-0.013	0.025**
	(0.021)	(0.020)	(0.011)
IHS total earnings	-0.000	-0.000	-0.000
	(0.002)	(0.002)	(0.001)
IHS net financial wealth	0.001	0.001	0.001
	(0.001)	(0.001)	(0.001)
IHS net real wealth	0.002**	0.002**	0.001
	(0.001)	(0.001)	(0.001)
Employed or self-employed	-0.026	-0.035	-0.014
	(0.031)	(0.032)	(0.019)
Unemployed and looking for work	-0.024	-0.027	0.007
	(0.031)	(0.029)	(0.022)
Save for unforeseen expenses	0.002	0.002	0.001
	(0.005)	(0.005)	(0.003)
Number of observations	3,191	3,239	10,389
Number of individuals	928	939	3,043

Notes: PCC=Probability offspring buys first home. All specifications include a full set of year dummies, regional dummies, and a quadratic term in age to account for nonlinear age effects. Out of the labor force is the reference category for the employed and the unemployed dummies. In column (1) it is added among the explanatory variable a dummy that takes value 1 if the respondent is planning to leave a bequest and its interaction with PCC. In column (2) includes an interaction with total wealth. When constructing these interaction terms, the variables are taken in deviations from their means. In column (3), the model is estimated on the full sample covering 1993-2012. IHS = inverse hyperbolic sine transformation: $IHS(x) = \ln(x + \sqrt{x^2 + 1})$; p.e. = parameter estimates; s.e. = robust standard errorsl. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

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Table 5: Alternative dependent variable

	(1) Only currently transferring	(2) Substantial transfers	(3) Amount transferred (in €1000)
	p.e.	p.e.	p.e.
	(s.e.)	(s.e.)	(s.e.)
Probability that at least one child is credit constrained *(PCC)*	0.922*	0.837**	73,126.581
	(0.486)	(0.348)	(151,492.734)
Number of children	0.146***	0.038	
	(0.056)	(0.036)	
Number of children squared	-0.022***	-0.004	
	(0.007)	(0.006)	
Number of grandchildren	0.011***	0.002	-1,246.561
	(0.003)	(0.003)	(1,638.257)
Partner present in the household	-0.052	-0.064	-660.230
	(0.084)	(0.072)	(3,505.944)
Age of the oldest child	-0.005	-0.005	7,982.719
	(0.007)	(0.006)	(7,532.090)
In poor health (self-reported)	0.020	-0.020	-1,752.270
	(0.027)	(0.021)	(2,928.592)
IHS total earnings	0.004	0.000	3,010.350
	(0.002)	(0.002)	(3,368.282)
IHS net financial wealth	-0.002	0.001	85.971
	(0.002)	(0.001)	(327.006)
IHS net real wealth	0.001	0.002**	-1,298.634
	(0.002)	(0.001)	(1,953.375)
Employed or self-employed	0.003	-0.028	-1,381.367
	(0.040)	(0.031)	(5,145.749)
Unemployed and looking for work	-0.116**	0.051	
	(0.059)	(0.055)	
Save for unforeseen expenses	0.008	0.002	203.789
	(0.008)	(0.005)	(933.384)
Number of observations	3,239	3,239	91
Number of individuals	939	939	49

Notes: All specifications include a full set of year dummies, regional dummies, and a quadratic term in age to account for nonlinear age effects. Out of labor force is the reference category for the employed and the unemployed dummies. In column (1) the dependent variable takes value 1 only if the parent is transferring at the time of the interview. In column (2), the dependent variable equals 1 if the parent is making transfers and the transfers to family members are over 10,000 euros per year; In column (3) the dependent is the amount transferred to children, family and friends (IN39), conditional on being transferring to children at the time of interview (PLAN=2). IHS = inverse hyperbolic sine transformation: $IHS(x) = \ln(x + \sqrt{x^2 + 1})$; p.e. = parameter estimates; s.e. = robust standard errors. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

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Table 6: Alternative proxies for credit constraints

	(1) Baseline (First home)	(2) Intersection first home & first child	(3) Union first home & first child	(4) First child
	p.e. (s.e.)	p.e. (s.e.)	p.e. (s.e.)	p.e. (s.e.)
Number of children	0.043	0.040	0.039	0.036
	(0.038)	(0.037)	(0.037)	(0.037)
Number of children squared	-0.005	-0.004	-0.005	-0.003
	(0.006)	(0.006)	(0.006)	(0.006)
Number of grandchildren	0.002	0.001	0.002	0.001
	(0.003)	(0.002)	(0.003)	(0.003)
Partner present in the household	-0.076	-0.076	-0.078	-0.078
	(0.062)	(0.062)	(0.063)	(0.063)
Age of the oldest child	-0.005	-0.004	-0.005	-0.004
	(0.006)	(0.006)	(0.007)	(0.006)
In poor health (self-reported)	-0.013	-0.012	-0.013	-0.012
	(0.020)	(0.020)	(0.021)	(0.021)
IHS total earnings	-0.000	-0.000	-0.000	-0.000
	(0.002)	(0.002)	(0.002)	(0.002)
IHS net financial wealth	0.001	0.001	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)
IHS net real wealth	0.002**	0.002***	0.002**	0.002***
	(0.001)	(0.001)	(0.001)	(0.001)
Employed or self-employed	-0.033	-0.016	-0.027	-0.018
	(0.032)	(0.031)	(0.032)	(0.031)
Unemployed and looking for work	-0.025	-0.011	-0.020	-0.014
	(0.029)	(0.028)	(0.029)	(0.028)
Save for unforeseen expenses	0.002	0.002	0.002	0.001
	(0.005)	(0.005)	(0.005)	(0.005)
PCC measures	1.040***			
Probability at least one of the children buys a first home	(0.365)			
		10.447**		
Probability at least one of the children has first child *and* one of the children buys first home		(4.198)		
			0.640***	
Probability at least one of the children has first child *or* one of the children buys first home			(0.228)	
				0.964**
Probability at least one of the children has first child				(0.399)
Number of observations	3,239	3,239	3,239	3,239
Number of individuals	939	939	939	939

Notes: All specifications include a full set of year dummies, regional dummies, and a quadratic term in age to account for nonlinear age effects. Out of the labor force is the reference category for the employed and the unemployed dummies. IHS = inverse hyperbolic sine transformation: $IHS(x) = \ln(x + \sqrt{x^2 + 1})$; p.e. = parameter estimates; s.e. = robust standard errors. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

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APPENDIX

1 No inter vivos and no credit constraints

We assume there are no inter vivos (i.e., $R_s = 0\ \forall s$) and each generation faces no credit constraints and can borrow against future earnings and bequests. In this case, generation t maximizes its utility V_t with respect to the choice variables $c_{1t}, c_{2t+1}, A_t, b_{t+1}$:

$$\max_{c_{1t}, c_{2t+1}, A_t, b_{t+1}} u(c_{1t}) + u(c_{2t+1}) + \alpha V_{t+1}, \tag{9a}$$

subject to the following constraints:

$$c_{1t} = y_{1t} - A_t, \tag{9b}$$

$$c_{2t+1} = y_{2t+1} + A_t + b_t - b_{t+1}, \tag{9c}$$

$$b_{t+1} \geq 0. \tag{9d}$$

We assume $\lim_{x \to 0} u'(x) = \infty$, which rules out corner solutions at zero consumption. Then, from constraints (3) and (4), it follows that

$$A_t \in (-y_{2t+1} - b_t, y_{1t}), \tag{10}$$

meaning that generation t can borrow in period 1 from bequest b_t to be received in period 2.

Because the choices related to the transfers of generation t affect the behavior of the subsequent generation, a transversality condition is needed to solve the model by backward induction (Kamihigashi, 2008). That is, $t = T$ is such that the transfer b_T from generation $T-1$ to generation T is optimal. Then, conditional on b_T, the maximization can be solved for generation $T-1$ and then backwards for each previous generation.

Here, the optimality of b_T implies that generation $T-1$ maximizes its utility only with respect to c_{1T-1} and $c_{2\mathrm{T}}$, or equivalently with respect only to A_{T-1}. This leads to consumption smoothing:

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$$c_{1T-1} = c_{2T} = \frac{y_{1T-1}+y_{2T}+b_{T-1}-b_T}{2}. \quad (11)$$

The value of A_{T-1} at the optimum thus depends on the bequest b_{T-1} that generation $T-1$ receives from generation $T-2$:

$$A_{T-1} = \frac{y_{1T-1}-y_{2T}+\mathrm{b_T}-b_{T-1}}{2}. \quad (12)$$

Generation $T-2$ anticipates that generation $T-1$ will optimize its own utility, taking bequest b_{T-1} from generation $T-2$ as given. A_{T-1} at the optimum is a function of (exogenous) earnings only and a choice variable of generation $T-2$; that is, b_{T-1}. Hence, the utility of generation $T-1$, V_{T-1}, is a function of the generation $T-2$ choice variables only. Formally, it means that generation $T-2$'s optimization problem can be rewritten by adding A_{T-1} to the choice variables and adding in the constraints on generation $T-1$:

$$V_{T-2}(b_{T-2}) = \max_{A_{T-2},A_{T-1},b_{T-1}} \mathrm{u}(c_{1T-2}) + u(c_{2T-1}) + \alpha[u(c_{1T-1}) + u(c_{2T})], \quad (13a)$$

subject to

$$c_{1T-2} = y_{1T-2} - A_{T-2}, \quad (13b)$$

$$c_{2T-1} = y_{2T-1} + A_{T-2} + b_{T-2} - b_{T-1}, \quad (13c)$$

$$b_{T-1} \geq 0, \quad (13d)$$

$$c_{1T-1} = y_{1T-1} - A_{T-1}, \quad (13e)$$

$$c_{2T} = y_{2T} + A_{T-1} + b_{T-1} - b_T. \quad (13f)$$

From the first order conditions, it follows that

$$A_{T-2} = \frac{y_{1T-2}+b_{T-1}-y_{2T-1}-b_{T-2}}{2}, \quad (14)$$

which leads to consumption smoothing:

$$c_{1T-2} = c_{2T-1} = \frac{y_{1T-2}+y_{2T-1}+b_{T-2}-b_{T-1}}{2}. \quad (15)$$

Note that V_{T-1} at the optimum depends directly on the choice variables of generation $T-2$ (i.e.,

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b_{T-1}) and only indirectly on those of generation $T-3$.

Likewise, V_t at the optimum depends on the generation t choice variable b_{t+1} and on the choice variables of generation $t-1$ (i.e., b_t):

$$V_t = u(c_{1t}) + u(c_{2t+1}) + \alpha V_{t+1}(b_{t+1}) \tag{16}$$

In equilibrium then each generation smooths consumption:

$$c_{1t} = c_{2t+1} = \frac{y_{1t}+y_{2t+1}+b_t-b_{t+1}}{2}. \tag{17}$$

2. Proof of the theorem in Section 2

The Lagrangian function corresponding to optimization problem (6a)-(6h) is equal to

$$\begin{aligned} L \quad &= u(y_{1t} - A_t + R_{t-1} - R_t) + u(y_{2t+1} + A_t + b_t - b_{t+1}) \\ &+\alpha\left[u(y_{1t+1} - A_{t+1} + R_t - R_{t+1}) + u(y_{2t+2} + A_{t+1} + b_{t+1} - b_{t+2}) + \alpha V_{t+2}(R^*_{t+1}, b_{t+2})\right] \\ &+\mu_{t+1}(b_{t+1}) + \nu_t(R_t) + \lambda_t(A_t + y_{2t+1}) + \lambda_{t+1}(A_{t+1} + y_{2t+2}). \end{aligned}$$

From the first order conditions, it then follows that

$$u'(c_{1t}) = u'(c_{2t+1}) + \lambda_t \Leftrightarrow u'(c_{1t}) = u'(c_{2t+1})(1 + \lambda^*_t), \tag{18a}$$

$$\alpha u'(c_{1t+1}) = \alpha u'(c_{2t+2}) + \lambda_{t+1} \Leftrightarrow \alpha u'(c_{1t+1}) = u'(c_{2t+2})(\alpha + \lambda^*_{t+1}), \tag{18b}$$

$$u'(c_{2t+1}) = \alpha u'(c_{2t+2}) + \mu_{t+1} \Leftrightarrow u'(c_{2t+1}) = u'(c_{2t+2})(\alpha + \mu^*_{t+1}), \tag{18c}$$

$$u'(c_{1t}) = \alpha u'(c_{1t+1}) + \nu_t \Leftrightarrow u'(c_{1t}) = u'(c_{1t+1})(\alpha + \nu^*_t), \tag{18d}$$

where $\lambda^*_\tau = \frac{\lambda_\tau}{u'(c_{2\tau+1})}$ for $\tau = t, t+1$ denote rescaled Kuhn-Tucker multipliers corresponding to the two credit constraints (40); and $\mu^*_{t+1} = \mu_{t+1}/u'(c_{2t+2})$ and $\nu^*_t = \nu_t/u'(c_{1t+1})$ are the rescaled Kuhn-Tucker multipliers corresponding to the nonnegativity constraints (6f) and (6g). Equations (18a) to (18d) imply the following relation between these four rescaled Kuhn-Tucker multipliers:

$$\frac{(\alpha+\lambda^*_{t+1})}{\alpha(1+\lambda^*_t)} = \frac{(\alpha+\mu^*_{t+1})}{(\alpha+\nu^*_t)}. \tag{19}$$

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Equation (19) rules out the possibility that only one of the four inequality constraints in (6f), (6g), and (6h) is binding. If that was the case, only one of these multipliers would be positive with the others equal to zero, so (19) would be violated. Equation (19) also rules out the following two cases:

$$\lambda_t^* > 0; \lambda_{t+1}^* = 0; \mu_{t+1}^* > 0; \nu_t^* = 0,$$

$$\lambda_t^* = 0; \lambda_{t+1}^* > 0; \mu_{t+1}^* = 0; \nu_t^* > 0.$$

At the same time, generation $t+1$ can be neither credit constrained ($A_{t+1} = -y_{2t+2}, \lambda_{t+1}^* > 0$) nor a bequest nonrecipient ($\mathrm{b}_{t+1} = 0, \mu_{t+1}^* > 0$) because, according to equation (6e) ($c_{2t+2} = -b_{t+2} \leq 0$), in the latter case, generation $t+1$'s period 2 consumption would not be positive. There are thus no admissible solutions in which generation t smooths consumption while generation $t+1$ is credit constrained. In fact, based on a dynamic programming argument, no successive generations from $t+2$ onward can be credit constrained.

Finally, because $R_0 = b_1 = 0$, equation (7a) holds for $t = 1$, meaning that generation 1 is not credit constrained and smooths consumption. Likewise, based on the previous argument, successive generations are also not credit constrained.[10] Hence, after ruling out all the inadmissible cases, we find that at the optimum, either

$$c_{1t} = c_{2t+1}(\lambda_t^* = 0);\ c_{1t+1}^* = c_{2t+2}^*(\lambda_{t+1}^* = 0);\ b_{t+1} > 0(\mu_{t+1}^* = 0);\ R_t > 0(\nu_t^* = 0)$$

or

$c_{1t} = c_{2t+1}(\lambda_t^* = 0);\ c_{1t+1}^* = c_{2t+2}^*(\lambda_{t+1}^* = 0);\ b_{t+1} = 0(\mu_{t+1}^* > 0);\ R_t = 0(\nu_t^* > 0)$. Thus, all generations smooth consumption, and the first best solution is restored. ■

[10] It should further be noted that even though $R_0 = b_1 = 0$ is a natural choice, any combination of R_0 and b_1 that satisfies equation (41a) would allow generation 1 to smooth consumption.

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Declaration of interests

☒ The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

☐ The authors declare the following financial interests/personal relationships which may be considered as potential competing interests:

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