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The impact of bequest motives on labor supply and retirement behavior in Japan: A theoretical and empirical analysis

Charles Yuji Horioka [a,*], Emin Gahramanov [b], Aziz Hayat [c], Xueli Tang [d]

[a] Research Institute for Economics and Business Administration, Kobe University, Japan; Asian Growth Research Institute, Japan; and Institute of Social and Economic Research, Osaka University, Japan; and National Bureau of Economic Research, United States of America
[b] American University of Sharjah, United Arab Emirates
[c] Deakin University, Australia
[d] Deakin University, Australia

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ABSTRACT

Do individuals who want to leave a bequest work more and retire later than other individuals? Does the reason for wanting to leave a bequest (altruism vs. exchange) matter? In this paper, we conduct a theoretical and empirical analysis of the impact of bequest motives on the labor supply and retirement behavior of households in Japan, and to the best of our knowledge, it is virtually the first paper to do so. We conduct an empirical analysis using micro data from a unique survey—the Preference Parameters Study of Osaka University—and show that respondents with an altruistic or strategic/exchange bequest motive work more at the intensive margin than those without any bequest motive but that respondents with a strategic or exchange bequest motive work less at the extensive margin (i.e., retire earlier) than those without any bequest motive. Our findings for the strategic or exchange motive suggest that respondents with such a motive tend to work more than others before they retire so that they can earn more, leave a larger bequest to their children, and elicit more care from them but that they tend to retire earlier than others so that they can start receiving care for themselves and their spouses from their children sooner. Our findings have important policy implications because they imply that inheritance taxes may affect people's labor supply and retirement behavior by influencing the strength of their bequest motives and that these effects may differ by the type of bequest motive.

1. Introduction

Parents and children are connected in various ways, and one of the most important ways in which they are connected is through intergenerational transfers (i.e., bequests and inter vivos transfers) from parents to children. The desire to leave bequests and other intergenerational transfers to one's children is likely to affect the economic behavior of parents in many ways. In other words, it is quite possible that parents planning to leave a bequest to their children will behave very differently from those not planning to leave a bequest to their children. For example, parents planning to leave a bequest to their children may save more than those not planning to leave a bequest to their children because they need to save not only to finance their own retirement needs but also to leave a bequest to their children. Similarly, parents planning to leave a bequest to their children may work more at the intensive margin (i.e., work more hours per day and/or more days per year) and/or at the extensive margin (i.e., work longer and retire later) than those not planning to leave a bequest to their children so that they can increase their lifetime incomes and thence the amount that they can bequeath to their children. Moreover, work-related outcomes at both the intensive and extensive margins may differ by the nature of bequest motives (for example, by whether they are motivated by altruistic or strategic/exchange considerations). Surprisingly, however, little or no research has been done on the bequest-work relationship of parents, and the purpose of this paper is to fill this gap in the literature.

In this paper, we conduct a theoretical and empirical analysis of the impact of bequest motives on the labor supply and planned retirement decisions of households in Japan. We try to provide answers to the following two questions: (1) Do individuals who want to leave a bequest work more and retire later than other individuals? (2) Does the reason

* Corresponding author at: Research Institute for Economics and Business Administration, Kobe University, 2-1, Rokkodai-cho, Nada-ku, Kobe, Hyogo 657-8501, Japan.
E-mail address: horioka@rieb.kobe-u.ac.jp (C.Y. Horioka).

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for wanting to leave a bequest (altruism vs. exchange) matter? We first do a theoretical analysis of the impact of altruistic and strategic/exchange bequest motives on work-related outcomes at the intensive and extensive margins. We then test our theoretical model's predictions empirically using micro data from the Preference Parameters Study (*Kurashi no Konomi to Manzokudo ni tsuite no Chousa)* of Osaka University, a unique survey that collects detailed information on bequest motives, labor supply, planned retirement, and all of the other variables needed for our analysis. Consistent with our theoretical model's predictions, we find that respondents with an altruistic or strategic/exchange bequest motive work more at the intensive margin (empirically measured by individual's working hours per week) than those without any bequest motive but that respondents with a strategic or exchange bequest motive work less at the extensive margin (i.e., retire earlier, empirically measured by planned/desired retirement age) than those without any bequest motive. Our findings for the strategic or exchange bequest motive are entirely plausible because respondents with such a motive may want to work more than others before they retire so that they can earn more, leave a larger bequest to their children, and elicit more care from them but that they may want to retire earlier than others so that they can start receiving care from their children sooner.

Moreover, the altruistic bequest-work relationship in Japan appears to be driven primarily by young respondents (those aged less than 40 years), which suggests that altruistic respondents decide their work behavior at a relatively young age. By contrast, the strategic or exchange bequest-work relationship appears to be driven primarily by male respondents, especially married males. A possible explanation for the latter finding is that married males have a greater demand for care from their children because they as well as their wives are potential care recipients.

We employ a battery of robustness checks to show that our empirical findings concerning the bequest-work relationship are highly robust, remaining significant and consistent with the predictions of our theoretical model in every case.

We make an original contribution to the literature in at least three respects. First, our paper is virtually the first paper to conduct a theoretical and empirical analysis of the impact of bequest motives on the labor supply and retirement behavior of parents. Many studies have analyzed the impact of time and monetary transfers from parents on the recipients' (children's) work behavior (see, for example, Holtz-Eakin et al. (1993), Joulfaian and Wilhelm (1994), Wolff (2006), Dustman et al. (2009), Gong (2009), Brown et al. (2010), Dimova and Wolff (2011), Elinder et al. (2012), Blau and Goodstein (2016), and Doorley and Pestel (2016) for studies for other countries and Sugano and Matsuyama (2017) and Niizeki and Hori (2019) for studies for Japan), and most of these studies find that the receipt of bequests and inter vivos transfers reduces the work behavior (the workforce participation, the number of hours worked, and the retirement age) of recipients (the so-called "Carnegie conjecture"). Similarly, many previous studies have examined the impact of bequest motives on saving and wealth accumulation behavior, and most of them have found that parents planning to leave a bequest to their children do, in fact, save more than those not planning to leave a bequest to their children (see, for example, Horioka et al. (1996), Horioka et al. (2002), Horioka and Niimi (2017), Niimi and Horioka (2019), and Ventura and Horioka (2020); see Hurd (1990) for a comprehensive survey). However, we have not been able to find any papers that analyze the impact of bequest motives on the work behavior of bequest givers (parents). The only related paper of which we are aware is Brown et al. (2015), which finds that Croatian retirees are more likely to opt for a larger but deferred stream of pension benefits if they have a stronger bequest motive. To the extent that those who choose to defer are more likely to continue working, this result implies that bequest motives have an impact on retirement behavior.

Second, our paper is unique in distinguishing among different types of bequest motives including altruistic and selfishly motivated strategic or exchange bequest motives and in showing that the impact of bequest motives on labor supply and retirement behavior differs by the type of bequest motive.

Third, to the best of our knowledge, this paper is the first to conduct an analysis of the impact of bequest motives on labor supply and retirement behavior for the case of Japan. As Horioka (2014, 2021) shows, bequest motives are predominantly altruistic in the United States, India, and other countries whereas they are more heterogeneous in Japan, with altruistic and selfishly motivated strategic or exchange bequest motives coexisting. Since the impact of bequest motives on labor supply and retirement behavior differs by the type of bequest motive, it is especially interesting to analyze the Japanese case.

Our findings have important policy implications because they imply that inheritance taxes may affect people's labor supply and retirement behavior by influencing the strength of their bequest motives and that these effects may differ by the nature of their bequest motives, as discussed in greater detail in the concluding section.

The remainder of this paper is organized as follows: Section 2 presents a theoretical model of the impact of bequest motives on labor supply and retirement behavior, Section 3 tests the predictions of our theoretical model about the impact of bequest motives on work behavior (e.g., working hours and planned retirement age) using micro data from the Preference Parameters Study of Osaka University, and Section 4 is a concluding section.

2. The theoretical model

In this section, we present a theoretical model that shows the impact of bequest motives on labor supply and retirement behavior. In subsection 2.1, we present the basic setup of the model; in subsection 2.2, we consider the case of altruistic bequest motives; in subsection 2.3, we consider the case of strategic or exchange bequest motives; and in subsection 2.4, we summarize our findings.

2.1. Basic setup

Dynamic optimization models resulting in closed-form solutions to endogenous consumption, saving, and labor supply are, to our knowledge, rare. They are often used in quantitative finance and related economics literature to investigate decision-making under uncertainty. For example, Rogers (2013) augments a standard infinite-horizon Merton problem with the intensive margin of labor supply and numerically simulates the solutions. Similarly, Rogers (2013, p. 99) presents a Merton-type model with endogenous retirement and presents an explicit solution to the critical value of wealth that would trigger retirement. Farhi and Panageas (2007) endogenize risky investment with endogenous retirement choice only. This allows the authors to focus on closed-form solutions. Our model abstracts from risky investment and focuses on closed-form solutions pertinent to both margins of labor supply in the context of parent-offspring transfers. The dynamic quantitative-theoretical literature with labor supply is large. The interested reader might refer, for instance, to Bagchi's (2015) study, which numerically simulates the effect of the U.S. Social Security system on different margins of labor supply in an environment with mortality and labor income risk and also cites many studies that look at dynamic pension reforms and labor supply distortions.

Our model features a standard bounded optimal control framework in which we focus on closed-form solutions by explicitly taking into account the time constraint on leisure. Most standard theoretical studies with closed-form solutions consider an interior solution with respect to labor supply for ease of exposition (e.g., Bütler 2001), but we follow the approach developed in Gahramanov and Tang (2016a,b) for deriving the optimal age of retirement and hours worked. In addition, under various assumptions, we are able to provide analytic solutions for the optimal inheritance level.

Our model is set in continuous time, and time itself is denoted by t. To derive closed-form solutions, we attempt to keep the environment as

simple as possible. The main decision-maker (the "agent" or "parent") enters the workforce at birth ($t = 0$) and exits the model by age $t = T > 0$. The time endowment is normalized to unity. The retirement age (T_{ret}) must be chosen optimally. For each unit of labor endogenously devoted to market work at date t, exogenously determined efficiency units ($e(t)$) are supplied to production. The wage per labor efficiency unit is $w > 0$. All wage income not consumed flows into the individual's financial asset account $k(t)$, which grows at rate r. The main decision-maker starts the life cycle with a given amount of bequest received from her own parent ($B^R \geq 0$), and she finishes the life cycle with some assets k (determined endogenously) that she will bequeath to her offspring at time $t = T$.

Suppose that culture and social norms help to shape the care level a person might devote to her parent (and possibly to others, such as other family members). The overall amount of care requires a sacrifice of time and is a strictly increasing function of the bequest received (see subsection 2.2 for more discussion of this.)

Remark 1. From hereonin, we assume that the main decision-maker starts her life with no assets ($B^R = 0$), and provides no care to her own parents. This assumption is innocuous because at the start of the model, B^R and the resulting care-to-own-parents will be exogenously given by assumption and will be mainly driven by the decisions of the parents of the main decision-maker. Setting these values to zero allows us to state our forthcoming solutions in a more compact way and to focus exclusively on the interaction between the main decision-making agent and her children.

The agent enjoys (derives utility from) private consumption ($c(t)$) and personal leisure ($l(t)$). Note that the agent's hours of work ($1 - l(t)$) are endogenous since $l(t)$ is a choice variable. In what follows, we consider two separate cases—the case of an altruistic bequest motive and the case of a selfishly motivated strategic or exchange bequest motive.

2.2. Case 1: altruistic bequest motives

When modeling the case of altruistic bequest motives, we assume that the bequest left by the parent increases her utility because it increases the present value of resources available to her child and thus by implication the child's ultimate consumption. By contrast, Wilhelm (1996), Kopczuk (2010), and especially Laitner and Ohlsson (2001) have in mind Barro-type recursive altruism models in which the parent cares about the *consumption* and therefore the well-being of her children, grandchildren, and more distant descendants. These models assume that the inheritance provided by the parent directly influences the consumption available to the child (see Eq. (1) on p. 208 in Laitner and Ohlsson, 2001). Laitner and Ohlsson (2001, p. 210) and Kopczuk (2010, p. 6) differentiate our formulation from the altruism model and refer to it as the "egoistic model" or the "joy-of-giving model," and indeed the two formulations have very different implications for public policy. However, since we are not concerned about Ricardian equivalence or tax considerations, we can presume that this fine distinction in the parent's motivations is not important for our purposes and that our Case 1 corresponds in broad terms to the "altruistic bequest motive" setting. Wilhelm (1996) makes a similar argument (see also Arrondel and Masson, 2006, and Laferrere and Wolff, 2006).

The objective in our altruism model is to maximize

$$U = \int_0^T e^{-\rho t}(\phi_1 \ln[c(t)] + \phi_2 \ln[l(t)])dt + \gamma e^{-\rho T} \ln[\Psi(k(T))], \tag{1}$$

where ϕ_1, ϕ_2, γ are positive constants, and ρ is nonnegative.

Remark 2. Let function Ψ summarize the present value of economic resources available to the child over the latter's lifetime as seen from the perspective of the decision-making parent. We assume that the parent believes that if her offspring is given a larger bequest, this will increase the present value of resources available to the latter; that is, $\frac{\partial \Psi}{\partial k(T)} > 0$.[1]

Observe from (1) that a function of the terminal stock $k(T)$ is added to the integral, and this "scrap value function" has the standard economic interpretation (e.g., Léonard and Van Long, 1992, pp. 226-229). In other words, the parent attaches some positive value to what she leaves behind at time T because she has an altruistic bequest motive.

The optimization problem is subject to the dynamic budget equation, control constraints, and the endpoint conditions given in (2)-(5):

$$\frac{dk(t)}{dt} = rk(t) + w\epsilon(t)(1 - l(t)) - c(t), \tag{2}$$

$$0 \leq l(t) \leq 1, \tag{3}$$

$$k(0) = 0, \tag{4}$$

$$k(T) = \text{free}. \tag{5}$$

Eq. (4) is consistent with Remark 1. Note that the chosen utility function allows us to ignore the additional control constraint on $c(t)$. Further, given (5), the solution to the problem can be obtained by using a transversality condition for a free endpoint with scrap value that would essentially equate the marginal benefit of an increase in the terminal asset level to the associated marginal cost over the entire time interval. For ease of exposition, however, we proceed with the two-step procedure outlined in the remark below when deriving the solution.

Remark 3. Here we adapt the two-step solution strategy as follows: (i) solve the optimization problem treating $k(T)$ as fixed (i.e., $k(T)$ is arbitrarily fixed at some amount of B^G or "bequest given"), and then (ii) solve for the optimal value of B^G given that consumption and labor supply are chosen optimally for every possible B^G value.[2]

In the first step, we thus define the Hamiltonian function

$$H_1 = e^{-\rho t}(\phi_1 \ln[c(t)] + \phi_2 \ln[l(t)]) + \mu(t)(rk(t) + w\epsilon(t)(1 - l(t)) - c(t)), \tag{6}$$

where $\mu(t)$ is a dynamic multiplier. Optimal controls must satisfy the following conditions:

$$\frac{dk(t)}{dt} = \frac{\partial H_1}{\partial \mu(t)} = rk(t) + w\epsilon(t)(1 - l(t)) - c(t), \tag{7}$$

$$\frac{d\mu(t)}{dt} = -\frac{\partial H_1}{\partial k(t)} = -\mu(t)r, \tag{8}$$

and

$$\max_{\{1-l(t)\geq 0, c(t)\}} H_1 \Leftrightarrow$$

$$\max_{\{1-l(t)\geq 0, c(t)\}} \{H_2 = e^{-\rho t}(\phi_1 \ln[c(t)] + \phi_2 \ln[l(t)]) + \mu(t)(w\epsilon(t)(1 - l(t)) - c(t))\}. \tag{9}$$

A necessary condition is that there exists a dynamic multiplier $\lambda(t) \leq 0$ such that if the Lagrangian of the Hamiltonian

$$H = e^{-\rho t}(\phi_1 \ln[c(t)] + \phi_2 \ln[l(t)]) + \mu(t)(w\epsilon(t)(1 - l(t)) - c(t)) + \lambda(t)(l(t) - 1), \tag{10}$$

then (11)-(14) hold:

$$\frac{\partial H}{\partial c(t)} = \phi_1 e^{-\rho t} c(t)^{-1} - \mu(t) = 0, \tag{11}$$

[1] In principle, it is possible that a larger bequest would discourage, say, work effort and ultimately leave the child financially worse off (or no better off), but we assume that the parent rules out such a possibility when making a decision.

[2] Furthermore, since the solution to such dynamic problems can still easily become cumbersome, we will assume that the discount rate and the interest rate are equal in order to facilitate the analysis.

$$\frac{\partial H}{\partial l(t)} = \phi_2 e^{-\rho t} l(t)^{-1} - \mu(t) w\epsilon(t) + \lambda(t) = 0, \tag{12}$$

$$\lambda(t)(l(t) - 1) = 0, \tag{13}$$

$$1 - l(t) \geq 0. \tag{14}$$

We focus our attention on standard labor supply behavior. Let there be some internal point in time $T_{ret} \in (0, T)$ (to be determined) on or after which the agent stops working, and hence $l(t) = 1$. Thus,

$$l(t) < 1 \text{ for } t \in [0, T_{ret}), \tag{15}$$

$$l(t) = 1 \text{ for } t \in [T_{ret}, T]. \tag{16}$$

The complementarity condition implies that if $\lambda(t) = 0$, then $l(t) < 1$, and we have the following system of equations:

$$\begin{pmatrix} k(t) \\ \mu(t) \end{pmatrix}' = \begin{pmatrix} rk(t) + w\epsilon(t)(1 - l(t)) - c(t) \\ -\mu(t) r \end{pmatrix} \tag{17}$$

for $t \in [0, T_{ret})$.

If, on the other hand, $\lambda(t) < 0$, then $l(t) = 1$, and we have the following system of equations:

$$\begin{pmatrix} k(t) \\ \mu(t) \end{pmatrix}' = \begin{pmatrix} rk(t) - c(t) \\ -\mu(t) r \end{pmatrix} \tag{18}$$

for $t \in [T_{ret}, T]$. Hence, the optimal solution can be found by joining together the solutions of (17)-(18). Note that the function $\mu(t)$ is defined over the entire planning interval, and from (17) and (18) we see that it obeys the same law of motion. Since the function is continuous, we obtain

$$\mu(t) = ae^{-rt} \text{ for } t \in [0, T], \tag{19}$$

where a is a constant to be determined.

From (11), we obtain

$$c(t) = \phi_1 e^{-\rho t} / \mu(t). \tag{20}$$

Now, note that if $\lambda(t) = 0$, then $l(t) < 1$. Hence, (12) leads to

$$\mu(t) = ae^{-rt} = \phi_2 e^{-\rho t} l(t)^{-1} (1 / w\epsilon(t)). \tag{21}$$

Recall that $l(T_{ret}) = 1$. Substituting this into (21) (and recalling that $r = \rho$), we can express the constant a in terms of T_{ret} as

$$a \equiv a(T_{ret}) = \phi_2 / (w\epsilon(T_{ret})). \tag{22}$$

Thus,

$$\mu(t) = a(T_{ret}) e^{-rt} \text{ for } t \in [0, T]. \tag{23}$$

Substituting (23) into (20), we obtain from (18)

$$\frac{dk(t)}{dt} = rk(t) - \frac{\phi_1}{a(T_{ret})}, \tag{24}$$

for $t \in [T_{ret}, T]$.

Using (5) for an arbitrarily fixed terminal stock value B^G, we derive the solution to (24) as

$$k(t) = \frac{\phi_1}{ra(T_{ret})} \left(1 - e^{r(t-T)}\right) + B^G e^{r(t-T)}, \tag{25}$$

for $t \in [T_{ret}, T]$.

Evaluating (25) at $t = T_{ret}$, we obtain

$$k(T_{ret}) \equiv \Lambda_1(T_{ret}) = \frac{\phi_1}{ra(T_{ret})} \left(1 - e^{r(T_{ret} - T)}\right) + B^G e^{r(T_{ret} - T)}. \tag{26}$$

Next, substituting (23) into (11) and (12) and considering the $\lambda(t) = 0$ case (recall that $r = \rho$), we solve for the optimal consumption and leisure paths as functions of T_{ret}:

$$c(t) = \frac{\phi_1}{a(T_{ret})}, \tag{27}$$

$$l(t) = \frac{\phi_2}{a(T_{ret}) w\epsilon(t)}, \tag{28}$$

for $t \in [0, T_{ret})$.

Remark 4. Note from (28) that for the agent to retire before exiting the model, it is necessary that the labor productivity profile, $\epsilon(t)$, decline sufficiently rapidly after some point in time.

Substituting (27) and (28) into (17), we obtain

$$\frac{dk(t)}{dt} = rk(t) + w\epsilon(t) \left(1 - \frac{\phi_2}{a(T_{ret}) w\epsilon(t)}\right) - \frac{\phi_1}{a(T_{ret})}, \tag{29}$$

for $t \in [0, T_{ret})$. Using (4), the solution to (29) is

$$k(t) = e^{rt} \int_0^t \left(w\epsilon(u) \left(1 - \frac{\phi_2}{a(T_{ret}) w\epsilon(u)}\right) - \frac{\phi_1}{a(T_{ret})}\right) e^{-ru} du, \tag{30}$$

for $t \in [0, T_{ret})$. Expression (30) implies that

$$k(T_{ret}) \equiv \Lambda_2(T_{ret}) = e^{rT_{ret}} \int_0^{T_{ret}} \left(w\epsilon(t) \left(1 - \frac{\phi_2}{a(T_{ret}) w\epsilon(t)}\right) - \frac{\phi_1}{a(T_{ret})}\right) e^{-rt} dt. \tag{31}$$

Hence, for a given bequest amount B^G, T_{ret} is the solution to the following equation:

$$\Lambda_1(T_{ret}) = \Lambda_2(T_{ret}). \tag{32}$$

Remark 5. It is clear from (32) that even a simple dynamic model can easily lead to a cumbersome solution, and it might be impossible to derive a closed-form solution. To obtain a tractable, closed-form solution, we introduce additional simplifying assumptions. First, we assume that the interest rate $r = 0$ (an assumption that is quite reasonable in the case of Japan). Also, we assume that $\epsilon(t) = 1 - (1/T)t$.

Consequently, recalling (22), we obtain

$$\lim_{r \to 0} \Lambda_1(T_{ret}) = B^G + \frac{w(T - T_{ret})^2 \phi_1}{T\phi_2}, \tag{33}$$

$$\lim_{r \to 0} \Lambda_2(T_{ret}) = \frac{wT_{ret}(T_{ret}(2\phi_1 + \phi_2) - 2T\phi_1)}{2T\phi_2}. \tag{34}$$

Thus, setting (33) equal to (34), we can solve for the optimal retirement age for a given bequest amount. Under the assumption of both roots being real, a positive root takes the form

$$T_{ret}(B^G) = \frac{-T\phi_1 + \sqrt{D}/w}{\phi_2}, \tag{35}$$

where

$$D \equiv wT\left(2B^G {\phi_2}^2 + wT\phi_1(\phi_1 + 2\phi_2)\right). \tag{36}$$

Remark 6. It is clear from (36) that an exogenous increase in the amount of the bequest given B^G would raise the age of retirement. However, the next task is to find the optimal bequest amount. For that purpose, we need to specify the form of the Ψ function.

For the sake of simplicity, let us assume that the parent believes that a one-unit increase in the bequest given increases the lifetime well-being of her offspring by $s > 0$ units, where s can be sufficiently small. Let

$$\Psi(B^G) = sB^G. \tag{37}$$

Recalling that $r = \rho = 0$, using (22), (27)-(28), (35), and (37), let us rewrite (1) as

$$\Gamma_1 + \Gamma_2, \tag{38}$$

where

$$\Gamma_1 \equiv \phi_1 \int_0^{T_{ret}(B^G)} \ln\left[\frac{\phi_1}{a(T_{ret}(B^G))}\right] dt + \phi_2 \int_0^{T_{ret}(B^G)} \ln\left[\frac{\phi_2}{a(T_{ret}(B^G))wc(t)}\right] dt + \gamma \ln\left[sB^G\right], \tag{39}$$

$$\Gamma_2 \equiv \phi_1 \int_{T_{ret}(B^G)}^{T} \ln\left[\frac{\phi_1}{a(T_{ret}(B^G))}\right] dt + \phi_2 \int_{T_{ret}(B^G)}^{T} \ln[1] dt. \tag{40}$$

The optimal bequest amount B^G is the one that solves

$$\frac{\partial \Gamma_1}{\partial B^G} + \frac{\partial \Gamma_2}{\partial B^G} = 0. \tag{41}$$

Under the assumption of real roots, the optimal bequest amount ($B^G_{opt} = k(T)_{opt}$) is

$$B^G_{opt} = \frac{w\gamma\left(T(\phi_1+\phi_2)+\gamma-\sqrt{D_1}\right)}{T\phi_2^2}, \tag{42}$$

where

$$D_1 \equiv (T\phi_1+\gamma)(T\phi_1+2T\phi_2+\gamma). \tag{43}$$

Substituting (42) into (35), we obtain the optimal retirement age (T^{opt}_{ret}) as follows:

$$T^{opt}_{ret} = -\frac{1}{\phi_2}\left(T\phi_1 - \sqrt{D_2 - 2\gamma\sqrt{D_1}}\right). \tag{44}$$

where

$$D_2 \equiv 2\gamma^2 + 2T\gamma(\phi_1+\phi_2) + T^2\phi_1(\phi_1+2\phi_2). \tag{45}$$

Analogously, we can find the optimal leisure profile ($l(t)^{opt}$), and ultimately the optimal labor supply ($LS(t)^{opt}$) during the working life as follows:

$$LS(t)^{opt} \equiv 1 - l(t)^{opt} = \frac{T\phi_1 + t\phi_2 - \sqrt{D_2 - 2\gamma\sqrt{D_1}}}{(t-T)\phi_2}. \tag{46}$$

The optimal consumption profile takes the form

$$c(t)^{opt} = w\phi_1 \frac{T(\phi_1+\phi_2) - \sqrt{D_2 - 2\gamma\sqrt{D_1}}}{T\phi_2^2}. \tag{47}$$

Notice that

$$\frac{\partial B^G_{opt}}{\partial \gamma} = -w\frac{\left(\sqrt{D_1} - \gamma - T(\phi_1+\phi_2)\right)\left(\sqrt{D_1} - \gamma\right)}{T\phi_2^2\sqrt{D_1}}. \tag{48}$$

The term $\sqrt{D_1}$ is strictly less than $\gamma + T(\phi_1+\phi_2)$, while $\sqrt{D_1}$ is strictly greater than γ. Therefore, (48) is strictly positive in sign, indicating that the more the parent cares for her child's financial well-being, the larger the bequest she intends to leave. Similarly,

$$\frac{\partial LS(t)^{opt}}{\partial \gamma} = \frac{4\gamma^2 + 6T\gamma(\phi_1+\phi_2) + 2T^2\phi_1(\phi_1+2\phi_2) - (4\gamma + 2T(\phi_1+\phi_2))\sqrt{D_1}}{2(t-T)\phi_2\sqrt{D_1}\sqrt{D_2 - 2\gamma\sqrt{D_1}}}. \tag{49}$$

The denominator of (49) is negative since up to the age of retirement, $t < T$. The numerator is negative since the term $(4\gamma + 2T(\phi_1+\phi_2))^2 D_1$ exceeds the term $(4\gamma^2 + 6T\gamma(\phi_1+\phi_2) + 2T^2\phi_1(\phi_1+2\phi_2))^2$ by a positive amount $4T^3\phi_2^2(2\gamma(\phi_1+\phi_2) + T\phi_1(\phi_1+2\phi_2))$. Thus, an increase in the strength of the altruistic bequest motive increases the number of working hours.

Finally,

$$\frac{\partial T^{opt}_{ret}}{\partial \gamma} = \frac{\partial LS(t)^{opt}}{\partial \gamma}(T-t). \tag{50}$$

Since (49) is positive, so is (50), implying that an increase in the strength of the altruistic bequest motive delays retirement. Thus, we conclude with

Remark 7. An increase in the strength of the altruistic bequest motive will cause parents to not only work more hours per week but also to work longer and retire later, as shown by Eqs. (49) and (50).

2.3. Case 2: strategic or exchange bequest motives

In this subsection, we assume that parents leave a bequest to elicit care and/or attention from their children. This is the so-called strategic or exchange bequest motive discussed by Laitner and Ohlsson (2001, p. 211) and Bernheim et al. (1985). Some questions arise immediately. Suppose a child took good care of her elderly parents by sacrificing time and resources. How can he/she be sure that his/her parents will reward him/her properly and will not renege on their implicit or explicit promise? By contrast, even if parents gave the promised reward to their child, the latter might still fail to carry out his/her duties as promised. After all, if intra-household gifts and exchanges are based on purely selfish motives to begin with, selfish individuals might consider breaking their promises whenever they felt like doing so.

Real life is more complex, however. Even if it is in an individual's self-interest to break an agreement, often a society develops social customs and rules to minimize such deviant behavior, and such social customs might be easier to enforce between members of one family (who tend to be bound by intra-household trust and affection) than between total strangers. Moreover, another way to ensure that both parents and children hold up their end of the bargain is for them to draw up and sign a legally enforceable contract (or at least an implicit or verbal contract).

To proceed with our technical analysis simply, we need to specify a quid pro quo bequest/care function. Note that care to parents can take many forms. We assume that care takes the form of a time sacrifice on the part of children (e.g., when they spend time interacting with, and entertaining, their parents or running errands for them). Certainly, it is not necessary to assume that parents and children are expected to always spend time together as nothing prevents an arrangement whereby, for example, a child paints her parent's fence while the latter is at work or on vacation elsewhere, but to simplify the analysis, we assume in our model that care always takes the form of spending time with parents. Fundamentally, even though spending time with parents entails various opportunity costs, the reward is a bequest.

Remark 8. Let us introduce the "care function" $z(\boldsymbol{v}, k(T), t)$, where $\boldsymbol{v}$ is the vector of functions, and assume that the care function is known and shaped by social customs and traditions. In line with the mathematical theory of optimal processes, let function z be continuously differentiable in all of its arguments, none of which is a derivative. Assume that $0 \leq z(\boldsymbol{v}, k(T), t) < 1$ and that $\frac{\partial z(\boldsymbol{v}, k(T), t)}{\partial k(T)} > 0$. Hence, we assume that a ceteris paribus increase in the bequest amount $k(T)$ increases the amount of care time the child spends with her parent.

Note that time might enter function z in the sense that, before some age, the expected care from one's child might be minimal since the parent is presumably healthy and busy at work but that it might increase rapidly with time as the parent ages and children mature. Vector $\boldsymbol{v}$ might include, among other things, the child's bargaining power and outside opportunities (that is, a child with better outside options would need to be promised a larger bequest to exert the same amount of care effort).

For any given bequest amount, the parent expects her child to spend $z(\boldsymbol{v}, k(T), t)$ fraction of time with the parent. For example, consider a parent who promises to bequeath $k(T) = \$10,000$. Suppose that, at a certain point in time, the parent enjoys nine hours of non-sleep time as leisure, while social customs require that, in this case, the child spend

one hour with the parent (i.e., $z(\boldsymbol{v}, k(T), t) = 1/9$). Thus, the parent enjoys eight hours of leisure alone (away from the child) and one hour with the child. If the promised bequest amount increases to $20,000, the child would promise to spend, say, an hour and a half with the parent ($z(\boldsymbol{v}, k(T), t) = 1/6$) at time t. In this case, the parent enjoys seven and a half hours of leisure alone, and an hour and a half with the child.

Let the lifetime utility function of the main decision-maker now be

$$U = \int_0^T e^{-\rho t}(\phi_1 \ln[c(t)] + \phi_2 \ln[(1 - z(\boldsymbol{v}, k(T), t))l(t)] + \phi_3 \ln[z(\boldsymbol{v}, k(T), t)l(t)])dt. \tag{1a}$$

Remark 9. We assume that the parent derives utility not only from leisure spent alone but also from leisure spent with her child. Note from (1a) that when the parent leaves a larger bequest to her child ($k(T)$ is greater), she ends up buying more joint time with the child, and thus, by definition, spends less time alone. There is a trade-off between leisure enjoyed privately and leisure enjoyed jointly with the child. Note, moreover, that the parent does not derive any utility directly from the amount of her bequest or the consumption of her child because she is not altruistic. The parent's bequest increases her utility only by increasing the amount of time she can spend with her child.

Let us for clarity of exposition denote terminal capital stock $k(T)$ as B^G. We now consider two separate assumptions about the care function, the first one being

Assumption 1. Care is given by $z(\boldsymbol{v}, B^G, t) = z_0 B^G$, where z_0 is positive yet small.

Under Assumption 1, we consider a truly simplistic case, where the care level is simply proportional to the amount of the assets bequeathed to the child. This greatly facilitates the analysis, yet leads (as will be seen shortly) to one-sided results. Following the same steps as in Subsection 2.2, we can re-state the analogue of (12) as the first-order necessary condition for leisure:

$$\frac{\partial H}{\partial l(t)} = (\phi_2 + \phi_3)e^{-\rho t} l(t)^{-1} - \mu(t) w\epsilon(t) + \lambda(t) = 0 \tag{12a}$$

Hence, the analogues of (22) and (28) are

$$a \equiv a(T_{ret}) = (\phi_2 + \phi_3)/(w\epsilon(T_{ret})) \tag{22a}$$

and

$$l(t) = \frac{\phi_2 + \phi_3}{a(T_{ret}) w\epsilon(t)}, \tag{28a}$$

for $t \in [0, T_{ret})$, respectively. We can thus rewrite (31) as

$$k(T_{ret}) \equiv \Lambda_2(T_{ret}) = e^{rT_{ret}} \int_0^{T_{ret}} \left(w\epsilon(t)\left(1 - \frac{\phi_2 + \phi_3}{a(T_{ret}) w\epsilon(t)}\right) - \frac{\phi_1}{a(T_{ret})}\right) e^{-rt} dt. \tag{31a}$$

Taking the limit of (31a) as $r \to 0$, and equating the resulting expression with the analogue of (33) (where ϕ_2 is replaced with $\phi_2 + \phi_3$), we solve for the retirement age as follows:

$$T_{ret}(B^G) = \frac{-T\phi_1 + \sqrt{D_3}/w}{\phi_2 + \phi_3} \tag{35a}$$

where

$$D_3 \equiv wT\left(2B^G(\phi_2 + \phi_3)^2 + wT\phi_1(\phi_1 + 2(\phi_2 + \phi_3))\right) \tag{36a}$$

Thus, under Assumption 1, the optimal bequest amount can be computed as in Case 1, this time rewriting (1a) as (and recalling that $r = \rho = 0$)

$$\Delta_1 + \Delta_2 \tag{38a}$$

where

$$\begin{aligned}\Delta_1 \equiv \phi_1 &\int_0^{T_{ret}(B^G)} \ln\left[\frac{\phi_1}{a(T_{ret}(B^G))}\right] dt \\ &+ \phi_2 \int_0^{T_{ret}(B^G)} \ln\left[\frac{\phi_2 + \phi_3}{a(T_{ret}(B^G)) w\epsilon(t)}\left(1 - z(\boldsymbol{v}, B^G, t)\right)\right] dt \\ &+ \phi_3 \int_0^{T_{ret}(B^G)} \ln\left[\frac{\phi_2 + \phi_3}{a(T_{ret}(B^G)) w\epsilon(t)} z(\boldsymbol{v}, B^G, t)\right] dt\end{aligned} \tag{39a}$$

$$\begin{aligned}\Delta_2 \equiv \phi_1 &\int_{T_{ret}(B^G)}^{T} \ln\left[\frac{\phi_1}{a(T_{ret}(B^G))}\right] dt + \phi_2 \int_{T_{ret}(B^G)}^{T} \ln\left[\left(1 - z(\boldsymbol{v}, B^G, t)\right)\right] dt \\ &+ \phi_3 \int_{T_{ret}(B^G)}^{T} \ln\left[z(\boldsymbol{v}, B^G, t)\right] dt\end{aligned} \tag{40a}$$

The optimal bequest amount is the amount that solves

$$G \equiv \frac{\partial \Delta_1}{\partial B^G} + \frac{\partial \Delta_2}{\partial B^G} = 0 \tag{41a}$$

Unfortunately, even under Assumption 1, it is practically impossible to obtain B^G_{opt} from (41a) as an explicit function of the exogenous parameters. However, let (41a) implicitly define the optimal bequest amount as a function of exogenous parameters. Consequently,

$$\frac{\partial B^G_{opt}}{\partial \phi_3} = -\frac{\partial G/\partial \phi_3}{\partial G \Big/ \partial B^G_{opt}} \tag{51}$$

We verify that the right-hand side of (51) can be strictly positive around a range of points satisfying (41a), implying that an increase in ϕ_3 might increase the optimal bequest amount. Using this fact and expression (35a) (where we replace B^G with B^G_{opt}), we can compute the comparative statics as follows:

$$\frac{\partial T^{opt}_{ret}}{\partial \phi_3} = \frac{-T\phi_1\left(wT(\phi_1 + \phi_2 + \phi_3) - \sqrt{D_4}\right) + \frac{\partial B^G_{opt}}{\partial \phi_3} T(\phi_2 + \phi_3)^3}{(\phi_2 + \phi_3)^2 \sqrt{D_4}}, \tag{50a}$$

where

$$D_4 \equiv wT\left(2B^G_{opt}(\phi_2 + \phi_3)^2 + wT\phi_1(\phi_1 + 2(\phi_2 + \phi_3))\right) \tag{52}$$

Even when (51) is positive, the sign of (50a) is ambiguous. The same ambiguity is certainly observed when considering the number of hours worked during the working phase of life, which can be expressed as

$$LS(t)^{opt} \equiv 1 - l(t)^{opt} = 1 + \frac{T^{opt}_{ret} - T}{T - t} \tag{46a}$$

Remark 10. Under Assumption 1, both the retirement age and hours worked move in the same direction in response to the rise in the strength of the exchange motive (see (46a) and (50a)).

Intuitively, in the case of the quid pro quo strategic or exchange bequest motive, the decision-making parent wants to extract as much care as possible from her child and for that reason she wants to leave as large a bequest as possible, which follows from Eq. (51). This encourages the parent to maximize lifetime income, which in turn requires the parent to supply more labor and to retire later. However, in order to be able to afford to leave a larger bequest, the parent might want to reduce private consumption, which can be compensated for by increasing the amount of leisure. Interestingly, equation (46a) implies that if the strategic or exchange bequest motive induces the parent to increase her labor supply at the intensive margin, it will also induce her to retire

later, and conversely. Thus, both the retirement age and number of hours worked move strictly in the same direction under Assumption 1.

Note, however, that Assumption 1 assumes for the sake of simplicity that parents' need for care and attention from their children does not change over the course of their working years. In reality, however, younger parents may have less need for care and attention from their children because they are healthier and/or because they are more preoccupied with their work duties, as a result of which they feel less lonely and less vulnerable. However, as parents age and approach retirement age, their need for care and attention from their children might increase because their health deteriorates and/or because they are less preoccupied with their formal work duties. We thus propose an alternative specification for the care function, as given by the following assumption.

Assumption 2. Care is given by

$$z(\boldsymbol{v}, B^G, t) = \frac{z_1 B^G}{1 + e^{z_2(1-l(t))}}, \tag{53}$$

where z_1 and z_2 are exogenous parameters.

Thus, under the second assumption, the care function takes a logistic form (which is differentiable) and again rises with the amount of bequest left, B^G. However, notice that during younger working ages (when $l(t)$ is small), the level of care is low. As the agent ages and thus approaches retirement ($l(t)\rightarrow 1$), the care level demanded from the child can rise rapidly.

When care is given by (53), we can try to derive the analogue of (12a), which now will become much more complicated.

$$\frac{\partial H}{\partial l(t)} = (\phi_2 M_1 + \phi_3 M_2) e^{-\rho t} l(t)^{-1} - \mu(t) w \epsilon(t) + \lambda(t) = 0, \tag{12b}$$

where

$$M_1 \equiv \frac{1 - \frac{z_1 B^G}{1+e^{z_2(1-l(t))}} M_2}{1 - \frac{z_1 B^G}{1+e^{z_2(1-l(t))}}}, \tag{54}$$

$$M_2 \equiv 1 + \frac{e^{z_2(1-l(t))} l(t) z_2}{1 + e^{z_2(1-l(t))}}. \tag{55}$$

We can see that, in Assumption 1, essentially $M_1 = M_2 = 1$. Next, we obtain

$$a \equiv a(T_{ret}) = \frac{(z_1 B^G (2 + z_2) - 4)\phi_2 + \phi_3 (2 + z_2)(z_1 B^G - 2)}{2 w \epsilon(T_{ret})(z_1 B^G - 2)}. \tag{22b}$$

In what follows, it is important to solve (12b) for leisure $l(t)$ when $\lambda(t) = 0$ so that dynamic budget constraints can be used to pin down the optimal retirement age for a given terminal bequest level. Unfortunately, no closed-form solution exists in this case, which makes it extremely difficult to analytically infer the effect of a quid pro quo strategic or exchange bequest motive on the optimal retirement age and intensive labor supply. However, we have conducted a number of computations using various techniques as well as programmed simulations in GPOPS II (Patterson and Rao, 2014). Some interesting numerical results are provided in Table 1.

We observe from the last column of Table 1 that parents with a stronger quid pro quo strategic or exchange bequest motive bequeath more. The second and third columns show that the optimal retirement age and hours worked move in opposite directions. Hence, we conclude with the following

Remark 11. Under Assumption 2, it is possible that the stronger the quid pro quo strategic or exchange bequest motive, the larger is the number of working hours and the earlier is the retirement age, as shown by Table 1.

2.4. Summary

To summarize, our theoretical model has shown that different types of bequest motives have different impacts on the work behavior of households. Households with a stronger altruistic bequest motive unambiguously work more hours and retire later than households with a weaker bequest motive, but the impact of a quid pro quo strategic or exchange bequest motive on work behavior is theoretically ambiguous. Households with a stronger strategic or exchange bequest motive may work more or fewer hours and retire earlier or later than households with a weaker strategic or exchange bequest motive.

Table 1
Numerical results for the case of strategic or exchange bequest motives.

Strength of exchange motive (ϕ_3)	Age of retirement	Average number of hours worked per week	Optimal bequest
0.40	60.55	40.66	5.02
0.50	60.10	40.77	5.33
0.60	59.53	41.24	5.56
0.70	59.30	41.42	5.73
0.80	58.93	41.84	5.88
0.90	58.65	42.20	6.00

Notes: Refer to the main text for details. These results correspond to the following parameters of the model: The wage rate (w) is 1, the age of death ($T + 25$) is 80, the weight on personal consumption (φ_1) is 0.10, the weight on personal leisure (φ_2) is 0.20, and the care function parameters z_1 and z_2 are 0.20, and 5.00, respectively.

The reason for the ambiguity concerning the impact of a strategic or exchange bequest motive on the timing of retirement is that, on the one hand, the parent might want to work longer to increase her lifetime income and the amount of her bequest in order to elicit more care from children, while on the other hand, she might want to retire earlier so she can start receiving care from her children sooner. Thus, when a strong strategic or exchange bequest motive is present, bequest motives have a complex impact on various margins of work behavior. However, we showed that, if the care function is specified more flexibly as in Eq. (53), a stronger strategic or exchange bequest motive may lead individuals to work more hours during their working years but to retire earlier. In Section 3, we conduct a careful empirical analysis to see whether or not our theoretical predictions are borne out by the data.

3. Empirical analysis

In this section, we present the results of our empirical analysis of the impact of bequest motives on the labor supply and retirement behavior of households in Japan using micro data from the Preference Parameters Study of Osaka University. More specifically, in Subsection 3.1, we derive testable hypotheses from our theoretical analysis; in Subsection 3.2, we explain our data source and sample selection criteria; in Subsection 3.3, we explain our estimation model and variable definitions; in Subsection 3.4, we conduct a univariate analysis of individual work behavior under different bequest motives; and in Subsection 3.5, we present and interpret our estimation results.

3.1. Hypothesis development

In this subsection, we derive testable hypotheses from our theoretical analysis in Section 2. Our theoretical model predicts that a parent with a stronger altruistic bequest motive will leave a larger bequest to her children and thus work more at both the intensive and extensive margins (see Remark 7 on page 10). Thus, the testable hypothesis regarding the altruistic bequest motive is as follows:

H1: The stronger an individual's altruistic bequest motive, the larger the bequest she will leave to her children and the more she will work at both the intensive and extensive margins.

By contrast, our theoretical model shows that an individual with a strategic or exchange bequest motive confronts a dilemma. On the one hand, she wants to work more in order to be able to earn more, to leave a larger bequest to her children, and to elicit more care from them, but on

the other hand, she wants to work less so that she can spend more time with (and receive more care from) her children. As a result, the net impact of this type of bequest motive on the amount of work at the intensive and extensive margins is ambiguous (see Remark 11 on page 16). However, since the social norm in Japan is to work hard, a Japanese individual may work more at the intensive margin (for example, work more hours per week) in order to earn more, to leave a larger bequest to her children, and to elicit more care from them, but retire earlier in order to be able to start receiving care from her children sooner. Thus, the testable hypothesis regarding the strategic or exchange bequest motive is as follows:

H2: An individual with a strategic or exchange bequest motive will work more at the intensive margin but work less at the extensive margin (i.e., retire earlier).

Hypothesis H1 is framed in terms of a continuous variable measuring the strength of the altruistic bequest motive, and H2 is framed in terms of a variable measuring how much value the parent places on spending time with her children (which can be interpreted as measuring the strength of his/her exchange or strategic bequest motive), but as discussed in Subsection 3.2 below, we only have discrete information on whether or not respondents have each type of bequest motive. Therefore, we test these hypotheses by analyzing how the work behavior of a respondent with an altruistic or strategic/exchange bequest motive compares with that of a respondent with no bequest motive whatsoever.

3.2. Data source and sample selection criteria

In this subsection, we discuss the data source we use for our analysis and our sample selection criteria. We use micro data from the 2012 wave the Preference Parameters Study (*Kurashi no Konomi to Manzokudo ni tsuite no Chousa*) of Osaka University, a panel survey that was conducted in Japan and three other countries by the 21st Century Center of Excellence (COE) Program "Behavioral Macrodynamics Based on Surveys and Experiments" and the Global COE Project "Human Behavior and Socioeconomic Dynamics" of Osaka University. The survey was conducted annually during the 2003-13 period, but we chose to use data from the 2012 wave because the question about bequest motives was not asked in every year and 2012 was the most recent year for which this question was asked. The survey collects data on a nationwide random sample of both sexes, and the 2012 survey had 4588 respondents.

The 2012 wave is perfectly suited for our purposes because it collects detailed information on bequest motives, working hours, planned retirement age, and all of the other variables needed for our analysis. The complete survey instrument (questionnaire form) for the survey that we used for this analysis can be found at the following website: https://www.iser.osaka-u.ac.jp/survey_data/doc/japan/questionnaire/english/2012QuestionnaireJAPAN.pdf.

Since the data source we used is a panel survey, it would have been preferable to do a panel analysis with fixed effects to control for individual heterogeneity, but unfortunately, we were not able to do so because some questions such as the ones pertaining to bequest motives were not asked in every wave. Fortunately, however, the survey we used collects information on a multitude of individual and household attributes, so we were able to control for such heterogeneity by including a large number of individual- and household-related covariates.

The sample selection criteria we used are as follows:

(1) We dropped all observations for respondents who are currently not working because information on the outcome variables (planned retirement age and hours worked per week) are not available for such respondents.
(2) We dropped all observations for which there were missing values for at least one of the other variables used in the estimations.
(3) We dropped all observations for which respondents have no children because we were interested in examining whether respondents' intention of leaving bequests to their children has any impact on their work behavior.
(4) Since the value of the wage rate (WAGE) was unreasonably high or low in some cases due to the reported number of hours worked being unreasonably high or low, we dropped all observations that were in the top 1% or the bottom 1% of the distribution of WAGE.

3.3. Estimation model and variable definitions

In this subsection, we describe the estimation model and the variables we constructed from the survey questions to test the hypotheses regarding the impact of bequest motives on individuals' work behavior that we derived and discussed in Subsection 3.1. The question number in parentheses for each variable indicates the survey question we used to construct that variable.

The estimation model for an individual i's work behavior is as follows:

$$y_i = \alpha_0 + \alpha_a bm_{ai} + \alpha_c bm_{ci} + \alpha_f bm_{fi} + \alpha_b bm_{bi} + \alpha_w bm_{wi} + \beta' x_i + \varepsilon_i, \qquad (56)$$

where y_i is the dependent variable that represents work-related outcomes at the intensive and extensive margins for individual i as defined below:

Log(HRSPERWEEK) = the natural logarithm of the number of hours the respondent is working per week (a measure of the intensive margin, survey question B9), and

Log(RETAGE) = the natural logarithm of the age at which the respondent plans to retire (a measure of the extensive margin, survey question B12).[3]

HRSPERWEEK pertains to the intensive margin (i.e., how much the respondent works during a given period of time, given that he or she works) whereas RETAGE pertains to the extensive margin (i.e., how long the respondent plans to work before retiring completely). We estimate a separate Eq. for each of these two dependent variables[4]. More precisely, we estimate the HRSPERWEEK and RETAGE Eq.s using ordinary least squares.

In addition, we use the probability of working full-time as an alternate measure of the intensive margin in our robustness checks to be presented later:

FULLTIME = 1 if the respondent is working full-time and 0 if the respondent is working part-time (survey question B13b)

The explanatory variables pertaining to bequest motives in the estimation model above (bm), which are of most interest for our purposes, are as follows:

BEQMOTALT (bm_a) = 1 if the respondent is planning to leave a bequest to his or her child(ren) under any circumstances and 0 otherwise (survey question A31)

BEQMOTCARE (bm_c) = 1 if the respondent is planning to leave a bequest to his or her child(ren) only if his or her child(ren) provide care

[3] Note that those who do not plan to retire (i.e., who plan to work indefinitely) presumably wrote down their expected age of death as their planned retirement age or did not answer this question. In the latter case, they would be dropped from the sample, leading to sample selection bias, but this is not a serious problem because the number of such respondents was very small.

[4] It is quite possible that the two work-related variables—number of hours worked per week and planned retirement age—are seemingly contemporaneously correlated. For example, an individual who plans to retire earlier may choose to work for more hours per week. This can make the error terms of the two work-related dependent variables (log(RETAGE) and log(HRSPERWEEK)) contemporaneously correlated. These equations can be estimated jointly using the Seemingly Unrelated Regression (SUR) method. However, the joint (SUR) estimates and the single equation (ordinary least squares or OLS) estimates are identical when the right-hand side variables are the same. In our case, the right-hand side variables are the same in the two equations, and hence we estimate each equation separately.

(including nursing care) during old age and 0 otherwise (survey question A31)

BEQMOTFIN (bm_f) = 1 if the respondent is planning to leave a bequest to his or her child(ren) only if his or her child(ren) provide financial assistance during old age and 0 otherwise (survey question A31)

BEQMOTBUS (bm_b) = 1 if the respondent is planning to leave a bequest to his or her child(ren) only if his or her children carry on the family business and 0 otherwise (survey question A31)

BEQMOTWEAK (bm_w) = 1 if the respondent does not plan to make special efforts to leave a bequest to his or her child(ren) but will leave whatever is leftover and 0 otherwise (survey question A31)

We regard BEQMOTALT as an altruistic bequest motive because the respondent does not impose any preconditions for leaving a bequest, and we regard BEQMOTCARE, BEQMOTFIN, and BEQMOTBUS as strategic or exchange bequest motives because the respondent imposes preconditions for leaving a bequest in all three cases. The default categories are respondents who do not plan to leave a bequest to their children under any circumstances and respondents who want to leave a bequest to their children but will not because they do not have the financial capacity to do so. Since we benchmark on individuals with no bequest motive[5], the α's measure the impact of each type of bequest motive on the individual's work behavior. For instance, the sign and significance of α_a and α_c can shed light on the impact of altruistic and strategic or exchange bequest motives on work behavior as stated in H1 and H2 above, respectively.

To control for the impact of other individual- and household-specific factors on the three work-related outcomes, we include the following variables in vector x following, for example, (Blau and Kahn, 2007; Brown et al., 2015; Farhi and Panageas, 2007; Honig, 1998), among others:

log(WAGE) = the natural logarithm of the respondent's wage rate (hourly wage) (survey questions B9 and B18)

In the data source we used, respondents have a choice between writing down his/her monthly salary or his/her hourly wage. For respondents who wrote down their hourly wage, we used this information as is, but for respondents who wrote down their monthly salary, we converted their monthly salary to an hourly wage by dividing their monthly salary by the number of hours worked per month. Since respondents are asked to report the number of hours they work per week, we converted it to the number of hours they work per month by multiplying it by 52, then dividing by 12 (or by multiplying by 4.33333).

Since the work decisions of respondents will be affected by the earned income of other household members, we also include the respondent's household earned income excluding the respondent's own earned income: log(OTHERINC+1) = the natural logarithm of one plus the non-respondent earned income, which was calculated as the respondent's household earned income excluding the respondent's own earned income, (survey questions B19 and B36)[6]

BEQREC = 1 if the respondent has received a bequest (including real and financial assets) with a total value of 5,000,000 yen or more from his or her parents or parents-in-law in the past and 0 otherwise (survey question A32)

BEQEXP = 1 if the respondent expects to receive a bequest (including real and financial assets) with a total value of 5,000,000 yen or more from his or her parents or parents-in-law in the future and 0 otherwise (survey question A33)

We include wealth-related variables such as WAGE, OTHERINC, BEQREC, and BEQEXP to eliminate the possibility that bequest motives are merely acting as a proxy for wealth, and we believe that BEQREC and BEQEXP are especially suitable for this purpose because they are largely exogenous, being the decision of the respondent's parents.

Furthermore, we include the following personal and work-related attributes of the respondent to eliminate the possibility of omitted variable(s) (endogeniety) bias that can bias the bequest-work relationship due to the model's errors (ε_i) being correlated with bequest motives[7]:

MALE = 1 if the respondent is male and 0 if the respondent is female (survey question B1)

MARRIED = 1 if the respondent is married or cohabiting with a partner and 0 if the respondent is never married, divorced, widowed, or separated and in the process of getting divorced (survey question B2)

HEALTH = the respondent's health status on a scale of 1 to 5 (with 5 being the highest level of health (excellent health)) (survey question B51)

WORRY = the extent to which the respondent is worried about his or her life after age 65 (future life in the case of respondents who are 65 or older) on a scale of 1 to 5 (with 5 being the highest) (survey question A1)

WORK = the extent to which the respondent feels that "work is something to live for" on a scale of 1 to 5 (with 5 being the highest) (survey question A1)

WORKSAT = the extent to which the respondent is satisfied with work on a scale of 1 to 5 (with 5 being the highest) (survey question B18)

SALWKR = 1 if the respondent is a salaried worker and 0 if the respondent is self-employed or a family worker (survey question B13a)

PENSION = the proportion of the living expenses after the retirement of the respondent and his or her spouse (if any) that the respondent expects to be able to cover using public pension benefits (in percent) (survey question B42)

NUMCHILDREN = the number of children the respondent has (survey question B15)

GAMBLE = 1 if the respondent gambles at least several times a year and 0 otherwise (included as a proxy for the degree of risk aversion) (survey question B57)

We believe that our estimates are free from reverse causality (endogeneity) bias—a bias arising from the fact that the respondent works hard simply because he/she enjoys working, that he/she ends up being able to accumulate more wealth than he/she can use himself/herself because he/she works more, and that this makes it easier for him/her to leave a bequest–because we include WORK and WORKSAT (both of which are presumably fundamental or exogenous variables) to eliminate the possibility of reverse relationship bias. Note, moreover, that, even if including WORK and WORKSAT is not sufficient to eliminate reverse causality bias, the survey we used lists five types of bequest motives (BEQMOTALT, BEQMOTCARE, BEQMOTFIN, BEQMOTBUS, and BEQMOTWEAK), and respondents who accumulate more wealth than they can use themselves because they enjoy working will presumably be more likely to have a weak (unintended) bequest motive (BEQMOTWEAK) rather than an altruistic bequest motive (BEQMOTALT) or a strategic or exchange bequest motive for care

[5] "No bequest motive" includes the following three out of eight responses to the bequest motive question in the survey: "I do not plan to leave a bequest to my child(ren) under any circumstances because doing so may reduce their will to work," "I do not plan to leave a bequest to my child(ren) under any circumstances because I want to use my wealth myself," and "I want to leave a bequest to my child(ren) but I won't because I do not have the financial capacity to do so."

[6] One was added to OTHERINC because, otherwise, those for whom OTHERINC is zero would be dropped from the sample since the natural logarithm of zero is not defined.

[7] For example, omitting MALE may cause ε_i to be correlated with bequest motives (bm) since males are the main contributor to household wealth in Japan.

(BEQMOTCARE). For all of these reasons, reverse relationship bias is unlikely to be applicable in the case of our main variables of interest.[8]

3.4. Univariate analysis

In this subsection, we conduct a univariate analysis of the variables relating to work behavior and bequest motives. As can be seen from Table 2, the mean values of the three work-related outcomes are as follows: 59.4% of the sample works full-time, the average number of hours worked per week is 41.3, and the average planned retirement age is 64.7 years. The average planned retirement age is reasonable because, in Japan, the mandatory retirement age (and the age at which workers can start receiving public pension benefits) are in the process of being raised from 60 to 65.

As for bequest motives, 29.4% of the sample has an altruistic bequest motive, 3.0% of the sample has a strategic or exchange bequest motive pertaining to providing care to parents, 0.8% of the sample has a strategic or exchange bequest motive pertaining to providing financial assistance to parents, 0.8% of the sample has a strategic or exchange bequest motive pertaining to carrying on the family business, 47.3% of the sample has a weak bequest motive, and 18.7% of the sample has no bequest motive at all.

Among the strategic or exchange bequest motives, we confine our discussion to the motive pertaining to providing care to parents because this is the motive that is closest in spirit to our theoretical model and because the shares of the other strategic or exchange bequest motives are less than 1% of the sample. Moreover, the weak bequest motive is not related to H1 and H2 so we do not discuss the results for this motive either although we include all bequest motives in the estimation model so we can estimate the partial effects α_a and α_c of the bequest motives in which we are interested, i.e., BEQMOTALT (bm_a) and BEQMOTCARE (bm_c).

Before turning to our regression analysis, we present the results of our univariate analysis of the bequest-work relationship (as hypothesized in H1 and H2) in Table 3 with the average values of the two work-related outcomes being broken down by bequest motive. We can see from this table that the outcome variables differ substantially by bequest motive in systematic ways. For example, respondents with an altruistic bequest motive (those who plan to leave a bequest to their children under any circumstances) show higher values of both outcome variables than other respondents: i.e., they work more hours per week and plan to retire later. By contrast, respondents with a strategic or exchange bequest motive for care (those who plan to leave a bequest to their children only if they provide care (including nursing care) during old age) work more hours per week but plan to retire *earlier* than other respondents.

Our theoretical model showed that those with an altruistic bequest motive work more and retire later than others but that those with a strategic or exchange bequest motive tend to work more but retire earlier than others. Thus, our preliminary findings based on univariate analysis are fully consistent with H1 and H2 regarding the bequest-work relationship. However, we need to see whether these findings hold up even after we control for the impact of individual- and household-specific factors on the two work-related outcomes using regression analysis, which is precisely what we do in the next subsection.

3.5. Estimation results and empirical findings

In this subsection, we present and discuss the estimation results for our econometric model of the work behavior of individuals in Japan (Eq. (56)) with emphasis on the impact of the bequest motives of interest (α_a, α_c) thereon. More specifically, we present and discuss the estimation results for the two (dependent) variables—one for work at the intensive margin, i.e., the number of hours worked per week and the other for work at the extensive margin, i.e., the planned retirement age. Our interest in individual- and household-specific factors (x) is limited to controlling for their impact on individuals' work behavior.

3.5.1. The bequest-work relationship

We present the estimation results for the bequest-work relationship in Tables 4-5. Table 4 shows the results for the number of hours worked per week, while Table 5 shows the results for the planned retirement age, both estimated using ordinary least squares.

We show estimation results for the full sample, for the married sample, for the male sample, and for the married male sample for all ages and for those aged 40 or older because work behavior tends to differ by marital status, gender, and age and because this may help us to find the subsample, if any, that drives the bequest-work relationship in the full-sample. We are especially interested in the results for those aged 40 or older because individuals who are younger than that are not likely to have already thought seriously about their bequest motives. We also obtained results for the female sample, but these results were not as strong as those for the male sample, presumably because females have, on average, a weaker attachment to the labor market (see, for example, Kambayashi and Kato (2017) for empirical evidence that Japanese women do have, on average, a weaker attachment to the labor market, as measured by their job retention rate). We have therefore not shown them in the paper.

As discussed earlier, we are interested primarily in the altruistic bequest motive and the strategic or exchange bequest motive for care, and we present these results under "bequest motives of interest" in Tables 4-5.

Looking first at the results for the full sample, we find that α_a is positive and statistically significant at the 10% level for the full sample (see the column marked "Both sexes, all ages") in the log(HRSPERWEEK) regression, as shown in Table 4. Thus, as in the case of our univariate analysis, the number of working hours per week of respondents with an altruistic bequest motive (BEQMOTALT) is significantly higher than that of respondents without any bequest motive. However, we do not find similar support for respondents' planned retirement age as α_a is statistically insignificant for the full sample in the log(RETAGE) regression, as shown in Table 5. The fact that more significant results are obtained for all ages than for the 40-plus sample in the log(HRSPERWEEK) regression suggests that the significant altruistic bequest-work relationship for the full sample appears to be driven by respondents who are less than 40 years old, which in turn suggests that altruistic respondents modify their work behavior at a relatively early age. Thus, we find partial support for H1 (i.e., an altruistic bequest-work relationship) in the case of Japan.

Our empirical results pertaining to H2 are consistent with theoretical predictions as well as with the univariate analysis discussed in Subsection 3.4 for both work-related outcomes. We find that α_c, which measures the strength of the strategic or exchange bequest-work relationship, is positive and statistically significant at the 5% level for the full sample (see the column marked "Both sexes, all ages") in the log (HRSPERWEEK) regression, as shown in Table 4, and negative and statistically significant at the 5% level for the full sample in the log (RETAGE) regression, as shown in Table 5. These results imply that the

[8] Moreover, respondents who worked for many hours per week and accumulated considerable wealth as a result may or may not choose to leave a bequest. For example, Andrew Carnegie strongly opposed leaving inheritances to one's children even though he worked hard and became one of the world's wealthiest men because he felt that it would weaken their will to work and to contribute to society (see Carnegie, 1962; this motive corresponds to the first response in footnote 5). Indeed, he set an example by giving away all of his massive wealth to charitable causes and leaving nothing to his daughter, and there are many other wealthy individuals who behave similarly. Thus, we believe that bequest decisions arise from deep parameters that are exogenous and that whether or not one has a bequest motive is independent of one's work effort or wealth level.

Table 2
Summary statistics.

Variable	Mean	Std. dev.	Median	Minimum	Maximum	No. of obs.
Dependent variables						
HRSPERWEEK	41.347	15.151	40	1	105	1574
log(HRSPERWEEK)	3.632	0.480	3.689	0	4.654	1574
RETAGE	64.694	5.402	65	35	90	1574
log(RETAGE)	4.166	0.084	4.174	3.555	4.500	1574
FULLTIME	0.594	0.491	1	0	1	1574
Explanatory variables pertaining to bequest motives						
BEQMOTALT	0.294	0.456	0	0	1	1574
BEQMOTCARE	0.030	0.172	0	0	1	1574
BEQMOTFIN	0.008	0.087	0	0	1	1574
BEQMOTBUS	0.008	0.091	0	0	1	1574
BEQMOTWEAK	0.473	0.499	0	0	1	1574
BEQMOTNONE	0.187	0.390	0	0	1	1574
Other explanatory variables						
WAGE	1521.143	856.469	1296.154	346.154	6527.473	1574
log(WAGE)	7.196	0.501	7.167	5.847	8.784	1574
OTHERINC	10.045	6.628	13.5	0	24.2	1574
log(OTHERINC+1)	2.053	1.004	2.674	0	3.227	1574
BEQREC	0.341	0.474	0	0	1	1574
BEQEXP	0.267	0.443	0	0	1	1574
MALE	0.571	0.495	1	0	1	1574
MARRIED	0.922	0.267	1	0	1	1574
AGE	51.230	9.852	51	26	79	1574
log(AGE)	3.917	0.199	3.932	3.258	4.369	1574
HEALTH	3.475	0.917	3	1	5	1574
WORRY	3.494	1.068	4	1	5	1574
WORK	3.576	0.858	4	1	5	1574
WORKSAT	3.283	0.944	3	1	5	1574
SALWKR	0.838	0.369	1	0	1	1574
PENSION	48.221	24.424	55	5	95	1574
NUMCHILDREN	2.165	0.431	2	1	5	1574
GAMBLE	0.431	0.495	0	0	1	1574

Notes: Refer to the main text for variable definitions. "log" denotes natural logarithm.
Data source: The 2012 wave of the Preference Parameters Study (*Kurashi no Konomi to Manzokudo nit suite no Chousa*) of Osaka University.

Table 3
Work-related outcomes by bequest motive.

	Full sample	BEQMOTALT	BEQMOTCARE	BEQMOTFIN	BEQMOTBUS	BEQMOTWEAK	BEQMOTNONE
				HRSPERWEEK			
Mean	41.3	44.0	42.9	39.4	41.8	39.9	40.6
Std. dev.	15.2	14.5	14.5	11.1	19.4	14.6	16.9
# of obs.	1574	463	48	12	13	744	294
				RETAGE			
Mean	64.7	64.8	64.3	63.3	68.5	64.6	64.7
Std. dev.	5.4	5.5	5.3	5.8	8.5	5.5	4.9
# of obs.	1574	463	48	12	13	744	294

Note: Refer to the main text for variable definitions.
Data source: The 2012 wave of the Preference Parameters Study (*Kurashi no Konomi to Manzokudo nit suite no Chousa*) of Osaka University.

number of hours worked per week of respondents who plan to leave a bequest only if their children provide care (including nursing care) during old age (BEQMOTCARE) is significantly higher but that their planned retirement age is significantly lower than that of respondents without any bequest motive. These results provide strong support for H2.[9]

Looking at the results for various subsamples, the altruistic bequest-work relationship is not statistically significant for any subsample shown in Tables 4 and 5, but unreported results show that the impact of altruistic bequests on working hours is driven by those aged 40 or younger. This suggests that altruistic individuals decide their work behavior at a relatively young age.

The strategic or exchange bequest-work relationship is stronger for the male sample than for both sexes in the log(HRSPERWEEK) regression (in fact, α_c is statistically significant at the 1% level in all male samples). This suggests that the strategic or exchange bequest motive affects the number of hours worked per week of male respondents more than that of female respondents and that male respondents are the ones driving the results for the full sample.

Moreover, the strategic or exchange bequest-work relationship is stronger for the married male sample than for the full male sample in the log(RETAGE) regression. This suggests that the strategic or exchange bequest motive affects the planned retirement age of married males more than it affects that of unmarried males, which suggests that it is married males who are driving the results for the full sample (our unreported results for female respondents provide further support for this claim). A possible explanation for this finding is that married males have

[9] It should be noted that only 48 respondents report having a care-related bequest motive BETMOTCARE, but we confirmed that these respondents do not differ significantly from other respondents with respect to age, wage, gender, and marital status.

Table 4
The determinants of the number of hours worked per week.

	Dependent variable: log(HRSPERWEEK)							
Explanatory variable	Both sexes, all ages	Both sexes, age>=40	Both sexes, married, all ages	Both sexes, married, age>=40	Males, all ages	Males, age>=40	Married males, all ages	Married males, age>=40
Bequest motives of interest								
BEQMOTALT	0.053*	0.039	0.048	0.034	0.009	0.021	0.010	0.021
	(0.031)	(0.034)	(0.031)	(0.035)	(0.027)	(0.029)	(0.027)	(0.030)
BEQMOTCARE	0.121**	0.099*	0.141***	0.121**	0.096***	0.110***	0.102***	0.117***
	(0.052)	(0.056)	(0.053)	(0.057)	(0.035)	(0.037)	(0.037)	(0.039)
Other bequest motives								
BEQMOTFIN	-0.063	-0.102	-0.111	-0.170	-0.240**	-0.240*	-0.239**	-0.242*
	(0.105)	(0.117)	(0.121)	(0.137)	(0.120)	(0.131)	(0.119)	(0.130)
BEQMOTBUS	0.040	0.044	0.027	0.031	-0.210	-0.177	-0.208	-0.175
	(0.173)	(0.169)	(0.175)	(0.171)	(0.246)	(0.240)	(0.247)	(0.240)
BEQMOTWEAK	0.028	0.023	0.022	0.020	-0.016	-0.008	-0.011	-0.003
	(0.030)	(0.033)	(0.030)	(0.032)	(0.027)	(0.029)	(0.028)	(0.030)
Other explanatory variables								
log(WAGE)	1.097*	0.719	1.034*	0.681	0.432	0.504	0.559	0.649
	(0.597)	(0.590)	(0.604)	(0.598)	(0.641)	(0.665)	(0.675)	(0.704)
$\log(WAGE^2)$	-0.081**	-0.055	-0.076*	-0.052	-0.036	-0.041	-0.045	-0.051
	(0.041)	(0.040)	(0.041)	(0.041)	(0.044)	(0.045)	(0.046)	(0.048)
log (OTHERINC+1)	-0.009	-0.004	-0.012	-0.008	0.005	0.010	0.002	0.007
	(0.010)	(0.011)	(0.011)	(0.012)	(0.010)	(0.011)	(0.010)	(0.011)
BEQREC	-0.012	-0.005	-0.015	-0.007	0.009	0.009	0.011	0.011
	(0.024)	(0.024)	(0.025)	(0.025)	(0.020)	(0.021)	(0.021)	(0.022)
BEQEXP	0.017	-0.010	0.011	-0.015	0.004	0.001	0.002	0.0005
	(0.022)	(0.023)	(0.024)	(0.024)	(0.020)	(0.022)	(0.021)	(0.022)
MALE	0.530***	0.520***	0.536***	0.526***				
	(0.029)	(0.031)	(0.031)	(0.033)				
MARRIED	-0.161***	-0.156***			-0.009	0.002		
	(0.042)	(0.045)			(0.044)	(0.046)		
log(AGE)	-0.285***	-0.570***	-0.270***	-0.542***	-0.448***	-0.672***	-0.449***	-0.676***
	(0.065)	(0.086)	(0.067)	(0.088)	(0.054)	(0.079)	(0.055)	(0.080)
HEALTH	0.003	0.011	0.0003	0.009	0.009	0.008	0.010	0.009
	(0.012)	(0.013)	(0.013)	(0.014)	(0.011)	(0.013)	(0.011)	(0.013)
WORRY	-0.002	-0.009	-0.011	-0.018	0.011	0.008	0.010	0.007
	(0.011)	(0.011)	(0.012)	(0.011)	(0.009)	(0.010)	(0.009)	(0.010)
WORK	0.025*	0.028**	0.021	0.024*	0.017	0.018	0.020*	0.022*
	(0.013)	(0.014)	(0.013)	(0.014)	(0.011)	(0.012)	(0.012)	(0.013)
WORKSAT	-0.019	-0.020	-0.014	-0.015	0.005	0.011	0.002	0.009
	(0.013)	(0.014)	(0.013)	(0.014)	(0.012)	(0.013)	(0.012)	(0.014)
SALWKR	0.058	0.057	0.053	0.054	0.007***	-0.005	0.010	-0.002
	(0.036)	(0.040)	(0.037)	(0.040)	(0.032)	(0.034)	(0.033)	(0.035)
PENSION	-0.001***	-0.001**	-0.001***	-0.001**	-0.001	-0.001**	-0.001***	-0.001**
	(0.0005)	(0.001)	(0.001)	(0.001)	(0.0004)	(0.0005)	(0.0004)	(0.0005)
NUMCHILDREN	-0.009	-0.015	-0.001	-0.004	0.015	0.010	0.018	0.014
	(0.015)	(0.017)	(0.016)	(0.018)	(0.012)	(0.013)	(0.012)	(0.013)
GAMBLE	-0.009	-0.013	-0.003	-0.009	0.001	0.004	0.001	0.004
	(0.021)	(0.022)	(0.021)	(0.023)	(0.018)	(0.019)	(0.018)	(0.020)
Constant	0.916	3.439	0.909	3.287	4.265*	4.901**	3.781	4.366*
	(2.209)	(2.174)	(2.251)	(2.233)	(2.369)	(2.483)	(2.502)	(2.640)
Adjusted R^2	0.283	0.283	0.292	0.290	0.161	0.177	0.163	0.179
# of observations	1,574	1,369	1,452	1,263	899	792	868	763

Notes: The dependent variable is the natural logarithm of the respondent's number of hours worked per week. The model is estimated by ordinary least squares and the standard errors, within parentheses, are robust to heteroscedasticity. The p-values for the significance of the coefficients are expressed as *p < 0.1, ** p < 0.05, and ***p < 0.01. Refer to the main text for variable definitions.
Data source: The 2012 wave of the Preference Parameters Study (*Kurashi no Konomi to Manzokudo nit suite no Chousa*) of Osaka University.

a greater demand for care from their children because they as well as their wives are potential care recipients[10].

Our interpretation of the strategic or exchange bequest-work relationship is that respondents with a strategic or exchange bequest motive tend to work more intensively than others before they retire so that they can earn more, leave a larger bequest to their children, and elicit more care from them after they retire but that they tend to retire earlier than others so that they can start receiving care from their children sooner.

Comparing our results for the altruistic and strategic/exchange bequest motives, α_c is more than twice as large as α_a in almost all cases, as can be seen from Tables 4 and 5, implying that the strategic or exchange bequest motive (whereby parents leave a bequest to their children in exchange for receiving care) has a much greater impact on their employment status and working hours than the altruistic bequest motive (whereby parents give a unilateral transfer to their children without receiving anything in return).

3.5.2. *The impact of other factors on work behavior*

In this subsection, we discuss our findings relating to the other factors that can affect the various work-related outcomes considered in the estimation model. We included the sixteen control variables discussed in Subsection 3.2, plus the natural logarithm of wage squared to account

[10] Our unreported results indicate that the strategic or exchange bequest-work relationship is supported for married couples and especially for married males aged less than 50 years old. This suggests that planning for bequests and retirement starts relatively early in Japan.

Table 5
The Determinants of the Planned Retirement Age.

	Dependent variable: log(RETAGE)							
Explanatory variable	Both sexes, all ages	Both sexes, age>=40	Both sexes, married, all ages	Both sexes, married, age>=40	Males, all ages	Males, age>=40	Married males, all ages	Married males, age>=40
Bequest motives of interest								
BEQMOTALT	-0.005	-0.007	-0.006	-0.008	0.006	-0.002	0.003	-0.005
	(0.005)	(0.005)	(0.006)	(0.006)	(0.007)	(0.007)	(0.007)	(0.007)
BEQMOTCARE	-0.022**	-0.022**	-0.026**	-0.027**	-0.017	-0.019	-0.023**	-0.026**
	(0.010)	(0.010)	(0.010)	(0.011)	(0.011)	(0.012)	(0.011)	(0.011)
Other bequest motives								
BEQMOTFIN	-0.044**	-0.018	-0.050**	-0.020	-0.026	-0.015	-0.028	-0.016
	(0.021)	(0.012)	(0.024)	(0.013)	(0.021)	(0.016)	(0.022)	(0.016)
BEQMOTBUS	0.012	0.006	0.011	0.006	0.037	0.028	0.035	0.027
	(0.025)	(0.024)	(0.025)	(0.024)	(0.035)	(0.034)	(0.035)	(0.034)
BEQMOTWEAK	-0.009*	-0.013***	-0.009*	-0.013**	-0.001	-0.006	-0.002	-0.007
	(0.005)	(0.005)	(0.005)	(0.005)	(0.006)	(0.006)	(0.006)	(0.006)
Other explanatory variables								
log(WAGE)	-0.161**	-0.153*	-0.180**	-0.169**	-0.319***	-0.284***	-0.366***	-0.338***
	(0.079)	(0.078)	(0.082)	(0.083)	(0.109)	(0.108)	(0.107)	(0.106)
$\log(\text{WAGE}^2)$	0.010*	0.010*	0.012**	0.011*	0.020***	0.018**	0.024***	0.022***
	(0.005)	(0.005)	(0.006)	(0.006)	(0.007)	(0.007)	(0.007)	(0.007)
log (OTHERINC+1)	-0.004**	-0.003*	-0.001	-0.002	0.002	0.002	0.002	0.002
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
BEQREC	0.002	0.003	0.004	0.005	-0.003	-0.002	-0.002	-0.0002
	(0.004)	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)	(0.005)	(0.005)
BEQEXP	-0.013***	-0.012***	-0.014***	-0.013***	-0.009*	-0.007	-0.010**	-0.008
	(0.004)	(0.005)	(0.004)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
MALE	0.049***	0.046***	0.052***	0.049***				
	(0.004)	(0.004)	(0.004)	(0.004)				
MARRIED	-0.030***	-0.022***			-0.006	-0.004		
	(0.007)	(0.007)			(0.015)	(0.016)		
log(AGE)	0.119***	0.163***	0.121***	0.159***	0.111***	0.140***	0.113***	0.140***
	(0.012)	(0.013)	(0.012)	(0.014)	(0.013)	(0.016)	(0.014)	(0.016)
HEALTH	0.003	0.003	0.003	0.004*	0.004*	0.005*	0.005**	0.005**
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)
WORRY	-0.0001	-0.002	0.0005	-0.001	-0.0002	-0.002	-0.0002	-0.002
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
WORK	0.010***	0.010***	0.010***	0.010***	0.006**	0.007**	0.005*	0.005*
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
WORKSAT	0.004**	0.004**	0.004*	0.004*	0.003	0.004*	0.003	0.005*
	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)
SALWKR	-0.067***	-0.067***	-0.068***	-0.069***	-0.070***	-0.073***	-0.071***	-0.075***
	(0.005)	(0.005)	(0.006)	(0.006)	(0.007)	(0.007)	(0.007)	(0.007)
PENSION	-0.0003***	-0.0003***	-0.0003***	-0.0003***	-0.0002	-0.0002*	-0.0002	-0.0002*
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
NUMCHILDREN	0.001	0.0005	0.001	-0.0005	0.003	0.001	0.002	-0.001
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)	(0.003)	(0.003)
GAMBLE	-0.0003	-0.001	-0.001	-0.001	-0.004	-0.006	-0.002	-0.004
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Constant	4.339***	4.131***	4.362***	4.182***	5.003***	4.764***	5.172***	4.971***
	(0.299)	(0.295)	(0.311)	(0.314)	(0.415)	(0.417)	(0.405)	(0.410)
Adjusted R^2	0.316	0.366	0.323	0.373	0.305	0.344	0.319	0.364
# of observations	1,574	1,369	1,452	1,263	899	792	868	763

Notes: The dependent variable is the natural logarithm of the respondent's planned retirement age. The model is estimated by ordinary least squares and the standard errors, within parentheses, are robust to heteroscedasticity. The p-values for the significance of the coefficients are expressed as *p < 0.1, ** p < 0.05, and ***p < 0.01. Refer to the main text for variable definitions.
Data source: The 2012 wave of the Preference Parameters Study (*Kurashi no Konomi to Manzokudo nit suite no Chousa*) of Osaka University.

for possible non-linearity in the impact of wages. We provide explanations of the factors that are relevant and important in the Japanese context.

3.5.2.1. Wages and other income. The net effect of the respondent's wage rate (WAGE) on the number of hours worked per week is positive. More specifically, the marginal effect of an increase in the wage rate is $\frac{\partial y}{\partial w} = \beta_1 + 2\beta_2$, where w is the wage rate, which equals $1.097 + 2 \times (-0.081) = 0.935$ for the full sample in the log(HRSPERWEEK) regression (see the column marked "Both sexes, all ages" in Table 5). The effect seems to be intuitively reasonable as it implies that a one percentage point increase in the wage rate increases the number of hours worked per week by less than one percentage point.

By contrast, the respondent's wage rate has a consistently negative and statistically significant impact on the planned retirement age, as shown in Table 6, presumably because leisure is a luxury good, the demand for which increases (causing a decline in labor supply) as income increases. More specifically, the marginal effect of an increase in the wage rate is $-0.161 + 2 \times (0.01) = -0.141$ for the full sample in the log(RETAGE) regression (see the column marked "Both sexes, all ages" in Table 6).

As expected, an addition to non-respondent earned income (OTHERINC) induces respondents to retire earlier, again presumably reflecting the fact that leisure is a luxury good.

3.5.2.2. Bequest receipts and bequest expectations. Bequest receipts (BEQREC) and bequest expectations (BEQEXP), both of which are a

Table 6
The Determinants of Employment Status (Full-time vs. Part-time).

	Dependent variable: FULLTIME (full-time dummy)							
Explanatory variable	Both sexes, all ages	Both sexes, age>=40	Both sexes, married, all ages	Both sexes, married, age>=40	Males, all ages	Males, age>=40	Married males, all ages	Married males, age>=40
Bequest motives of interest								
BEQMOTALT	0.082**	0.021	0.079*	0.013	0.060*	0.021	0.061*	0.024
	(0.039)	(0.044)	(0.042)	(0.046)	(0.035)	(0.041)	(0.035)	(0.040)
BEQMOTCARE	0.141*	0.078	0.146**	0.076	0.133***	0.131*	0.128***	0.126*
	(0.074)	(0.088)	(0.073)	(0.089)	(0.050)	(0.071)	(0.048)	(0.069)
Other bequest motives								
BEQMOTFIN	-0.224	-0.310**	-0.375**	-0.488***	-0.385**	-0.527***	-0.369**	-0.511***
	(0.159)	(0.154)	(0.149)	(0.111)	(0.167)	(0.164)	(0.176)	(0.179)
BEQMOTBUS	0.134	0.102	0.134	0.104	-0.062	-0.071	-0.053	-0.056
	(0.184)	(0.185)	(0.189)	(0.190)	(0.118)	(0.124)	(0.113)	(0.116)
BEQMOTWEAK	0.033	-0.008	0.039	-0.003	0.022	-0.001	0.035	0.015
	(0.038)	(0.041)	(0.040)	(0.044)	(0.036)	(0.041)	(0.036)	(0.041)
Other explanatory variables								
log(WAGE)	1.112	1.088	1.14	1.152	0.436	0.557	0.314	0.400
	(1.157)	(1.195)	(1.358)	(1.386)	(0.979)	(1.065)	(0.993)	(1.055)
$\log(\text{WAGE}^2)$	-0.054	-0.052	-0.055	-0.056	-0.019	-0.027	-0.011	-0.017
	(0.079)	(0.081)	(0.093)	(0.095)	(0.066)	(0.072)	(0.067)	(0.071)
log(OTHERINC+1)	-0.018	-0.019	-0.021	-0.026	0.012	0.011	0.013	0.013
	(0.015)	(0.016)	(0.016)	(0.017)	(0.013)	(0.014)	(0.013)	(0.014)
BEQREC	0.002	0.023	0.009	0.036	0.002	0.033	-0.001	0.033
	(0.031)	(0.033)	(0.033)	(0.034)	(0.029)	(0.030)	(0.029)	(0.03)
BEQEXP	0.072**	0.049	0.063*	0.033	0.062**	0.064*	0.058**	0.057*
	(0.032)	(0.035)	(0.034)	(0.036)	(0.029)	(0.033)	(0.029)	(0.033)
MALE	0.351***	0.337***	0.377***	0.369***				
	(0.030)	(0.033)	(0.031)	(0.034)				
MARRIED	-0.142***	-0.142**			0.166*	0.228**		
	(0.053)	(0.058)			(0.088)	(0.099)		
log(AGE)	-0.483***	-0.780***	-0.496***	-0.825***	-0.590***	-0.881***	-0.559***	-0.859***
	(0.086)	(0.121)	(0.092)	(0.131)	(0.099)	(0.132)	(0.098)	(0.131)
HEALTH	0.006	0.001	-0.002	-0.007	0.021	0.013	0.017	0.009
	(0.016)	(0.017)	(0.017)	(0.018)	(0.015)	(0.018)	(0.015)	(0.018)
WORRY	0.0003	-0.013	-0.013	-0.029*	0.017	0.006	0.011	-0.001
	(0.014)	(0.015)	(0.015)	(0.016)	(0.014)	(0.015)	(0.014)	(0.015)
WORK	-0.008	-0.013	-0.019	-0.024	-0.013	-0.014	-0.018	-0.020
	(0.018)	(0.019)	(0.019)	(0.021)	(0.018)	(0.020)	(0.018)	(0.020)
WORKSAT	-0.023	-0.004	-0.019	-0.003	-0.001	0.011	-0.003	0.010
	(0.017)	(0.018)	(0.018)	(0.019)	(0.017)	(0.019)	(0.017)	(0.019)
SALWKR	0.251***	0.237***	0.253***	0.232***	0.345***	0.300***	0.353***	0.305***
	(0.048)	(0.050)	(0.052)	(0.053)	(0.061)	(0.062)	(0.062)	(0.064)
PENSION	0.0001	0.0001	-0.0002	0.000	-0.0004	0.0002	-0.001	-0.0001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
NUMCHILDREN	0.045**	0.051**	0.041*	0.048*	0.043*	0.047*	0.037	0.038
	(0.021)	(0.024)	(0.023)	(0.026)	(0.023)	(0.027)	(0.023)	(0.026)
GAMBLE	0.047*	0.055*	0.057*	0.065**	0.025	0.029	0.035	0.041
	(0.029)	(0.03)	(0.030)	(0.032)	(0.027)	(0.03)	(0.027)	(0.03)
Correctly predicted (%)	77.26	76.77	77.9	70.99	82.31	82.2	81.44	70.99
McFadden R^2	0.27	0.27	0.29	0.15	0.28	0.29	0.31	0.15
# of observations	1,574	1,369	1,452	1,263	899	792	868	763

Notes: The dependent variable is an indicator variable for whether or not the respondent works full-time. The model is estimated by the probit method, the coefficients and the p-values are for (average) marginal effects, and the standard errors, within parentheses, are robust to heteroscedasticity. The p-values for the significance of the coefficients are expressed as *p < 0.1, ** p < 0.05, and ***p < 0.01. Refer to the main text for variable definitions.
Data source: The 2012 wave of the Preference Parameters Study (*Kurashi no Konomi to Manzokudo nit suite no Chousa*) of Osaka University.

measure of nonwage income, should have qualitatively similar impacts as non-respondent earned income (OTHERINC) on individual work behavior. However, the impact of BEQREC is never statistically significant, while BEQEXP has a negative and statistically significant impact in the log(RETAGE) regression. The latter finding implies that respondents expecting to receive bequests in the future plan to retire earlier than respondents without such expectations, as expected.

3.5.2.3. Gender, age, and marital status. The impact of gender (MALE) is significantly positive, as expected, reflecting the social norm in Japan that males are expected to work more than females at both the intensive and extensive margins.

As for the impact of marital status (MARRIED), being married shortens working time significantly at both the intensive and extensive margins in the full sample but does not have a significant impact on working time in the male sample. Our finding for the male sample may arise because the desire of married males to spend time with their wives and children, which would tend to reduce their working time, is offset by the social norm in Japan that wives bear a disproportionate share of the burden of housework and childrearing, which would enable married males to increase their working time.

The respondent's age (AGE) has a negative and statistically significant impact on the number of hours worked per week but has a positive and statistically significant impact on the planned retirement age. The former finding is plausible because mental and/or physical fatigue presumably increases with age, reducing how much the respondent can work at the intensive margin. The latter finding suggests that respondents postpone retirement as they get older, perhaps because they gradually realize that they do not have enough resources to finance their living expenses during retirement.

3.5.2.4. Work importance, work satisfaction, and occupation type. The importance of work (WORK) generally has a positive and statistically significant impact on the number of hours worked per week and on the planned retirement age, meaning that respondents for whom work is more important work more and work longer, which is as one might expect.

As expected, work satisfaction (WORKSAT) has a positive and statistically significant impact on the extensive margin (i.e., the planned retirement age), meaning that respondents who are satisfied with work, work longer but this is not the case at the intensive margin.

As for the impact of occupation type (SALWKR), salaried workers plan to retire earlier than the self-employed. This result is as one might expect because salaried workers face a mandatory retirement age, whereas the self-employed do not, and because the pension benefits of salaried workers are higher than those of the self-employed in Japan.

3.5.2.5. Public pension benefits. The generosity of public pension benefits (PENSION) has a negative and statistically significant impact on the number of hours worked per week and on the planned retirement age (Honig (1998) reports similar results for a sample of 590 white married women in the United States). This is evidence of the induced retirement effect identified by Feldstein (1974).

3.5.2.6. Number of children. As for the impact of the number of children (NUMCHILDREN), it does not have a significant impact on either work-related outcome.

3.5.2.7. Risk preference, health status, and worry about retirement. As for the impact of the degree of risk aversion (GAMBLE), risk-loving respondents who like to gamble do not differ significantly from other respondents with respect to the number of hours worked per week or with respect to their planned retirement age in the case of both sexes. Farhi and Panageas (2007) find that individuals who wish to retire earlier are less risk-averse and invest more in the stock market, but our finding that there is not a statistically significant association between the degree of risk aversion and the timing of retirement implies that Farhi and Panageas's (2007) finding does not apply in the case of Japan. However, this result might be due to the weak proxy we use for risk aversion.

The health status (HEALTH) of males delays their planned retirement age, which is as one would expect and which is also in line with the findings of Brown et al. (2015), who report that Croatian retirees in good health are more likely to opt for a deferred retirement package.

Finally, worry about life after 65 (WORRY) does not have a statistically significant impact on either work-related outcome.

3.6. Robustness checks

In this section, we discuss the large number of robustness checks that we conducted for our empirical analysis. First, we used the probability of working full-time as an alternative measure of the intensive margin. The model is estimated using the probit method. The results for the marginal effects are shown in Table 6, and as can be seen from this table, the results are generally very similar to those for the number of hours worked per week, especially for the bequest motive-related variables that are of the most interest to us. Even though working full-time is a weak proxy for work at the intensive margin because it is not a continuous variable, our results show that individuals with an altruistic or strategic/exchange bequest motive work more than individuals with no bequest motive at all, as we found when we used the number of hours worked per week.

We also conducted a battery of other robustness checks, but our main empirical results concerning the bequest-work relationship remained unchanged and significant. For example, we obtained broadly consistent results when we tried using the levels of HRSPERWEEK and RETAGE instead of taking the natural logarithms thereof, when we tried including respondents with a weak bequest motive (BEQMOTWEAK) in the reference category together with respondents who do not plan to leave a bequest to their children under any circumstances and those who want to leave a bequest to their children but will not because they do not have the financial capacity to do so, and when we tried including a dummy variable for good/excellent health (a dummy variable that equals one if HEALTH equals 4 or 5) in lieu of the ordinal variable HEALTH.

Note, moreover, that we added a long list of individual- and household-specific controls to eliminate the endogeneity bias arising from omitted variable(s), that our results are free from reverse relationship bias, as discussed in Subsection 3.3, and that we eliminated the possibility that bequest motives are merely acting as a proxy for wealth by including a large number of wealth-related variables such as WAGE, the square of WAGE, OTHERINC, BEQREC, and BEQEXP.

4. Conclusion and policy implications

In this paper, we conducted a theoretical and empirical analysis of the impact of bequest motives on the labor supply and retirement behavior of households in Japan, and to the best of our knowledge, it is virtually the first paper to do so. We conducted an empirical analysis using micro data from a unique survey—the Preference Parameters Study of Osaka University—and showed that respondents with an altruistic or strategic/exchange bequest motive work more at the intensive margin than those without any bequest motive but that respondents with a strategic or exchange bequest motive work less at the extensive margin (i.e., retire earlier) than those without any bequest motive. Our findings for the strategic or exchange motive suggest that respondents with such a motive tend to work more than others before they retire so that they can earn more, leave a larger bequest to their children, and elicit more care from them but that they tend to retire earlier than others so that they can start receiving care for themselves and their spouses from their children sooner.

Moreover, the altruistic bequest-work relationship in Japan appears to be driven primarily by young respondents (those aged less than 40 years), which suggests that altruistic respondents decide their work behavior at a relatively young age. By contrast, the strategic or exchange bequest-work relationship appears to be driven primarily by male respondents, especially married males. A possible explanation for the latter finding is that married males have a greater demand for care from their children because they as well as their wives are potential care recipients.

We employ a battery of robustness checks to show that our empirical findings concerning the bequest-work relationship are highly robust, remaining significant and consistent with the predictions of our theoretical model in every case.

Turning to the limitations of our analysis, we fail to take account of the possibility that the parent's bequest motives may be influenced by their child's circumstances. For example, the parent may be more likely to leave a bequest to his/her child if the child has an unstable job or unstable income or if the child has children (i.e., the parent has grandchildren). Overcoming this limitation is left as a direction for further research.

We conclude this paper by discussing the policy implications of our findings. When designing inheritance taxes, it is very important for policymakers to realize that the bequest-work relationship exists but that it varies by the type of bequest motive. In the case of a strategic or exchange bequest motive, which affects parents' work behavior as well as their retirement decision, inheritance tax policy should be set taking account of both the increased work effort at the intensive margin as well as the induced retirement effect of this motive. On one hand, a lower inheritance tax will encourage parents to work more before retirement so they can leave a larger bequest, and this will contribute to increasing the labor supply. However, a lower inheritance tax may also lead some parents to retire earlier than otherwise so that they can start receiving

care sooner, meaning that labor supply may not increase, on balance, as a result of a reduction in the inheritance tax. In the case of the altruistic bequest motive, by contrast, there does not seem to be any need to worry about the induced retirement effect, meaning that lowering inheritance taxes will unambiguously increase labor supply by encouraging individuals to leave larger bequests. Since the rapid ageing of Japan's population is projected to produce severe labor shortages in the coming years, reforming inheritance taxes and other government policies relating to bequests may be an effective way of encouraging people to work more, if implemented carefully.

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