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Care policy effects on individuals' decisions of marriage, fertility and family elderly care provision

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Abstract

Using a simple lifecycle model in which individuals are altruistic toward both their children and parents, we analyze decisions related to marriage, fertility, and elderly care provision for parents in a cooperative family Nash-bargaining model. Then, considering child-rearing subsidies and family elderly care subsidies, we analyze the policy effects of child-rearing and elderly care provision subsidies on marriage, fertility, and elderly care provision. The main findings are the following. Child-rearing subsidies increase the fertility rate. Elderly care subsidies always increase women's care provision. If the net utility sum from elderly care provision for their two pairs of parents and from having children is positive, then couples might form. Child-rearing subsidies discourage young people from marrying. Elderly care subsidies do not always encourage young people to marry. With a positive correlation between marriage and fertility, these subsidies might function to lower fertility. If individuals do not adequately evaluate elderly care for parents, then the subsidy policy will lower the fertility rate.

Keywords: child rearing subsidy, elderly care for parents, elderly care provision subsidy, fertility, marriage

JEL Classification: H24, I19, J12, J13, J18

Declaration: Conflict of interest

The author has no competing interest or personal relationship to this study.

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1 Introduction

Declines in both the marriage rate and the fertility rate have characterized economically developed countries in recent decades. Figure 1 depicts recent changes in the marriage rates (i.e., the number of marriages per 1000 inhabitants) and the total fertility rates of six countries among the Groupe Seven (G7) countries. For each country, the first two bars represent changes in the marriage rate, whereas the last two represent changes in the total fertility rate. Marriage rates and the total fertility rates have declined in most countries recently (described in the figure's notes). The marriage rate declined considerably in the UK, but it remained unchanged in Italy. Decline in the fertility rate was also great in the UK although those in Italy and Germany were slight. In these countries, some link apparently exists between changes in the marriage rate and changes in the fertility rate. Specifically, because the ratio of children born out of wedlock is extremely low in Japan among these countries, the relation between the marriage rate and the fertility rate is apparently closer in Japan than in other countries.[1] Changes in the marriage rate might strongly affect the fertility rate in Japan.

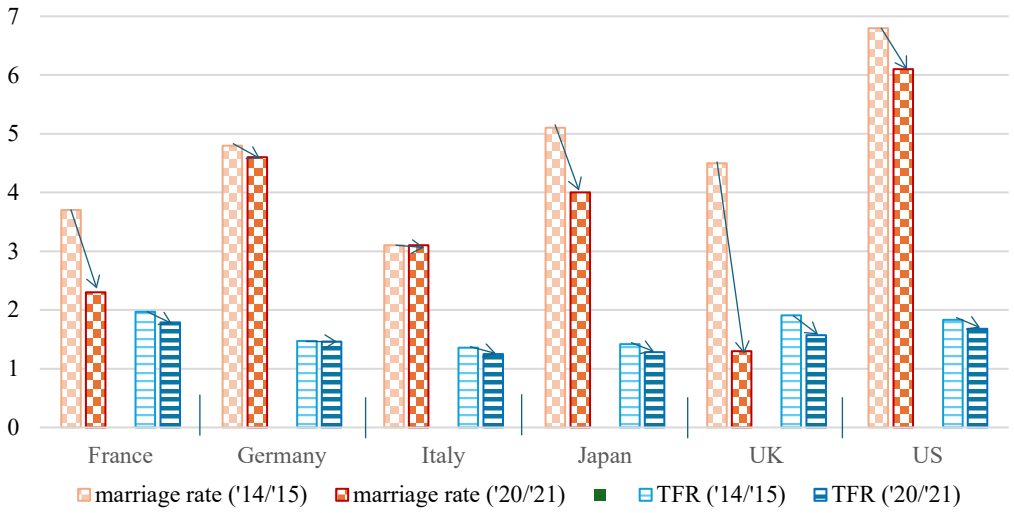

Fig. 1 Recent changes in Marriage rates and Total fertility rates.
Sources: UN World Population Prospects; UN Demographic Yearbook
Note: Changes during 2014-2020 for France, during 2014-2022 for Germany, during 2014-2021 for Italy, during 2015-2021 for Japan, during 2011-2020 for the UK, and during 2015-2019 for the US

[1] The Ministry of Labour, Health and Welfare of Japan (2013) reports that the ratios of children born out of wedlock are 52.6 (11.4) % in France, 43.7 (11.5) % in the UK, 40.6 (18.4) % in the US, 32.1 (15.1) % in Germany, 17.7 (4.3) % in Italy, and 2.1 (0.8) % in Japan in 2008 (where the ratios in parentheses respectively represent those in 1980).

Declines in the fertility rate are often recognized as exerting negative effects on societies. In fact, the fertility rate is below the sustainable level (replacement rate) of the population size in economically developed countries such as G7 countries. Such low fertility rates are regarded as contributing greatly to population aging, engendering greater burdens on social institutions. Governments have introduced some policies related to child rearing and elderly care provision to mitigate the social burdens. These policies have been conventionally analyzed separately in the literature. However, decisions related to marriage and fertility are made by individuals during their lifetime. It is appropriate to analyze these policy effects using a single model, simultaneously incorporating both of these decisions. This is the main aim of this paper.

As described herein, we first construct a lifecycle model of individuals. The first decision problem of individuals is to marry (including unmarried cohabitation) or not (being single). In either case, individuals provide elderly care for parents when they become dependent. When married, couples subsequently bargain cooperatively to determine how many children to care for and how to distribute the burdens of care for their parents between themselves. Then, we consider subsidy policy for child rearing and elderly care provision to analyze policy effects on decisions related to marriage and fertility behaviors.

Since Becker's (1973, 1974) seminal works, numerous reports of studies empirically and theoretically examining marriage have been published.[2] Among others, Cigno (2011) reports that marriage is losing ground to unmarried cohabitation throughout the developed world. Cohabitation without marriage has become socially acceptable, leading to increasing childbirths out of wedlock. However, the substance of such relationships and decision-making is equivalent to marriage. Cigno (2011; page 29) defines the role of marriage as a commitment to remain together for some time. In the most reports of the game-theoretic literature, the game is generally cooperative; the distribution of the surplus generated by marriage is the outcome of a two-person game.[3]

Easterlin (1971) poses a question of whether per-capita income growth has exerted a counter force tending to raise fertility. Since then, many reports have presented analyses of fertility rates occurring concurrently with economic development.[4] Higher wage rates

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[2] Chiappori (1992) presents a general collective approach of household labor supply. The empirical literature includes Gray (1998), Chiappori et al. (2002), and Gonzalez and Viitanen (2009).

[3] Lundberg and Pollak (1994) is an exception.

[4] Theoretical literature includes works by Becker and Barro (1988), Ehrlich and Lui (1991), and Yakita (2001).

along with economic development might raise the opportunity costs of the child-rearing time of young couples, consequently lowering the fertility rates.[5] When the fertility rate becomes lower than the replacement rate, a government might introduce some child care policy.

The literature describing theoretical studies of long-term care provision has been growing since approximately 2000, although numerous empirical studies were reported earlier.[6] Cremer et al. (2014, 2017) assume altruism of children toward parent to analyze long-term care provision by children. Klimaviciute et al. (2017) consider three long-term caring motives; altruism, exchange, and family norms. They conclude that, although the exchange model is rejected, moderate altruism is apparently applicable, except in eastern and southern countries.[7] When family solidarity is uncertain, the level of care provided by children might be insufficient for old-age lives of the couple's parents (e.g., Canta and Cremer, 2018). In such a case, public intervention of old-age support is expected to be introduced, as suggested by the specific egalitarianism proposed by Tobin (1970).

However, the literature cited above does not simultaneously present consideration of the decision of marriage and consideration of the distribution of child-rearing care provision and elderly care provision between the members of a couple when they are married in a single model. Often, it is reported that family care for children and elderly parents is provided mainly by women, as described respectively by a child penalty and family norm. Therefore, women might hesitate to marry because of these care burdens.[8] Such behaviors of women are expected to affect the fertility rate of the society. This fact suggests the importance of simultaneous analysis of both marriage and fertility decisions in a single model. Few studies have conducted such an analysis.

This paper first presents an analysis of individual decisions of a single generation related to marriage, family performance of regeneration, and elderly parents' care in Section 2. Specifically examining marriage, the analysis starts where the matching

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[5] Yakita (2018b) reports that if the price of child-rearing services outside the home is less than the young parents' wage rate, then they might be willing to purchase such child-rearing services from the market to increase the number of children.

[6] The empirical literature includes Pezzin and Schone (1997), van Houtven et al. (2013), and Skira (2015).

[7] By contrast, Alessie et al. (2014) conclude in favor of exchange and reject altruism. Horioka et al. (2018) report that individuals are affected strongly by altruism toward their parents as well as the exchange motive in Japan. The results of empirical studies are mixed.

[8] Kawata and Komura (2024) use Japanese data to present an analysis of only-child matching penalty in the marriage market, considering elderly care for parents. However, they confine their analysis to only-child individuals.

process among the cohort ends. In Section 3, considering child-care subsidy and old-age care subsidy policy, we then present analyses of these policy effects. Therefore, it is noteworthy that the present analyses might be characterized as comparative static analyses of the subjective equilibrium of individuals with respect to the policies. In Section 4, after presenting consideration of the decision of marriage, we present the analyses of the care policy effects on the decisions. The last section concludes the paper.

2 Model and Assumptions

First, the numbers of women and men are assumed, respectively, to be equal in a cohort, restricting our attention to heterosexual couples.[9] We consider a two-person cooperative Nash bargaining game in which the distribution of the surplus generated by marriage is the game outcome. As described in the preceding section, for simplicity of analyses, we start where the matching process among the cohort ends. Therefore, two cases exist in which all individuals are married or remain single. Although this assumption is unrealistic, it enables us to obtain the policy effects clearly. Once they decide to form a couple, they are assumed not to divorce. Individuals, female and male, live three periods: childhood, young adulthood, and retirement. Each is reared by parents during childhood: Each individual works, saves a part of the wage income for retirement, and provides elderly care for the individual's parents during young adulthood. Also, the individual consumes the savings and receives elderly care from the individual's children during retirement. For expositional simplicity, the wage rates and the interest rate are given exogenously. The interest rate is assumed to be zero. The time preference is also assumed to be zero. Under these assumptions, consumption during young adulthood and retirement are perfect substitutes.

The utility function of individuals is assumed as a quasi-linear function[10]

$$u^f = \begin{cases} c^f + \varepsilon^f u(n) + H^f(z^f, \tilde{z}^m) & \text{if married} \\ c^f + H_s^f(\overline{z}^f) & \text{if single} \end{cases} \tag{1}$$

for women and

[9] Doepke and Tertilt (2009) report that assortative matching cannot arise if all families are homogeneous. Marriage and fertility decisions of individuals in an overlapping generations model with a marriage market were analyzed, for example, by Aiyagari et al. (2000).

[10] Echevarria and Merlo (1999), Yakita (2018a), and Cremer et al. (2014, 2017) also assume such a quasi-linear utility function in a Nash bargaining game.

$$u^m = \begin{cases} c^m + \varepsilon^m u(n) + H^m(z^m, \tilde{z}^f) & \text{if married} \\ c^m + H_s^m(\bar{z}^m) & \text{if single} \end{cases} \quad (2)$$

for men. Herein, c^j represents consumption, n denotes the number of the couple's children, and z^j designates elderly care time provided by individual j for their two sets of parents ($j = m, f$). Superscripts f and m respectively designate female and male. Parameters ε^j are the utility weights of individual j assigned to having children ($j = m, f$). The literature supports that $\varepsilon^f > \varepsilon^m$ (e.g., Doepke and Tertilt, 2009). Function $u(n)$ represents the utility of this couple from having n children and $H^j(z^j, \tilde{z}^h)$ measures the utility of individual j from providing care z^j for their parents, expecting that spouse h provides care $\tilde{z}^h$ for their parents. It is assumed that $u'(n) > 0$ and $u''(n) < 0$ for $n > 0$, and that $H_1^j > 0$, $H_{11}^j < 0$ and $H_{12}^j < 0$ ($j = m, f$). Function $H_s^j(z)$ measures the utility of individual j when the individual remains single. On this point, it is noteworthy here that under such a quasi-linear utility function, consumption c^j can be regarded as lifecycle consumption, i.e., the sum of consumptions during young working period and retirement. [11] If individuals are unmarried, then they provide elderly care for their own parents, which is assumed to be given exogenously as $\bar{z}^j (> 0)$ for analytical simplicity. For simplicity, the care time is assumed to be the same for a woman and for a man: $\bar{z}^f = \bar{z}^m = \bar{z}$. This assumption is apparently safe because each elderly dependent needs an almost identical level of care,

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[11] Letting c_y^j, c_o^j, and x respectively represent consumption during the young and old period, and lifecycle savings, we have consumption during retirement as $c_o^j = x$, and the utility from consumption during the two periods as $c_y^j + c_o^j$. Therefore, we can represent $c^j = c_y^j + c_o^j$ in utility functions (1) and (2). The retired generation consumes savings and receives elderly care from their children.

whether a child is a boy or a girl.[12] In this case, the utility from elderly care provision is also constant, i.e., $H_s^j = H_s^j(\bar{z}^j)$ $(j = m, f)$.

By cooperative Nash bargaining, couples determine the number of children they have and the level of elderly care they provide for their parents. Letting the time endowment of each in the second working period be normalized to unity, we assume that both spouses provide elderly care, but that only women provide child-rearing care, as commonly assumed in the literature (e.g., Yakita, 2018a). Reflecting the fact that women are the main family caregivers for elderly parents, we assume that the utility of women from providing care for parents is higher than that of men, for example, because of social norms (e.g., Pestieau and Sato, 2008). We also assume that a couple provides elderly care of $z^m/2 + z^f/2$ equally for each spouse's parents for analytical purposes, where elderly care provided by women and men are qualitatively perfect substitutes for parents. Nevertheless, when evaluating elderly care provision, each member of a couple obtains a greater marginal altruistic utility from the individual's own care time than that of the partner.

Government subsidizes a fraction $1-\sigma$ of the mother's child rearing cost and a fraction $1-s$ of the individual's elderly care time for parents. These subsidies are financed by lump-sum taxes levied on young adults.

First, we consider the budget constraint for couples. Men allocate the time endowment between elderly care time for parents and the market labor supply. Women allocate the time endowment among care time for children, care time for elderly parents, and the market labor supply. As commonly assumed in the literature (e.g., Galor and Weil, 1996), the male wage rate w^m is assumed to be higher than the female wage rate w^f, i.e., the gender wage gap exists.[13] The budget constraint of a couple is therefore

$$w^m(1-sz^m) + w^f(1-\sigma qn - sz^f) - T = c^m + c^f, \tag{3}$$

where T represents a lump-sum tax levied on the couple. The lump-sum tax for each spouse is $T/2$. Parameter q represents the per-child rearing time, which is assumed to

[12] Nevertheless, if lump-sum taxes are adjusted correspondingly, then assuming that the care provision levels are different between a woman and a man does not fundamentally alter the argument.

[13] The OECD (2024) reports that the gender wage gap (the difference between median earnings of men and women relative to median earnings of men) of OECD countries ranges from 3.3% of Italy to 21.3% of Japan. The average of OECD countries is 11.4%. Recent evidence presented by Drago et al. (2004) and Stancanelli (2007) indicates that a large minority of women in economically developed countries earn more than men.

be constant.

If individuals remain single, the budget constraints of women and men are given as

$$c^j = w^j(1-s\bar{z}) - t^j, \quad (j = m, f), \tag{4}$$

where t^j denotes lump-sum tax levied on the individual j ($j = m, f$). We do not consider redistribution between unmarried individuals through taxes.

The government budget constraint in the case of couples is expressed as

$$(1-\sigma)qw^f + (1-s)(w^m z^m + w^f z^f) = T. \tag{5}$$

The government budget constraint in the case where individuals are unmarried is

$$(1-s)\bar{z}w^j = t^j, \quad (j = m, f). \tag{6}$$

3 Optimization of Couples

After first considering the optimization of couples to obtain the surplus of marriage in this section, we consider the issue of marriage decision in the next section.

Each couple solves the following cooperative Nash-bargaining problem (P1):

$$\underset{c^m, c^f, n, z^m, z^f}{Max} \{c^m + \varepsilon^m u(n) + H^m(z^m, \tilde{z}^f) - w^m(1-\bar{z}) - H_s^m\}$$

$$\times\{c^f + \varepsilon^f u(n) + H^f(z^f, \tilde{z}^m) - w^f(1-\bar{z}) - H_s^f\}, \tag{P1}$$

subject to

$$w^m(1-sz^m) + w^f(1-\sigma qn - sz^f) - T - c^m - c^f = 0 \tag{3'}$$

Herein, the outside options for individuals include the utility of being single, i.e., $c^j + H_s^j = w^j(1-s\bar{z}) - t^j + H_s^j = w^j(1-\bar{z}) + H_s^j$. The lifetime utility of individuals in the case of being single is constant, as inferred from (4) and (6). The first-order conditions are obtained as shown below.

$$c^m: \quad \{c^f + \varepsilon^f u(n) + H^f(z^f, \tilde{z}^m) - w^f(1-\bar{z}) - H_s^f\} - \lambda = 0, \tag{7}$$

$$c^f: \quad \{c^m + \varepsilon^m u(n) + H^m(z^m, \tilde{z}^f) - w^m(1-\bar{z}) - H_s^m\} - \lambda = 0, \tag{8}$$

$$n: \quad \varepsilon^m n'\{c^f + \varepsilon^f u(n) + H^f(z^f, \tilde{z}^m) - w^f(1-\bar{z}) - H_s^f\}$$

$$+\varepsilon^f u'\{c^m + \varepsilon^m u(n) + H^m(z^m, \tilde{z}^f) - w^m(1-\bar{z}) - H_s^m\} - \lambda\sigma q w^f = 0, \quad (9)$$

$$z^m: \quad H_1^m\{c^f + \varepsilon^f u(n) + H^f(z^f, \tilde{z}^m) - w^f(1-\bar{z}) - H_s^f\} - \lambda s w^m = 0, \quad (10)$$

$$z^f: \quad H_1^f\{c^m + \varepsilon^m u(n) + H^m(z^m, \tilde{z}^f) - w^m(1-\bar{z}) - H_s^m\} - \lambda s w^f = 0. \quad (11)$$

Herein, λ represents the Lagrange multiplier attached to budget constraint of the couple (3). From (7) and (8) we have the following equation.

$$[c^f + \varepsilon^f u(n) + H^f(z^f, \tilde{z}^m)] - [w^f(1-\bar{z}) + H_s^f]$$

$$= [c^m + \varepsilon^m u(n) + H^m(z^m, \tilde{z}^f)] - [w^m(1-\bar{z}) + H_s^m]. \quad (12)$$

The differences between lifetime utility when married and when single are equalized between spouses. When both sides of (12), which is equal to λ, are positive, individuals obtain higher lifetime utility by marriage than by being single. Inserting (7) and (8) into (9) and rearranging terms, we obtain the following condition.

$$(\varepsilon^m + \varepsilon^f)u'(n) = \sigma q w^f. \quad (13)$$

The left-hand side of (13) is the marginal utility of the cooperative couple derived from having children, whereas the right-hand side represents the marginal cost derived from having children after subsidization: the number of children is chosen to equalize the marginal utility and the marginal cost of children. In the present setting, elderly care provision does not affect the fertility decision of couples. From (13) we obtain

$$\frac{dn}{d\varepsilon^j} > 0 \ (j = m, f), \ \frac{dn}{d\sigma} < 0, \ \frac{dn}{dq} < 0, \text{ and } \frac{dn}{dw^f} < 0. \quad (14)$$

Increases in the utility weight of couples on having children increase the number of children. Formal child-care subsidies also increase the fertility rate, thereby lowering the child-rearing burden of couples. Increases in per-child rearing time lower the fertility rate. Increases in the female wage rate raise the opportunity cost of child-rearing time, consequently lowering the fertility rate. Childcare and elderly care can be safely assumed to be independent for an individual. The elderly care subsidy policy is independent of the fertility behaviors of individuals.

Summing up the arguments, we obtain the following proposition:

Proposition 1

The Nash equilibrium number of children balances the marginal utility of children for the couple and the marginal opportunity cost, i.e., the subsidized family per-child rearing time multiplied by the female wage rate. An increase of the subsidy rate therefore increases the number of children per couple.

The result of Theorem 1 is consistent with the result reported in the literature, such as the report presented by van Groezen et al. (2003).

Next, from (7), (8), (10), and (11), we obtain the following conditions.

$$H_1^f(z^f, \tilde{z}^m) = sw^f . \tag{15}$$

$$H_1^m(z^m, \tilde{z}^f) = sw^m , \tag{16}$$

Equations (15) and (16) respectively express the female reaction function to the expected male's elderly care provision $\tilde{z}^m$ and the male's reaction function to the expected female's elderly care provision $\tilde{z}^f$, where $\tilde{z}^j$ ($j = m, f$) represents an expected elderly care provision by the partner. To obtain explicit Nash-bargaining solutions, we specify functions H^j as

$$H^f(z^f, z^m) = (az^f + bz^m)^\beta \quad \text{and} \quad H^m(z^m, z^f) = (az^m + bz^f)^\alpha , \tag{17}$$

where a, b, α, and β are positive constants. We assume here that they satisfy conditions $a > b$ and $\alpha < \beta$. The former condition implies that individuals have greater satisfaction from the marginal care provision than that from the spouse's care provision. The latter condition implies that the utility elasticity of (total) elderly care for women is higher than that for men. In light of these specifications, conditions (15) an (16) can be written as presented below

$$az^f + b\tilde{z}^m = (a\beta / sw^f)^{1/(1-\beta)} . \tag{18a}$$

$$az^m + b\tilde{z}^f = (a\alpha / sw^m)^{1/(1-\alpha)} , \tag{18b}$$

The Nash bargaining solution is obtainable by setting $z^m = \tilde{z}^m$ and $z^f = \tilde{z}^f$, Therefore,

we can obtain the following from (18) as

$$z^f = [a(\frac{a\beta}{sw^f})^{1/(1-\beta)} - b(\frac{a\alpha}{sw^m})^{1/(1-\alpha)}] / D \quad \text{and} \tag{19}$$

$$z^m = [a(\frac{a\alpha}{sw^m})^{1/(1-\alpha)} - b(\frac{a\beta}{sw^f})^{1/(1-\beta)}] / D, \tag{20}$$

where $D = a^2 - b^2 > 0$ by assumption. Because of assumptions related to parameters, equation (19) gives $z^f > 0$. However, the sign of (20), z^m, is indeterminate a priori. For our analytical purposes, we consider the case in which elderly care provision is positive for both women and men. For this case to hold true, it must be assumed that

$$\frac{a}{b} > (\frac{a\beta}{sw^f})^{1/(1-\beta)} / (\frac{a\alpha}{sw^m})^{1/(1-\alpha)}. \tag{21}$$

The relative evaluation of elderly care provision by oneself is sufficiently greater than that of the partner. In this case, it can be shown that $z^f > z^m$ from (19) and (20). Women provide greater amounts of elderly care for their parents than men do. Figure 2 depicts the Nash-bargaining solution.

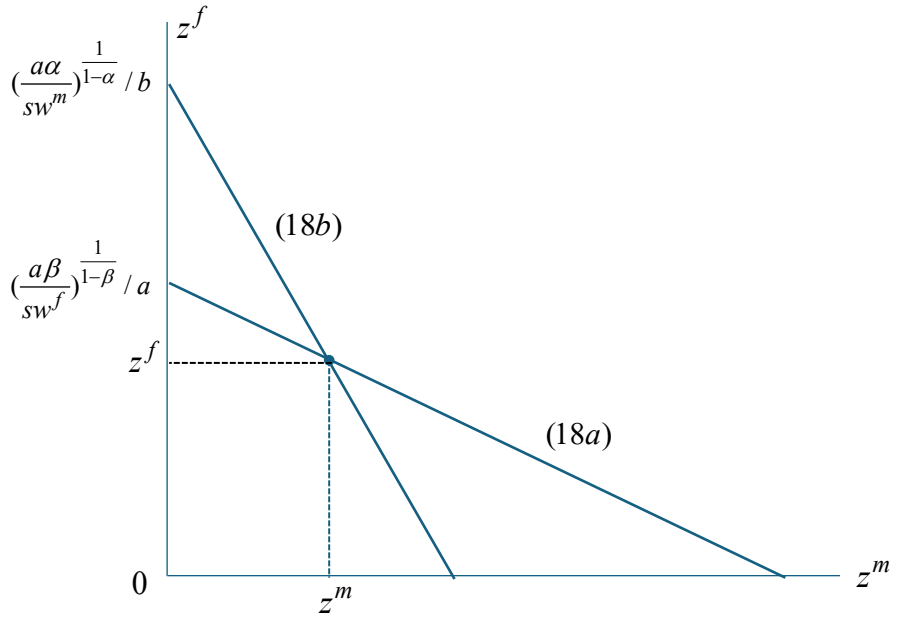

Fig. 2 Nash bargaining solution of elderly care provision.

From (19) and (20) we can demonstrate the following:

$$\frac{dz^m}{dw^m} < 0, \quad \frac{dz^f}{dw^m} > 0, \quad \frac{dz^m}{dw^f} > 0, \text{ and } \quad \frac{dz^f}{dw^f} < 0. \tag{22}$$

An increase in the female (male) wage rate decreases elderly care provision by women (men) but increases elderly care provision by men (women): Increases in the wage rate of the partner increase the care provision by the individual. The marginal utility of care provision is decreasing whilst the marginal utility of consumption is not decreasing. Therefore, the individual substitutes consumption for care provision. As increases in the partner's wage rate decrease the partner's care provision, the individual will increase care provision to compensate for the decrease.

Proposition 2

The women's utility weight of elderly care toward parents is assumed to be greater than the men's utility weight. If there exists a Nash bargaining solution for elderly care toward parents, then women's care provision is greater than the men's care provision.

Next, we consider the effects of increases in the elderly care subsidy rate. From (19) and (20) we obtain

$$\frac{dz^f}{ds} = [\frac{b}{1-\alpha}(\frac{a\alpha}{sw^m})^{1/(1-\alpha)} - \frac{a}{1-\beta}(\frac{a\beta}{sw^f})^{1/(1-\beta)}] / (sD) \quad \text{and} \tag{23}$$

$$\frac{dz^m}{ds} = [\frac{b}{1-\beta}(\frac{a\beta}{sw^f})^{1/(1-\beta)} - \frac{a}{1-\alpha}(\frac{a\alpha}{sw^m})^{1/(1-\alpha)}] / (sD). \tag{24}$$

The sign of (23) is negative, i.e., $dz^f / ds < 0$.[14] If the proportion of family elderly care burden decreases, then the elderly care provision by women increases. By contrast, the sign of (24) is indeterminate a priori. We can demonstrate that if β is sufficiently small and approximately equal to α, i.e., if the elasticities of utility with respect to elderly care are mutually close between women and men, alternatively if the utility weight on the partner's elderly care provision b is sufficiently small, then decreases in the proportion of family elderly care burden increase the elderly care provision by men, i.e., $dz^m / ds < 0$. Nevertheless, if otherwise, decreases in family elderly care burden decrease the amount of elderly care provision by men, i.e., $dz^m / ds > 0$. In this case, the couple obtains a utility gain by increasing the female partner's care provision and decreasing the male partner's care provision. These cases are explainable using Figure 2. A decrease in family elderly care fraction s shifts both reaction functions upward. In the former case, the upward shits of these reaction curves are not greatly different. Nevertheless, in the

[14] Conditions $b > a$, $\alpha < \beta$, and $w^m > w^f$ are assumed for these analyses.

latter case, the reaction curve of women (18a) shifts to become larger than that of men. The Appendix presents relevant details.

The result of the argument presented above can be summed up as expressed below.

Proposition 3

If the women's utility function of elderly care for parents is more concave than that of men, then the family care subsidy also increases the men's care provision. Otherwise, the men's elderly care provision might decrease with family elderly care subsidies. By contrast, the elderly care subsidy always increases the women's elderly care provision.

Finally, consumption of a couple is obtained from the budget constraint (3) and condition (12). Conditions (7) and (8) give

$$c^f = w^f - \frac{qnw^f + \bar{z}(w^f - w^m) + \sum_{j=f,m} w^j z^j + (\varepsilon^f - \varepsilon^m)u + [(H^f - H_s^f) - (H^m - H_s^m)]}{2}, \tag{25}$$

$$c^m = w^m - \frac{qnw^f + \bar{z}(w^m - w^f) + \sum_{j=f,m} w^j z^j + (\varepsilon^m - \varepsilon^f)u + [(H^m - H_s^m) - (H^f - H_s^f)]}{2}. \tag{26}$$

The second terms on the right-hand side of (25) and (26) represent compensatory utility transfers between the members of a couple. The first terms of the numerator of the second term of (25) and (26) reflect transfers from men to women to equalize child-rearing burdens between them, i.e., $qnw^f/2$ is transferred from men to women. The second terms reflect transfers from men to women corresponding to the difference in parental elderly care burdens when single. The third terms reflect transfers that are executed to equalize elderly care provision burdens when married, i.e., $(w^m z^m - w^f z^f)/2$ is transferred from women to men. The fourth terms reflect transfers from women to men responding to the difference of utility of having children. The last terms reflect transfers between spouses to compensate for the change in the net-utility of elderly care provision for parents when forming a couple from when being single. These transfers adjust the difference in the gender wage gap to equate lifetime utility between spouses of a couple,

as shown in (12).

From (25) and (26) and considering (22), we can infer that the effects of changes in the wage rates are indeterminate, i.e., the signs of dc^i / dw^j are indeterminate $(i, j = m, f)$.

4 Condition for Marriage and the Policy Effect

We have analyzed the optimal solution in the case of marriage. In this section, we consider the conditions for marriage, i.e., the question is whether the individuals are willing to get married. As Doepke and Tertilt (2009) have described, because of the assumption of homogeneous families, assortative matching does not arise. All individuals become married or all individuals remain single. If the lifetime utility associated with being married is higher than the utility associated with being single, then all individuals marry; if the reverse is true, then they remain single.[15]

The conditions for marriage for women and men are given respectively as

$$[c^f + \varepsilon^f u(n) + H^f(z^f, z^m)] - [w^f(1-\bar{z}) + H_s^f] \geq 0, \tag{27}$$

$$[c^m + \varepsilon^m u(n) + H^m(z^m, z^f)] - [w^m(1-\bar{z}) + H_s^m] \geq 0. \tag{28}$$

After inserting c^f from (25) into (27) and rearranging terms, we obtain

$$\frac{1}{2}\{[(\varepsilon^m + \varepsilon^f)u(n) - qnw^f] + H\} \geq 0, \tag{29a}$$

where

$$H = \sum_{j=f,m} [(H^j - w^j z^j) - (H_s^j - w^j \bar{z})]. \tag{29b}$$

The first term in the parentheses on the right-hand side of (29a) represents the net utility of having children for the couple. The second term H is the net utility increment of their elderly care provision for their two pairs of parents when they form a couple. The first term in the parentheses on the right-hand side of (29b) is the net utility of spouse j from elderly care provision for the couple's parents when forming a couple. The second term is the net utility individual j from providing care for the individual's own parents when

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[15] Japanese data from single people surveyed by the National Institute of Population and Social Security Research (2003) indicate that single persons emphasize as merits of marriage in 2021 that they can have their own children and family (39.4% of female and 31.1% of male) and that they can have a place in life to enjoy peace (25.3% of women and 33.8% of men).

being single. The right-hand side of (29b) represents the sum of the net utility of a couple when married over the net utility of each spouse when unmarried. Therefore, if the sum of the net utility of having children and the net utility increment from providing elderly care for their two pairs of parents when forming a couple is positive, then the two individuals are willing to be married. It is noteworthy that forming a couple necessarily involves utility transfers between spouses because the net utility increment of a spouse might be negative.

Inserting c^m from (26) into (28) and rearranging terms gives women the same condition for marriage. Summing up the argument, we obtain the following proposition:

Proposition 4

If the sum both of the net utility from having children and the net utility increment of providing elderly care for the two pairs of parents are positive, then the two individuals, female and male, are willing to form a couple and perhaps have children. Otherwise, they choose to remain single without having children.

Next, we analyze the effects of child-care service policy and elderly car subsidy policy on the conditions for marriage. Letting two times the left-hand side of (29) be $\Omega(\sigma, s)$, then

$$\Omega(\sigma, s) = [(\varepsilon^m + \varepsilon^f)u(n) - qnw^f] + H . \tag{30}$$

Because a child-rearing subsidy policy does not affect elderly care provision by couples, we obtain the effects of child rearing subsidy policy from (19) and (20) as

$$\frac{d\Omega}{d\sigma} = [(\varepsilon^m + \varepsilon^f)u' - qw^f]\frac{dn}{d\sigma}, \tag{31}$$

where $dn/d\sigma < 0$ from (14). From the Nash-bargaining solution (13), the sign of (31) is positive for child-rearing subsidy policy $\sigma \in (0,1)$, i.e., $d\Omega/d\sigma > 0$. Decreases in the family child-rearing burden σ (increases in child-rearing subsidy) make the left-hand sides of (27) and (28) smaller, i.e., the lifetime utility when married becomes lower in a relative sense. The child-rearing subsidies negatively affect the marriage decisions of individuals. The underlying reason is the following. When only women bear the child-rearing burden, child-rearing subsidies lower the opportunity cost of child rearing for women. Therefore, it is good for couples to increase the number of children. However, the increased number of children decreases the labor supply of women, thereby lowering the wage income and hence the consumption of couples. The marginal utility of having children is decreasing while the marginal utility of consumption is constant. Consequently,

the decision to have a greater number of children might worsen the couples' welfare relative to being single. It is noteworthy that each couple transfers utility in Nash bargaining between them.

Therefore, we have the following proposition:

Proposition 5

Child-rearing subsidies discourage young people from getting married.

Then, we consider policy effects of family elderly care subsidies. Because the decisions of providing elderly care are independent of child-rearing decisions, we obtain from (29) that

$$\frac{d\Omega}{ds}=\frac{dH}{ds}=\frac{dH^m}{ds}+\frac{dH^f}{ds}-w^m\frac{dz^m}{ds}-w^f\frac{dz^f}{ds}, \tag{32}$$

where

$$\frac{dH^m}{ds}+\frac{dH^f}{ds}=s(w^f\frac{b}{a}+w^m)\frac{dz^m}{ds}+s(w^m\frac{b}{a}+w^f)\frac{dz^f}{ds}. \tag{33}$$

The sign of (32) is not determined a priori. If the elasticity of utility from providing elderly care for parents is almost identical for both sexes, alternatively if the utility weight on the partner's elderly care provision, then the sign of (33) is negative, as discussed in relation to (23) and (24), i.e., $d(H^m+H^f)/ds<0$. By contrast, the last two terms in the parenthesis on the right-hand side of (32) are negative in this case, i.e., $-d(w^m z^m+w^f z^f)/ds>0$. If the former effect dominates the latter, then the sign of (32) becomes negative, i.e., $d\Omega/ds<0$. Decreases in the proportion of the family elderly care burden, i.e., decreases in s, increase the lifetime utility of couples, thereby positively affecting the decisions of marriage. By contrast, if the latter effect dominates the former, then the sign of (32) becomes positive, i.e., $d\Omega/ds>0$. In this case, decreases in the family elderly care burden negatively affect the marriage decisions of individuals.

Policy effect (33) represents that decreases in the family elderly care burden increase the utility derived from providing elderly care for parents, whereas the last two terms represent that decreases in the family elderly care burden decrease the opportunity cost of elderly care provision for parents. Therefore, when the elasticity of utility of providing elderly care provision does not differ greatly between spouses, whether the family elderly care subsidies encourage marriage or not depends on the relative magnitudes of the policy

effect on costs (opportunity costs) and the effect on benefits (altruistic utility) of elderly care provision by the couple. Therefore, providing an elderly care subsidy to couples does not necessarily discourage marriage.

The argument presented above is specifically related to the case of $dz^m / ds \leq 0$. However, the indeterminacy of the policy effect holds true even when $dz^m / ds > 0$ (case (i) in the Appendix A1).

Finally, from (30) we can ascertain if changes in the wage rates encourage marriage or not is indeterminate, i.e., if the signs of $d\Omega / dw^m$ and $d\Omega / dw^f$ are indeterminate. Increases in the female wage rate do not necessarily discourage marriage.

Therefore, we have the following proposition:

Proposition 6

Elderly care subsidies do not always encourage young people to get married. If increases in elderly care toward parents caused by the subsidy increase the cost of providing elderly care more than the altruistic utility from them, then the increased subsidy discourages marriage of individuals, and vice versa.

The analytical result indicates that the effect of elderly care subsidy on the marriage decisions of individuals is generally ambiguous: depending on the altruistic preferences of individual, and on wage rates. Nevertheless, in Japan, for instance, the marriage rate began to decline when the Long-Term Care Insurance (LTCI) system was introduced. The LTCI system is a mandatory insurance system in which all residents 40 years old and older in Japan must enroll and pay a premium. The care provision of the system is financed about 50% by national and local taxes. Therefore, the elderly care provided by the LTCI system can be regarded as subsidized care. From the perspective of these analyses in this study, the LTCI system might increase the cost of providing more elderly care, to a level higher than the altruistic utility of providing the care, thereby negatively affecting the marriage decisions of individuals in Japan.[16]

5 Concluding Remarks

In a simple lifecycle model of individuals who live three periods, i.e., childhood, young adulthood, and retirement periods, we have obtained the following findings: Child-rearing

[16] The persistent decline of the marriage rate can be explained at least partly by increasing longevity even after the introduction of LTCI system. Elderly care time has also increased along with longevity.

subsidies increase the fertility rate. An elderly care subsidy always increases women's care provision. Child-rearing subsidies discourage young people from marrying. Elderly care subsidies do not always encourage young people to get married. It is noteworthy that child-rearing subsidy works to reduce the marriage rate and thereby lower the total fertility rate, although it increases the number of children per couple.

These results have important policy implications. Subsidies to family elderly care provision might not increase the marriage rate and also the fertility rate. In other words, mitigating the burden of elderly care provision for parents from young generations might not encourage young individuals to marry and have children. By contrast, child-rearing subsidies exert positive effects on individual's decisions of the number of children, although the policy negatively affects the marriage decisions. Therefore, the total fertility rate might increase or decrease with these subsidy policies.

Some caveats are in order because of our assumed model simplicity. First, the results might depend on the model specification, e.g., a quasi-linear utility function. Such assumptions are introduced to obtain explicit solutions. More general formulations might be introduced. Second, we have considered decisions of a generation without incorporating intergenerational interactions and market adjustments. Finally, for specific examination of individuals' marriage and fertility decisions, we have assumed homogeneity of individuals aside from sex and the same numbers of women and men. These assumptions engender an extreme result related to marriage decisions of individuals: all marry or none marry. When analyzing decisions of a society as a whole, the assumption must be relaxed. Individual's decisions might depend on their income levels, whether they are the first child or not, and so on other factors. The model should therefore be extended to these directions to encompass other possibilities.

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Appendix

A1: Sign of (24)

We can rewrite (24) as

$$\frac{dz^m}{ds}=\frac{a(\frac{a\alpha}{sw^m})^{1/(1-\alpha)}}{sD(1-\beta)}[\frac{(\frac{a\beta}{sw^f})^{1/(1-\beta)}/a}{(\frac{a\alpha}{sw^m})^{1/(1-\alpha)}/b}-\frac{1-\beta}{1-\alpha}]. \quad \text{(A1)}$$

From condition (21), we have $1>[(\frac{a\beta}{sw^f})^{1/(1-\beta)}/a]/[(\frac{a\alpha}{sw^m})^{1/(1-\alpha)}/b]$. Therefore, we obtain the following two cases:

$$\text{(i)}\ \ \frac{dz^m}{ds}>0\ \ \text{as}\ \ 1>\frac{(\frac{a\beta}{sw^f})^{1/(1-\beta)}/a}{(\frac{a\alpha}{sw^m})^{1/(1-\alpha)}/b}>\frac{1-\beta}{1-\alpha}, \quad \text{(A2)}$$

$$\text{(ii)}\ \ \frac{dz^m}{ds}\le 0\ \ \text{as}\ \ \frac{1-\beta}{1-\alpha}\ge\frac{(\frac{a\beta}{sw^f})^{1/(1-\beta)}/a}{(\frac{a\alpha}{sw^m})^{1/(1-\alpha)}/b}>0. \quad \text{(A3)}$$

If $\frac{1-\beta}{1-\alpha}\approx 1$, then we will have case (ii). Because b appears only in the denominator of the condition of (A3), the right-hand side of the condition of (A3) goes to zero as parameter b approaches zero. When $\beta>\alpha$, we will also have case (ii).

A 2: Shifts of the reaction curves

Differentiating the interceptions of the reaction curve with respect to s, we have the following:

$$\frac{d}{ds}[\frac{(\frac{a\alpha}{sw^m})^{1/(1-\alpha)}}{b}-\frac{(\frac{a\beta}{sw^f})^{1/(1-\beta)}}{a}]=\frac{(\frac{a\alpha}{sw^m})^{1/(1-\alpha)}}{s(1-\beta)b}[\frac{(\frac{a\beta}{sw^f})^{1/(1-\beta)}/a}{(\frac{a\alpha}{sw^m})^{1/(1-\alpha)}/b}-\frac{1-\beta}{1-\alpha}]. \quad \text{(A4)}$$

The sign of the equation above is the same as that of (A1). In case (i), reaction curve (18a) shifts upward more than that of (18b) when the family elderly care fraction s decreases. The reverse holds in case (ii).

Supplementary memorandum

S1: Marriage rates and fertility rates of six countries (data of Figure 1)

country		base year	compared year
US	Marriage Rate	6.8 (2015)	6.1 (2019)
	Total Fertility Rate	1.83 (2015)	1.68 (2019)
UK	Marriage Rate	4.5 (2011)	1.3 (2020)
	Total Fertility Rate	1.91 (2011)	1.57 (2020)
Germany	Marriage Rate	4.8 (2014)	4.6 (2022)
	Total Fertility Rate	1.47 (2014)	1.46 (2022)
France	Marriage Rate	3.7 (2014)	2.3 (2020)
	Total Fertility Rate	1.97 (2014)	1.79 (2020)
Italy	Marriage Rate	3.1 (2014)	3.1 (2021)
	Total Fertility Rate	1.36 (2014)	1.25 (2021)
Japan	Marriage Rate	5.1 (2015)	4.0 (2021)
	Total Fertility Rate	1.42 (2015)	1.28 (2021)

Source: UN World Population Prospects: The 2024 Revision
UN Demographic Yearbook (each year)

note: Marriage is defined as the act, ceremony or process by which the legal relationship of spouses is constituted. Each country or area has been asked to indicate the estimated completeness of the number of marriages recorded in its civil register. Crude marriage rates are the annual number of marriages per 1000 mid-year population.
(https://unstats.un.org/unsd/demographic-social/products/dyb/documents/dyb2023/Notes23.pdf)

S2 Marriage rate and fertility rate in Japan (data and explanation of footnote 16)

The marriage rate, the total fertility rate (TFR), and the average completed fertility (number of children per couple) of Japan during 1980–2023 are presented in Figure S1.

Both the number of marriages and the marriage rate were observed to remain stable from the late 1970s (after the second baby boom) to about 2000. Nevertheless, the marriage rate began to decline after 2000. The total fertility rate has followed a downward trend for recent decades, declining even below the replacement rate recently. Although it rose slightly during the decade from 2006, the total fertility rate has recently declined again. The average completed fertility of couples began declining after 2002, but the rate of decline apparently decreased after 2010.

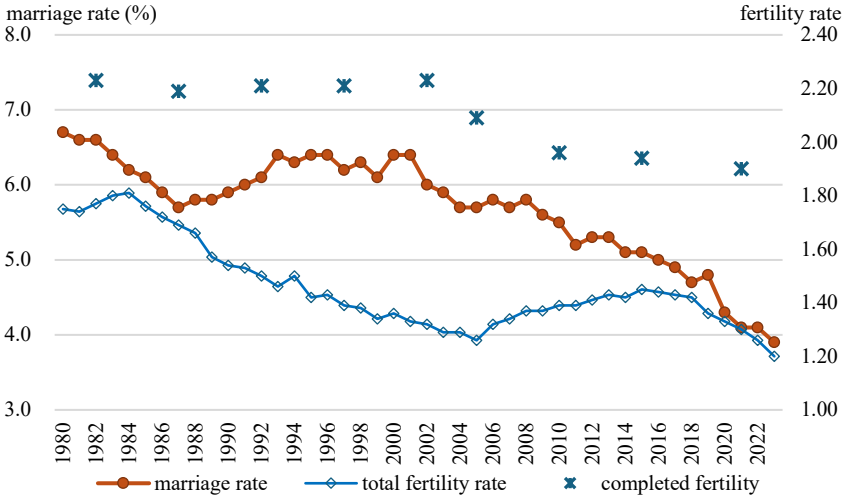

Fig. S1 Marriage rate and fertility rate.

Source: National Institute of Population and Social Security Research (2023). *Marriage and Childbirth in Japan Today: The Sixteen Japanese National Fertility Survey, 2021*: National Institute of Population and Social Security Research (2023). *Population Statistics, 2023*

Japan introduced Long-Term Care Insurance (LTCI) in 2000. In this mandatory insurance system, all residents 40 years old and older in Japan must enroll and pay a premium. The care provision of the system is financed about 50% by national and local taxes. Therefore, elderly care provision is subsidized when dependent individuals become care-receivers. It is noteworthy that, after introduction of the long-term care insurance system, the marriage rate began declining in Japan. This phenomenon can be explained according to the analysis of this paper as follows. Decreases in the proportion of elderly care provision tend to increase the elderly care provision of young individuals. The cost of the increased care provision for individuals is considered to be greater than the benefit of altruistic utility in Japan. The net cost of the elderly care subsidy negatively affects the marriage decisions of individuals, thereby lowering the marriage rate. The declines in the marriage rate work to decrease the total fertility rate (along the extensive margin) even if the number of children per couple remains constant (along the intensive margin).[17]

Figure S2 presents that the gender wage gap which is defined as the ratio of female wage rate to male wage rate declined in 2004 and then returned to the upward trend around the earlier 2010s. Herein, the gender wage gap is measured on the left hand-side axis of ordinate. The total fertility rate is measured on the right hand-side axis of ordinate. If the

[17] Our household model captures both the extensive and intensive fertility margins. The extensive margin is for individuals choosing between having children as a couple and not having as a single, and the intensive margin is for individuals choosing how many children to have.

gender wage gap can be regarded as the female wage rate deflated by the male wage rate which reflecting the price level, then the gender wage gap can be regarded as the real female wage rate. The finding in this study indicates that the decline in the female wage rate boosts the number of children of couples. The decline of the female wage rate might also contribute to the fertility rate increase in the late 2000s, although the total fertility rate is then on a downward trend again.[18]

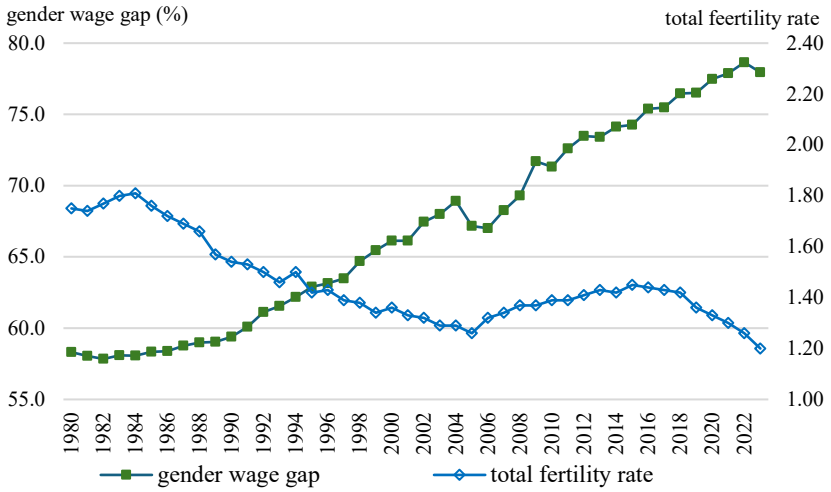

Fig. S2 Gender wage gap and Total fertility rate

Source: National Institute of Population and Social Security Research (2023). *Population Statistics, 2023;* OECD. *OECD Data Explorer: Gender wage gap,* aggregation operation: median.

It is also noteworthy that the increase in the total fertility rate after the latter 2000s until the mid-2010s might also be explained by intergenerational exchange motives for elderly care provision according to Yakita (2024), although Horioka et al. (2018) report that individuals are affected strongly by altruism toward their parents as well as the exchange motive in Japan. Yakita (2024) reports that the increase comes from high fertility rates of women of age 30 and over during this period and that the university entrance ratio of women started to increase in the 1990s when the mothers were about 18 years old. The parental education expenditures can be regarded as 'bequests' to their children. Nevertheless, the total fertility rate is recently on a downward trend again. By contrast, in the present study, elderly care provision subsidies are shown not to affect fertility decisions: decisions on both child-rearing and elderly care provision are based on

[18] Luci-Greulich and Thévenon (2014) report that the fertility rebound is robust after controlling for postponement of birth and that a low-re-increase in fertility in some countries such as Japan is because of the lack of additional institutional changes which help parents to combine childrearing and work.

altruism. Therefore, the observed dynamic behavior of the total fertility rate might be affected by actual factors such as child policy changes other than those considered herein.

The average completed fertility might be negatively affected by postponement of childbirths because of women's university entrance and labor participation. The introduction of LTCI might induce women to continue participating in labor market while simultaneously providing family elderly care for their parents.

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