Marital Status, Saving of Elderly Person and Education

安田，公治

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指導教員　衣笠智子

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Chapter 1

Introduction

Recently, some developed countries including Japan have been facing the problems of fertility decline and population ageing. In the past 50 years, the worldwide total fertility rate (TFR) decreased from 5 to 2.5, and the TFR of developed countries is significantly less than 2. As for population ageing, the ratio of the population aged 65 years and above increased from 4.99% to 8.27% between 1960 and 2015, and it is expected to increase to 15.95% by 2050 (World Bank). These two problems are expected to cause slower economic growth through a decrease in the future working population. Therefore, fertility decline and population ageing are crucial problems for developed countries. The purpose of this study is to identify an optimal policy for the low fertility and ageing society, and our study conducts some theoretical and empirical analyses.

Japan has been facing the twin problems of low fertility rate and increasing unmarried rate since the 1990s. According to Iwasawa (2008), a change in marital behavior can explain more than 80% of the change in fertility rate between 2000 and 2005 in Japan. Therefore, it is thought that the main reason of the fertility decline in Japan is marital decline. According to the result of Iwasawa, marital decline will be more important as a determinant of fertility than the other factors that affect fertility such as labor participation of married females or husbands' income. Therefore, our study is in the context of the positive effect of marital status on fertility. In addition, there are some theories of marital behavior (Becker, 1974; Oppenheimer, 1988), and we conduct an empirical analysis of marital status in Japan based on these studies in Chapter 2. In the analysis, we develop simultaneous equations by including marital status and fertility rate to identify the interrelationships among marital status, fertility, and other socioeconomic factors by using fixed-effect 2SLS. In addition to higher fertility due to an increase in the number of married females, we found that the economic conditions of males and male co-residence with parents have positive and negative correlations with married rate, respectively.

Both the household saving rate and elderly household saving rate rapidly decreased since the 2000s, and the saving behavior of elderly persons is particularly expected to

affect the saving rate trend in an ageing society such as Japan. Therefore, it is important to identify the saving behavior of elderly persons, and we conduct a theoretical and empirical study of this topic in this chapter. In Chapter 3, we develop a two-period life cycle model and analyze the asset accumulation of elderly people in Japan using micro data. Our study shows that both health status and bequest motives promote asset accumulation. In addition, we show that bequest motives affect asset accumulation in unhealthy people but they do not that in healthy people.

Both educational attainment and life expectancy have increased globally, and there is a close relationship between education and longevity. Ben-Porath (1967) showed a positive correlation between life expectancy and educational investment. The study explained that longer life expectancy increases lifetime working hours and benefits from education, so educational investment is promoted through higher educational return. In addition, some studies show that educational attainment promotes economic growth, and there is a negative correlation between education and fertility rate (Mankiw et al., 1992; Lee and Mason, 2010; Prettner et al., 2012). Economic growth can be attained by higher educational investment even if fertility rate decreases, so educational investment is important for particularly developed countries. In Chapter 4, we identify the effect of longevity and fertility on education by using country-level panel data and add the adult mortality rate into the model of Pretnner et al. (2012).

Chapter 2

An empirical analysis of marital status in Japan

2.1 Introduction

Since the 1990s, Japan has been facing the twin problems of low fertility rate and increasing unmarried rate. The TFR (total fertility rate) has been decreasing since it recorded a post-war low, 1.57 in 1989. The present TFR in Japan is much lower than 2.09, which is the minimum standard necessary to maintain the current population (1.41 in 2012)[1]. The country has also been suffering from an increasing non-marriage rate since the 1980s. As for lifetime non-marriage rate (non-marriage rate in the 50-year-old group), it recorded 20.14% for males and 10.61% for females in 2010 (national census).

There is a close relationship between fertility rate and marital status, and this relationship is interdependently decided by various socioeconomic factors. For example, Becker (1974) focuses on comparative advantage in household production activities as the reason for marriage, and Oppenheimer (1988) shows that recession increases asymmetric information regarding the future economic status of men, delaying the search for a marriage partner. Sakamoto and Kitamura (2007) focus on the relationship between co-residence rate and married rate[2]. They also demonstrate that parental economic conditions positively affect co-residence; however, income transfers from parents to their children negatively affect marital behavior.

Although many studies examined the relationship among marriage, fertility, and other socioeconomic factors, only a few focused on the interdependence of these factors. Our study aims to examine this interdependent relationship in Japan through simultaneous equations concerning marriage and fertility, which include the following

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[1] According to the estimate of the National Institute of Population and Security Research, 2012, Japan will record the lowest estimates for total fertility rate (1.12) and total population (80 million) by 2060.

[2] Here, co-residence implies unmarried adult children staying at their parental house. In Japan, unmarried children usually tend to live together with their parents, even though they have grown into adulthood. The existence of these unmarried adult children is considered as a social problem.

endogenous variables: current male and female married rates, TFR, female regular employment rate, number of convenience stores, and male and female co-residence rates. First, our study focuses on the positive influence of married rate on fertility rate. For female employment and convenience stores, these mean factors promote female independence and the ease of singlehood, respectively. We also used co-residence rates as factors that reduce the married rate based on Sakamoto and Kitamura (2007)[3]. For the analysis, we used the fixed-effect 2SLS on the data of prefectures in Japan, and we can cope with the fixed effect by prefectures and the interrelationship among marital rate, fertility, and other factors[4].

The results show that the female married rate positively affects the fertility rate, and female employment and convenience stores have negative correlation with marital behavior. Our main findings suggest that economic conditions of males had the most positive correlation with marital status, which is consistent with the results of Kitamura and Miyazaki (2011). Therefore, it was confirmed that men's economic stability is important in considering the marital status. As for the co-residence rate, we used a variable, parents' economic condition, which was divided into linear and quadratic terms. The former had a negative effect on co-residence rate, while the latter had a positive effect. This result indicates that unmarried children decide to live together with their parents because of parents' economic condition (poverty as well as affluence).

The remainder of this study is organized as follows. Section 2 presents a literature review on previous studies regarding marriage and fertility. Section 3 explains the simultaneous equation model and the definition of each variable. Section 4 explains the empirical results and their interpretations. Finally, Section 5 concludes the study and provides important policy implications.

2.2 Literature Review

Here, we discuss theoretical and empirical research concerning marriage and fertility rates. Theories of marital timing can be broadly divided into examining two hypotheses: the women's independence hypothesis and the assortative mating hypothesis.

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[3] In constructing our model, we also referred to the models of Kato (2002) and Yamaguchi and Kinugasa (2014).

[4] Fixed-effect 2SLS is the fixed effect model that includes 2SLS.

2.2.1 Relationships between household labor and marital status

First, one fundamental theory of marital behavior is Becker's household production theory, which assumes that household utility depends directly not on market goods but on the commodities produced by the household. Becker thus explained marital behavior based on comparative advantage between the man and the woman in household production activities. That is, marriage will occur only if, by specializing in his or her optimal role, each household member increases his or her utility (Becker, 1974, 1991).

Household labor is an important factor driving the marital behavior of both men and women, and some empirical studies focus on differences in time spent on housework between married and non-married households (South and Spitze, 1994; Gupta, 1999; Baxter, 2005; Baxter, Haynes, and Hewitt, 2010). According to the analysis of South and Spitze (1994), never-married men who live independently spend modestly more time on all types of housework (including outdoor housework) than married men do. On the other hand, Gupta (1999) found that never-married men do more significantly more housework (preparing meals, washing dishes, cleaning house, etc.) than married men. In addition, divorced or widowed men were found to spend more time than married men on housework in all of these studies. However, these studies also showed that women tend to increase the amount of housework they do after marriage, with the time spent on housework being higher for women than for men, regardless of marital status.

2.2.2 Female independence and the declining economic power of men

The female dependence hypothesis is based on household production theory and posits that an increase in female education level or income decreases the value of marriage, so the marriage rate among women decreases. However, empirical research testing this hypothesis has produced little evidence that female independence decreases the marriage rate. Cross-sectional analysis with macro data supported the female independence hypothesis, but time-series analysis using individuals' event-history data did not (Oppenheimer, 1997). On the other hand, some studies have shown that marriage increases with female educational attainment or economic power (Sweeny, 2002; Fukuda, 2009). Sweeny (2002) undertook an event-history analysis using data from the NLS (National Longitudinal Survey) and showed that an increase in female economic power increases marriage. Moreover, Fukuda (2009), via event-history analysis using data from the LSYA21 (Longitudinal Survey of Young Adults in the 21st Century), showed that women's independence increased marriage in the cohort born between 1968 and 1982.

Now, we will consider the assortative mating hypothesis, a theory that focuses on the decrease in men's economic power. The assortative mating hypothesis posits that a woman spends time searching for a marriage partner of the same level. According to Oppenheimer (1988), in a recession, there can be asymmetric information about the future socioeconomic status of marriage partners; this asymmetry makes women spend considerable time looking for suitable marriage partners. On the other hand, well-educated women have less uncertainty regarding their own income or social status, so it is possible that female independence promotes marriage (Oppenheimer, 1988). In terms of empirical research concerning assortative mating, Raymo and Iwasawa (2005) analyzed the determinants of marriage among Japanese females using Japanese National Fertility Survey data. They showed that a decline in the supply of highly educated men is the main reason for the decreasing marriage rate among highly educated women.

According to some empirical studies, education has a negative effect on marriage among men in their early 20s but a positive effect on those in their 30s (Kitamura and Miyazaki, 2011; Tian, 2013). For example, Tian (2013) used data from the Chinese General Social Survey, 2003 and 2008 waves, to show that an interaction term of education and age had a positive effect on the male marriage rate. Kitamura and Miyazaki (2011) conducted a group-data probit analysis of marriage using data on cities, towns, and villages in Japan. They showed that education decreased marriage among males in their 20s to early 30s; starting in the late 30s, however, education promoted marriage. These studies suggest that more educated men delay marriage while they are enrolled in college but will catch up later on.

Many empirical studies focus on not only educational attainment but also educational composition of the marriage market, which is an important factor in marriage partner searches and first marriage timing (Lewis and Oppenheimer, 2000; Çelikaksoy, Nekby, and Rashid, 2010; Choi and Mare, 2012; McClendon, Kuo, and Raley, 2014). Lewis and Oppenheimer (2000) analyzed the assortative mating pattern taking into consideration the educational composition of the local marriage market, and McClendon, Kuo, and Raley (2014) focused on educational concentration by occupation. The results showed that educational concentration in the marriage market positively affects assortative mating and the age at first marriage, particularly for women. Additionally, Çelikaksoy, Nekby, and Rashid (2010) and Choi and Mare (2012) analyzed the influence of migration on marital behavior or the pattern of assortative mating.

The relative income hypothesis, another theory about men's economic decline, is

based on the interaction between the intergenerational income gap and marital status. According to Easterlin, a main advocate of the theory, higher economic growth allows children to afford better living standards and get married, leaving their parental home. On the other hand, lower economic growth makes children choose a stable, wealthier life at the parental home (Easterlin, 1980). After Easterlin's study, additional studies of marriage focused on the importance of stable male incomes or employment (Watson and MacLanahan, 2010). Particularly, Watson and Maclanahan (2010) analyzed IPUMS sample data from the 1980 – 2000 U.S. Censuses, and the results showed that the ratio of men's income to the ideal income affects marital status only for low-income men. Last, there are some empirical studies concerning the relationships between marital status and female labor participation rate in Japan. Unayama (2012) showed that the capacity of nursing school promotes female labor supply in Japan. In addition, Abe (2013) shows that female regular employment has caused higher labor participation rate in the northern coastal area in Japan.

2.2.3 Co-residential relationships between adult children and parents

Some studies have focused on the interaction between parents' resources and their children's preferences for marital timing. These studies have argued that parents' socioeconomic status enables them to focus on the quality of their children's marriages. Parents not only decide the ideal marriage age for their children but also control this timing using their own resources (Modell, 1980; Waite and Spitze, 1981; Axinn and Thornton, 1992). Some analyses of this hypothesis have used children's ages as a proxy for parents' preferences. On the other hand, Axinn and Thornton (1992) used data on actual parents' opinions regarding the ideal marriage age for their children from a questionnaire fielded in the U.S. They found that parents' resources and opined ideal age had a negative effect on the timing of their children's marriages. The increase in adult children who are living with their parents is also an important factor in determining marital status, particularly in Japan where these unmarried people are called "parasite singles." Yamada (1999) argued that the shift from higher to lower economic growth caused an increase in parasite singles and a greater tendency towards late marriage in Japan. This explanation also supports Easterlin's argument.

As for empirical analysis, many studies have showed that parental assets have a positive effect on their children's decision to live together with the parents; these results are consistent with the relative income hypothesis (Manacorda and Moretti, 2006; Sakamoto and Kitamura, 2007; Iacovou, 2010). According to Manacorda and Moretti (2006), the co-residence rate among children and parents is over 80% in Italy. The

authors concluded that this was due to parents' preference for co-residence rather than children's dependence on parents. On the other hand, Iacovou (2010) analyzed the determinants of young people's decisions to leave the parental home in three regions of Europe (Nordic, South European, and North European) using the data from the European Community Household Panel. The results showed that higher parental incomes encourage single children to leave the parental home, which is inconsistent with Easterlin's hypothesis. In addition, parental income had a negative effect on children's likelihood of leaving the parental home to live together with a marriage partner only in southern Europe.

As for Japanese empirical research, Sakamoto and Kitamura (2007) analyzed marriage and co-residence rates among unmarried children and parents in Japan using data from the Panel Survey on Household Economics. In order to cope with endogeneity between marriage and co-residence, they used pooled sample selection in a two-stage probit model. As for the co-residence function, the results showed that parental income and home ownership rates positively affect co-residence. On the other hand, income transfers from parents to children decrease the probability of marriage for all generations. However, the income-transfer effect was not significant in cases where parents are of the postwar generation and children are of the post-bubble generation. According to the authors, this result indicates that the "parasite singles" theory does not hold true for these generations. That is, although children once enjoyed richer lives at the parental home instead of marriage, it is possible that unmarried people co-residing with their parents are not enjoying comfortable lifestyles at the parental home.

In our study, we use "co-residence unmarried" as a variable that represents the degree of dependence between unmarried children and their parents. Previous studies have shown that these factors have a negative influence on marital status, due to children's dependence on their parents. Our study focuses on not only the relationship of dependence between unmarried adult children and their parents but also that between poor parents and their children. We examine whether these relationships are valid or not by dividing parents' net monetary assets into a first-degree term and a quadratic term.

2.2.4 Previous studies on fertility rate

First, the studies of Leibenstein (1957) and Becker (1960) can be mentioned as theoretical studies regarding fertility rate. From the perspective of microeconomics, Leibenstein has explained the cause of lower fertility rate in developed countries as follows. The utility of having a child can be divided into consumption utility, labor utility, and security utility. The consumption utility indicates parents' pleasure that is

gained from childcare by treating children as consumer goods. The labor utility assumes children as a household production factor and security utility describes children's support for parents' old age. On the other hand, the disutility of having a child can be divided into direct cost and indirect cost: the former is the cost directly related to childcare, such as education or preparing a meal, and the latter is the opportunity cost, such as temporary retirement or suspension of business.

Leibenstein (1957) also stated that the increase in income from economic growth decreases labor utility and security utility, in particular. That is, the stability in living standard or social security would decrease the demand for children's support after retirement. Economic growth would increase the cost of childcare and promote female employment, increasing both direct and indirect costs. This explains the lower fertility rate in developed countries. Next, Becker attempted to clarify the fertility behavior by applying Leibenstein's theory to the theory of consumer behavior. Becker (1960) has focused on children's quantity (the number of children) and quality (human capital of children), and this model is known as the Quality-Quantity Model. The model assumed that the quality income elasticity of demand for children is larger than the quantity income elasticity. That is, higher income encourages parents to increase human capital of children through education rather than increase the number of children. Based on this assumption, Becker has theoretically shown the reason for the lower fertility rate in developed countries[5].

2.3 Model and Data

2.3.1 Interdependence model of marital status and socioeconomic factors

We construct an interdependence model with marriage, fertility rate, and other socioeconomic factors in Japan as variables. We also make a quantitative analysis based on these variables. This interdependence model comprises 7 endogenous variables and 15 exogenous variables. Particularly, endogenous variables include current male and female married rates, female regular employment rate, fertility rate, the number of

[5] Tournemaine and Tsoukis (2008) identified the relationship among socioeconomic status, fertility, and economic growth theoretically. As for the empirical analysis, Hashim and Mok (2013) analyzed age at marriage, household income, and number of children as determinants of fertility in Singapore. They showed that the relationship between fertility and household income is U-shaped.

convenience stores, and male and female co-residence rates. In addition, we analyzed panel data for 3 terms (2000, 2005, and 2010) and 47 prefectures using fixed effects 2SLS[6]. Doing so helped us to find an interdependent relationship between marriage behavior and the socioeconomic factors. As already mentioned, the number of convenience stores implies the ease of single life and the co-residence rate implies the relationship between unmarried adult children and their parents.

The model is comprised of the following simultaneous equations (see Table 2.1 regarding the definition of variables).

$$(1)\ \mathrm{Married}_{it} = B_0 + B_1\mathrm{Con}_{it} + B_2\mathrm{FLabor}_{it} + B_3\,\mathrm{Co} - \mathrm{R}_{it} + B_4\mathrm{Labor}_{it} + B_5\mathrm{Edu}_{it} + B_6\mathrm{Wage}_{it} + B_7\mathrm{FWage}_{it}$$
$$(-)\quad (-)\quad (-)\quad (+)\quad (-)\quad (+)\quad (-)$$

$$(2)\ \mathrm{FMarried}_{it} = B_0 + B_1\mathrm{Con}_{it} + B_2\mathrm{FLabor}_{it} + B_3\,\mathrm{FCo} - \mathrm{R}_{it} + B_4\mathrm{Labor}_{it} + B_5\mathrm{FEdu}_{it} + B_6\mathrm{Wage}_{it} + B_7\mathrm{FWage}_{it}$$
$$(-)\quad (-)\quad (-)\quad (+)\quad (-)\quad (+)\quad (-)$$

$$(3)\ \mathrm{Con}_{it} = B_0 + B_1\mathrm{Married}_{it} + B_2\mathrm{FLabor}_{it} + B_3\mathrm{Labor}_{it} + B_4\mathrm{Road}_{it} + B_5\mathrm{Residense}_{it} + B_6\mathrm{LRS}_{it}$$
$$(-)\quad (-)\quad (+)\quad (-)\quad (-)\quad (-)$$

$$(4)\ \mathrm{Fertility}_{it} = B_0 + B_1\mathrm{FMarried}_{it} + B_2\mathrm{FLabor}_{it} + B_3\mathrm{FCo} - \mathrm{R}_{it} + B_4\mathrm{Labor}_{it} + B_5\mathrm{FEdu}_{it} + B_6\,\mathrm{Nursery}_{it} + B_7\,\mathrm{Three-generation}_{it}$$
$$(+)\quad (-)\quad (-)\quad (+)\quad (-)\quad (+)\quad (+)$$

$$(5)\ \mathrm{FLabor}_{it} = B_0 + B_1\mathrm{Con}_{it} + B_2\mathrm{Fertility}_{it} + B_3\mathrm{Housing}_{it} + B_4\,\mathrm{FPW}_{it} + B_5\,\mathrm{PI}_{it} + B_6\,\mathrm{Three-generation}_{it}$$
$$(+)\quad (-)\quad (+)\quad (-)\quad (+)\quad (+)$$

$$(6)\ \mathrm{Co} - \mathrm{R}_{it} = B_0 + B_1\mathrm{Con}_{it} + B_2\mathrm{Labor}_{it} + B_3\mathrm{Edu}_{it} + B_4\mathrm{PI}_{it} + B_5\mathrm{Assets}_{it} + B_6\mathrm{Assets2}_{it}$$
$$(-)\quad (-)\quad (+)\quad (-)\quad (-)\quad (+)$$

$$(7)\ \mathrm{FCo} - \mathrm{R}_{it} = B_0 + B_1\mathrm{Con}_{it} + B_2\mathrm{FLabor}_{it} + B_3\mathrm{FEdu}_{it} + B_4\mathrm{PI}_{it} + B_5\mathrm{Assets}_{it} + B_6\mathrm{Assets2}_{it}$$
$$(-)\quad (-)\quad (+)\quad (-)\quad (-)\quad (+)$$

In addition, Table 2.2(a) and Table 2.2(b) show the descriptive statistics and the top five

[6] The sample size is 141 (47 prefectures and 3 terms (2000, 2005, and 2010)).

(and bottom five) prefectures in each main variable. We showed Table 2.2(b) to confirm whether there is enough variety in the main variables.

Next, we explain the equations.

Current male and female married rates

First, the reason why we used the number of convenience stores in the current married rate equations is that the accessibility of convenience stores would affect the utility of unmarried persons. As the convenience stores make everyday life more useful, singlehood would decrease the opportunity cost of household work or cooking. According to the theory of household production, as the opportunity cost of household production activity decreases, the merit of marriage decreases. Male and female employment rates are also important variables from the perspective of the living standard and the trade-off between female employment and marriage. In addition, we classify the influence of wages into two effects: income effect and substitution effect. Despite the difference between the income effect and substitution effect, these variables are also important. Finally, education and co-residence rate are also important.

Number of convenience stores

First, in the case of married men, the demand for convenience stores will decrease because of wives' help regarding household work or cooking. Next, the higher regular employment rate promotes overtime work of men, and it would increase the demand for convenience stores at a dinner. Even in the case of married men, they might work away from their family and tend to use the convenience store. Therefore, male regular employment rate will influence the number of convenience stores regardless of marital status. However, female regular employment may have little influence on the convenience stores because of female superiority to men in household work. Therefore, we used female regular employment rate as a variable that decreases the use of convenience stores. According to the assumption of Cho (2007), females who work on weekdays would hoard up cheaper living necessities at large retail stores on holidays. Then, our study assumes that the increase in female regular employment promotes the shift of female customers from convenience stores to economical large retail stores.

Next, we explain large retail stores, the area of residence, and the length of road. Matsui and Nariu (2003) used these variables as factors that decrease the density of retail stores. In addition, Matsui and Yukimoto (2004) showed that the increase of car ownership and expansion in size of residences are main reason of decline in the number of retail stores. These studies explain that the length of road or car ownership influence large retail stores in the suburbs, and these factors have negative effects on the number

of rival retail stores. Matsui and Nariu also stated that the area of residence influences the stock of household goods and the possession of cars; therefore, people could purchase many living necessities at suburban large retail stores. Finally, whereas Matsui and Nariu (2003) use the number of retail stores as dependent variables, our study uses the number of convenience stores to check whether the same result is obtained or not.

Fertility rate

First, the current female married rate is an essential factor to determine the fertility rate. Next, male regular employment rate will have a positive effect on the fertility rate because of the stability in living standard. It is also obvious that female work status has a negative effect on pregnancy and fertility. According to Becker's Quality-Quantity Model, well-educated women focus on the quality rather than the quantity of their children. Therefore, female education also works negatively for the fertility rate. As for the co-residence, Yamada (1999) attributes the existence of unmarried persons for the falling fertility rate.

Female regular employment rate

First, owing to the presence of many other commercial facilities in the area crowded with convenience stores, the demand for labor would increase. Female work status would have a close relationship with the fertility rate because the compatibility of fertility, childcare, and female employment is very difficult. Next, we used prefecture income and owned house rate of the elderly household in this model. The former indicates the short-term economic condition and the latter indicates the long-term one. In addition, the owned house rate of the elderly household would increase three-generation household. Here, three-generation household is a variable that implies parents' support for childcare or household work. Therefore, the increase of three-generation household or owned house rate would promote female labor supply. Finally, because of lack of data regarding prefectural wages of female regular employees, our study uses female part-timer wages as substitutes.

Male and female co-residence rates

First, the accessibility of convenience stores could influence the ease of single life of unmarried individuals. As for the variable of education, the unmarried adult children would depend on their parents during their education. Recently, the decreasing employment rate of new graduates would also increase the co-residence rate. Moreover, we use net assets of the elderly household and its square as variables of parent's economic condition. This will be discussed in further detail later.

2.3.2 Explanation of the variables used in the simultaneous equation model

Next, we explain the variables used in this model in detail. First, in line with Kitamura and Miyazaki (2011), this study emphasizes the marital status in the 20–39 age groups from the perspective of fertility. Therefore, we unified all variables into the 20–39 age groups. On the other hand, we chose over 60-year-old groups to collect information regarding the parents who live together with their unmarried adult children. These include households with one parent. In the case of the household with two parents, we chose households in which the male parent is over 60 years old. Lastly, we explain the variable of parent's economic status. This variable is shown by the below equation.

$$\frac{\text{Assets of the elderly household} - \text{Debt of the elderly household}}{\text{Consumption expenditure of the elderly household per month}}$$

If we take the economic condition of households, the consumption economies of scale of households would be important factor. However, due to lack of data for economic scale, we used the consumption expenditure as not a flow variable but as an alternative variable of the economic scale of each household. In addition, this variable could be interpreted as an indicator that shows how many months the present savings can cover consumption. If the value of this equation is higher, children can expect inheritance after parents' death. On the contrary, its lower value will force children to support their parents because of parent's economic poverty. Moreover, figure 1 shows the relationship between the co-residence rate and the economic condition of parents. As explained in Section 1, the latter variables are divided into linear and quadratic terms. Here, if the term of first degree has a negative coefficient and the quadratic term has a positive coefficient, we can draw a downward convex as that shown in figure 1. That is, on the right side of the quadratic curve, co-residence rate increases because of children's dependence on their parents. On the left side, co-residence rate increases because parents depend on children due to their poverty.

2.4. Empirical results

Next, we interpret the results of the analysis. As explained earlier, our model was estimated using the fixed effects 2SLS method (3 terms and 47 prefectures, sample size

is 141). The results are shown in Table 2.3. Our study aims to compare the extent of correlation among variables in each equation. Therefore, a logarithmic transformation is carried out for each variable, so we can interpret the regression coefficients as elasticity coefficients. In addition, we conducted robustness checks by dropping some variables such as co-residence rate and included the result of fixed-effect (without 2SLS) in Appendix A and B.

(1) Current male married rate

Here, we have explained the result of Table 2.3 (for the results of robustness checks, see Appendix A and B). First, the number of convenience stores had a negative, significant effect on the current married rates. It is believed that the merit of marriage decreased because the convenience stores made it easy for single males to perform household work. In addition, the establishment of ATMs (Automated Teller Machines) at the convenience stores might influence the marital status because of simplified administration of cash. However, there is a possibility that a larger number of single people promote demand in convenience stores. Li and Houston (2001), through their food consumption survey in Taiwan in 1999, empirically showed that unmarried people are likely to use convenience stores. Therefore, we should carefully discuss the correlation between convenience stores and marital status.

As for the regular employment rate, male regular employment rate had a positive, significant effect on the current married rate, and female regular employment rate had a negative, significant effect. Observing the coefficient elasticity, male employment status had close correlation with married rate and fertility; therefore, a decreasing economic status of males may be the primary determinant of lower married rate and fertility. Although this result indicates that male employment promotes male married rate, it could also mean that the married rate influences male employment because married men must feed their families. Therefore, the implication of this result should be carefully discussed, including the inverse causality. On the other hand, the higher female work status would discourage women to get married because marriage may negatively affect promotion at work.

Next, male co-residence rate also had a negative and significant effect. The interpretation of this result must be divided into two cases. First, the unmarried children depend on their parents, and second, the poverty-ridden parents depend on their children. In the former case, children would not prefer marriage because their parents could take over household work or living expenses. In the latter, however, children might give up the opportunity of getting married because they are forced to support their parents. This

result is also consistent with Sakamoto and Kitamura (2007), and the co-residence relationship could be an important factor for marital behavior along with the economic condition of males.

As for male education, the analysis found that the increasing academic levels cause a decreasing current married rate. In explaining this result, we can refer to Ota (2012), which found that increasing education levels caused job scarcity for the graduates. This study explained that most people came to enter the university in Japan, so incompetent graduates have failed to find employment. That is, high school education no longer would guarantee the stability of living standard, and the dropouts from graduate recruitment would miss the opportunity of getting married. Lastly, male wage had a positive and significant effect, while the effect of female wage was negative and insignificant.

(2) Current female married rate

The number of convenience stores had a positive, but insignificant effect on the current female married rate. According to Li and Houston (2001), women are not likely to use convenience stores. Therefore, it is possible that women do not need convenience stores due to their superiority in performing household tasks. Likewise, female co-residence rate also had a negative, insignificant effect. Women tend to live together with their parents before marriage in Japan, so this factor might also influence the result. Next, male regular employment rate had a positive and significant effect on the current female married rate, while female regular employment is negative and significant. Female education also negatively influenced the current female married rate. These are same results of current male married rate. Lastly, male and female wages did not have significant results. However, the data regarding male and female wages are not divided into the cases of regular employees and part-timers. For female wage particularly, therefore, it is possible that the existence of the married part-timer caused this insignificant results.

(3) Number of convenience stores

The analysis indicates that the increase in current male married rate has negative correlation with the number of convenience stores. This implies that married men who have their meals at home will be less likely to visit convenience stores. This result is consistent with Li and Houston (2001). Although our analysis could not confirm the causality between marital rate and the number of convenience stores, we showed a negative and significant correlation. Therefore, it is possible that the number of convenience stores is an important factor in marital behavior. Moreover, male regular

employment rate had a positive, significant effect on the convenience stores. First, if male regular employment rate increases, the demand for convenience stores for lunch or dinner will increase. Even in the case of married men, male regular employees, who are likely to work away from their family, will influence the demand for convenience stores positively.

On the other hand, female regular employment rate had a negative, significant effect. As we already explained, one reason is that women are superior to men in household work and cooking. Another reason is that women are unlikely to work overtime or work away from their family. In addition, it is possible that a female regular employee works for a longer duration on weekdays and purchases living necessities on holidays. So then, if we assume that the demand for convenience stores is substituted by large retail stores, it may be understood that a female employee negatively influences demand for convenience stores. This result coincided with the assumption of Cho (2007). Next, both the length of road and the area of residence had a negative, significant effect. These signs corresponded with the results of the analysis in Matsui and Nariu (2003). Lastly, as compared with Matsui and Nariu, we also used the area of residence as a proxy variable of the land price. A larger area of residence may indicate the lower price of the residential or commercial area. Therefore, large retail stores will have superiority over convenience stores regarding the number of stores.

(4) Fertility rate

First, it is obvious that the current married rate positively affects birth rate. Moreover, the female regular employment rate and co-residence rate have a negative, significant effect on the fertility rate. If female co-residence rate increases, the trend toward late marriage will increase. Higher age of first marriage clearly decreases the probability of pregnancy and fertility. Next, the male regular employment rate had a positive effect. This is a reasonable result from the perspective of the stability of living standard. Finally, female education, nursery school capacity, and three-generation households did not have any effect on the fertility rate in this analysis. From the above results, it was found that the tendency of late marriage and stable living standard had a significant effect on the fertility rate.

(5) Female regular employment rate

First, although we assumed that convenience stores would have a positive effect on the demand for labor, we did not obtain significant results regarding the same. However, three-generation household had a positive, significant effect. This result indicates that parents help married females with childcare or housework, so female regular

employment increases. It is also natural that the fertility rate worked negatively on female employment situation. Moreover, we have substituted part-timer wages for regular employee wages, which had a negative significant effect on female regular employment rate. This implies that it is possible that the rise in the number of female part-timers would have a negative effect on female regular employment. Prefecture income and owned house rate of the elderly household also had a positive, significant effect. Prefecture income and owned house rate indicate the economic condition of parents, so they have a positive effect on the demand for labor and female regular employment in that area.

Furthermore, owned house rate of the elderly household would increase the number of three-generation households. Therefore, it would decrease the cost of childcare and household work and encourage female labor supply. It is also believed that higher owned house rate has a negative effect on assets, owing to the possibility of housing loans. This in turn would require women to work, in order to meet the household finances. That is, the increase in three-generation households and owned house rate of the elderly household would have a positive effect on both demand and supply of labor. Lastly, as for prefecture income and owned house rate, the former indicates the short-term economic condition and the latter indicates the long-term one. Moreover, regarding the elasticity coefficient of these variables, prefecture income showed 0.69 and owned house rate showed 4.69. It seems that because regular employment is decided from the long-term point of view, owned house ratio had larger elasticity coefficient.

(6) Male co-residence rate

First, the number of the convenience stores had a positive, insignificant effect. However, male regular employment rate and prefecture income had a negative and significant effect, which indicates that the stable living standard of younger men decreases their dependence on parents. These results hold good for Easterlin's relative income hypothesis. On the contrary, male education had a positive, significant effect. The longer time men spend as students, the more likely they would depend on their parents. Next, considering the economic condition of parents, the first-degree term had positive correlation while the quadratic term had negative correlation. That is, as the economic condition of parents increases, co-residence rate also increases because of children's dependence on their parents. Nevertheless, this result also indicates that cohabitation rates would increase because parents depend on children due to their poverty.

(7) Female co-residence rate

The number of convenience stores had a negative, insignificant effect. Next, female regular employment rate had a negative, insignificant effect. It was found that female employment rate does not affect co-residence rate. As for female education and prefecture income, the former had a positive, significant effect and the latter had a negative, significant effect. These results are coherent with those of the male co-residence rate. Lastly, the economic condition of parents also had same results as those for the male co-residence rate. However, t-values of these variables are not as large as those for male co-residence rate. As already mentioned, these differences between male and female co-residence rates may indicate that unmarried women are still likely to co-reside with their parents in Japan.

Finally, we estimated the value of economic condition of parents on the bottom of the quadratic curve from simultaneous equations. The result is shown in Table 2.4. In Table 2.4, parents' economic condition had almost the same value for both male and female. As already explained, parents' economic condition is defined by the ratio of net assets to consumption expenditure of the elderly household. This ratio can be interpreted as the indicator that shows how many months the present savings can cover consumption. If the ratio is just 60, the present's savings can cover consumption for almost 5 years. That is, if the value is higher, children will expect support from their parents. However, if the value is close to zero, children will be forced to support their parents, so they would have difficulty in marriage.

2.5. Conclusion

In the conclusion of our study, we reconfirm the main points of our analysis and suggest policy proposals based on the empirical results. First, the result that male regular employment rate had the largest, positive elasticity coefficient for both male and female marital status indicates that male employment condition is the main determinant of marital status. On the other hand, our analysis could not exclude the existence of inverse causality. However, our analysis showed close correlation between regular employment of males and the marital rate, and Kitamura and Miyazaki (2011) empirically claimed the positive influence of economic condition of males on the married rate. Therefore, the stability of male employment could be an important problem in marital policy.

Second, the owned house rate of the elderly household has a positive effect on

three-generation household. This in turn would promote married women's labor supply because of the help of their parents regarding household work or childcare. However, in the case of the owned house, even the elderly household might have housing loans. Therefore, there is a possibility that women enter the labor force to compensate for the living expenses. This implies that the increase in female regular employment would not necessarily lead to an efficient use of female labor force. We should not only develop childcare or employment support for career-oriented women, but also establish a system or policy that provides an environment in which women can concentrate on both household work and childcare.

Finally, the main finding of our analysis is that pertaining to the co-residence of unmarried adult children with their parents. This co-residence is correlated with the economic condition of parents (poverty and affluence). That is, these unmarried adult children can be divided into two groups: those who enjoy richer life at parental home and those who are obliged to support their poor parents by staying at parental home. In the former case, we need to consider independence or employment support for the youth generation. According to the empirical results, education also causes the increase of co-residence, which would stem from the decline in the quality of students and the increase of jobless new graduates. Therefore, supports for the dropouts from graduate recruitment would also be required.

In the latter case, even if unmarried adult children expect a higher living standard after leaving parental home, there is probability that they miss the opportunity of obtaining a job or marriage for looking after their parents. In these cases, financial support or nursing benefits for the elderly household would lead to elimination of the economic barriers to entrance into the university, obtaining employment, and marriage of the youth generation. We also need to discuss the policy that encourages unmarried children to live together with parents after marriage. The increase in three-generation household not only promotes female labor supply but also leads to efficiency of the elderly persons through childcare or housework. Therefore, financial benefits for the elderly household would be important from the perspective of both self-reliance of the youth-generation and the efficiency of the elderly generation.

Data Resources

The number of currently married persons, prefecture population, the number of unmarried children, the number of regular employees, the number of students and graduates from universities, and the number of married persons living with parents: “National Census” (Ministry of Internal Affairs and Communication).

Total area per residence, owned house rate of the elderly household: “Building Stock Statistics” (Ministry of Internal Affairs and Communication).

TFR (Total Fertility Rate): “Jinko Toukei Shiryoshu” [“Demographic Statistics”] (National Institute of Population and Security Research).

Monthly wages per employee and wages of female part-timers: “Basic Survey on Wage Structure” (Ministry of Health, Labor, and Welfare).

Capacity of nursery schools: “Survey on Social Welfare Facilities” (Ministry of Health, Labor, and Welfare).

The number of convenience stores and large retail stores: “Census of Commerce” (Ministry of Economy, Trade, and Industry).

Sales of food and beverages: “Current Survey of Commerce” (Ministry of Economy, Trade and Industry).

Total production in prefecture: “Report on Prefectural Accounts” (Cabinet Office).

Total length of road: “Annual Report of Road Statistics” (Ministry of Land, Infrastructure, Transport, and Tourism).

The number of cars owned: “Statistical Data About the Number of Vehicles Owned” (Automobile Inspection and Registration Information Association).
http://www.airia.or.jp/

Table 2.1 Definition of endogenous and exogenous variables

Endogenous variables

Variable name	Variable definition
Married	Currently married males aged 20–39/Male population aged 20–39
FMarried	Currently married females aged 20–39/Female population aged 20–39
Con	The number of convenience stores/The area of prefecture
Fertility	Total fertility rate
FLabor	Female regular employees aged 20–39/Female population aged 20–39
Co-R	Unmarried males aged 20–39 who live together with parents/Male population aged 20– 39
FCo-R	Unmarried females aged 20–39 who live together parents/Female population aged 20–39

Exogenous variables

Variable name	Variable definition
Labor	Male regular employees aged 20–39/Male population aged 20–39
Edu	Male students and graduates from the university aged 20–39/Male population aged 20-39
Fedu	Female students and graduates from the university aged 20–39/Female population aged 20–39
Wage	Monthly wages per male employee (thousand yen)
Fwage	Monthly wages per female employee (thousand yen)
Road	Total length of road /The number of cars (km)
Residence	Total area per residence (m^2)
LRS	Number of large retail stores/Sales of food and beverages
Nursery	Capacity of nursery school/Female population aged 20–39
Fpw	Wages of female part-timers per hour (yen)
Three-generation	Married persons who live with parents /Population aged 20–39
PI	Total production in prefecture /Total population (yens/thousand)
Housing	Owned house rate of the elderly household (head of the household is over 60 years old)
Assets	Net assets of the elderly household/Consumption expenditure of the elderly household per month
Assets2	Square of Assets

Table 2.2(a) Descriptive statistics

	Mean	Standard deviation	Max	Min
Married	0.41	0.03	0.46	0.31
FMarried	0.50	0.04	0.58	0.39
Con	0.23	0.43	2.59	0.02
Fertility	1.43	0.14	1.87	1.00
Flabor	0.47	0.11	0.69	0.26
Co-R	0.24	0.09	0.41	0.08
FCo-R	0.23	0.11	0.43	0.02
Labor	0.68	0.08	0.82	0.41
Edu	0.31	0.06	0.45	0.20
FEdu	0.19	0.05	0.33	0.10
Wage	336	33.77	442	259
FWage	222	20.74	298	183
Road	25.97	12.87	102.51	6.05
Residence	105.89	19.03	154.75	63.00
LRS	65.63	20.48	121.51	25.03
Nursery	0.40	0.08	0.56	0.19
Three-generation	0.21	0.11	0.52	0.05
FPW	885	77.81	1156	723
Housing	0.85	0.06	0.94	0.63
PI	2727	414	4628	2018
Assets	68.02	12.37	95.38	30.14

Note: The value of each variable is the average from 2000 to 2010.

Table 2.2(b) Summary for top 5 and bottom 5 region

Top5	Married		FMarried		Fertility		Con		Flabor
Miyazaki	44.27%	Fukui	55.02%	Okinawa	1.80	Tokyo	2.519	Yamagata	56.24%
Kagawa	43.84%	Yamagata	54.29%	Shimane	1.61	Osaka	1.380	Toyama	55.57%
Wakayama	43.62%	Mie	54.01%	Miyazaki	1.59	Kanagawa	1.251	Fukui	55.28%
Mie	43.36%	Toyama	53.88%	Saga	1.59	Saitama	0.593	Shimane	54.79%
Fukui	43.31%	Fukushima	53.62%	Fukui	1.57	Aichi	0.501	Nigata	53.53%
Bottom 5									
Saitama	37.51%	Nara	46.72%	Kanagawa	1.26	Akita	0.031	Kyoto	41.53%
Chiba	37.51%	Osaka	45.86%	Nara	1.26	Hokkaido	0.030	Hyogo	41.47%
Kanagawa	36.36%	Fukuoka	44.18%	Hokkaido	1.25	Iwate	0.029	Nara	40.49%
Kyoto	35.59%	Kyoto	43.41%	Kyoto	1.21	Kochi	0.028	Osaka	40.02%
Tokyo	30.67%	Tokyo	40.25%	Tokyo	1.06	Shimane	0.024	Okinawa	39.29%

Table 2.3 Empirical results by Fixed effects 2SLS (Full model)

	Married	FMarried	Con	Fertility	Flabor	Co-R	FCo-R
Married			-3.52***(-3.13)				
FMarried				1.99***(2.56)			
Con	-0.03**(-2.29)	-0.04(-0.98)			0.58 (1.63)	0.27 (0.49)	-1.34 (-1.07)
Fertility					-0.40*(-1.87)		
Flabor	-0.18***(-4.24)	-0.11***(-3.59)	-0.94***(-3.85)	-0.55***(-5.24)			0.37 (0.71)
Co-R	-0.06***(-3.83)						
FCo-R		-0.01 (-1.48)		-0.05**(-2.15)			
Labor	0.29*** (4.75)	0.24***(5.47)	1.68***(3.58)	0.42**(1.98)		-2.45***(-8.66)	
Edu	-0.14***(-3.32)					2.92***(4.29)	
FEdu		-0.19***(-4.13)		0.16 (0.77)			4.52***(5.68)
Wage	0.17* (1.91)	0.10 (1.11)					
FWage	-0.11 (-1.34)	0.05 (0.80)					
Road			-0.11**(-2.03)				
Residence			-2.32***(-5.03)				
LRS			-0.05 (-0.51)				
Nursery				0.009 (0.09)			
Three-generation				0.05 (0.72)	1.31***(9.63)		
FPW					-0.51*(-1.71)		
PI					0.70**(2.41)	-1.16**(-1.99)	-2.26*(-1.70)
Assets						-13.43***(-2.88)	-16.70*(-1.69)
Assets 2						1.61***(2.88)	2.01*(1.70)
Housing					4.95***(4.54)		
Constant term	-1.65*** (-2.92)	-2.01***(-3.44)	5.86**(2.32)	1.75*(1.93)	1.58 (0.54)	38.79***(4.01)	55.82***(2.86)
Hausman test	Random effect	Fixed effect	Random effect	Fixed effect	Fixed effect	Fixed effect	Fixed effect
Chi^2(p)	7.87 (0.34)	29.49 (0.00)	9.25 (0.16)	41.11 (0.00)	163.92 (0.00)	64.68 (0.00)	35.60(0.00)
R-sq							
with in	0.74	0.94	0.19	0.69	0.92	0.87	0.79
between	0.56	0.39	0.60	0.15	0.33	0.0009	0.10
overall	0.58	0.50	0.59	0.22	0.20	0.14	0.09

Notes: 1. Coefficient values are shown on the left side, and t-values are shown in parentheses.

2. For the definitions of the variables, see Table 2.1.

3. * ,**, and*** indicate significance at 10% , 5%, and 1% levels, respectively.

4. In the bottom line of the table, chi-square values are presented, and their p-values are shown in parentheses.

Table 2.4 Parents' economic condition on the bottom of the quadratic curve

	Parents' economic condition
Male co-residence	66.02
Female co-residence	65.03

Notes: 1. This table shows the number of months for which parents' savings can cover consumption expenditure.

2. These values are calculated using the below equation.

$$\frac{\text{Assets of the elderly household} - \text{Debt of the elderly household}}{\textit{Consumption expenditure of the elderly household per month}}$$

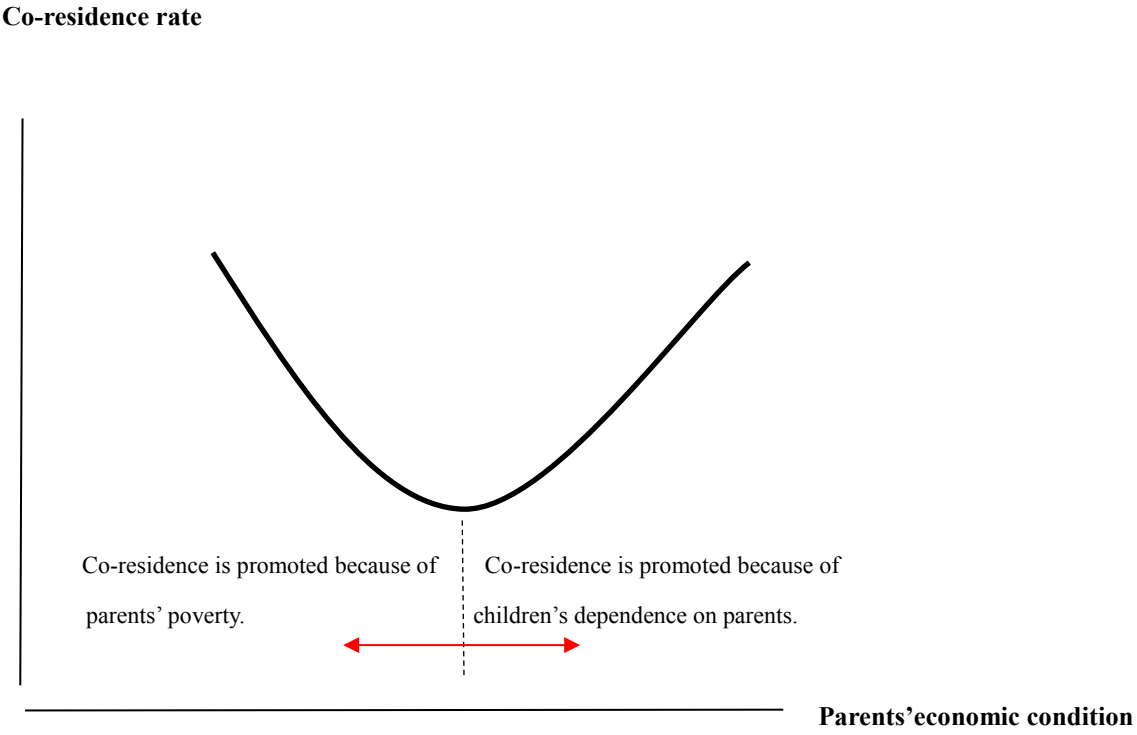

Figure 2.1 Relationship between co-residence rate and parents' economic condition

Chapter 3

The effect of health status on life cycle asset accumulation in Japan

3.1 Introduction

Throughout the era of high economic growth in Japan from the 1960s to the 1970s, the household saving rate was between 10% and 20%, and the amount of assets had been increasing. However, Japan faced a rapid decrease in saving rate since the 1990s, and the amount of household assets decreased. Horioka (2010a) explains that population ageing led to the decline in the household saving rate in Japan. On the other hand, the elderly household saving rate also decreased since the 2000s in Japan. According to Horioka (2010b), the decrease in the elderly household saving rate is due to the reduction of social security benefits or the increase of consumption expenditures, including medical expenses. In ageing societies such as Japan, identifying the saving behavior of the elderly household plays an important role in understanding the trend in the total saving rate.

The survival rate of elderly people is also important for saving behavior. Yaari (1965) introduces the survival rate into the life cycle model of Modigliani and Brumberg (1954). Yaari shows theoretically that the higher survival rate increases asset accumulation in preparation for consumption or medical expenses during the senior period. As for empirical studies that include lifetime uncertainty, Bloom, Canning, and Graham (2003) and Kageyama (2003) show empirically that longevity increases asset accumulation. Next, there are some empirical studies about the relationship between the aggregate saving rate and ageing population. The ageing population could have both positive and negative effects on the aggregate saving rate. Here, the positive effect indicates that young people save more money preparing for consumption during retirement (behavioral effect), and the negative effect indicates that an increase in retirees in the population (compositional effect) will reduce the aggregate saving rate. That is, the change of saving rate depends on which effect is larger, and these effects are sensitive to the data or sample selection (Kinugasa and Mason, 2007; Wong and Tang,

2013).

The uncertainty of social welfare benefits or future income will also be important for the decisions pertaining to saving behavior. According to the life cycle model, the increase in future pension (or income) reduces the uncertainty of the senior period; therefore, the necessity of saving money will decrease. There are some empirical studies about the relation between future income and asset accumulation (Alessie, Angelini, and Santen, 2013; van-Schie, Donkers, and Dellaert, 2012). These results show that people save more money when there is inadequacy of pension or future income. On the other hand, Horioka (2010b) explains that the reduction of the Japanese public pension rapidly increased the elderly dissaving rate.

On the other hand, the bequest motive is also an important factor in the life cycle model. Skinner (1985) conducts the main research that used the bequest motive in the life cycle model. According to the Skinner, longevity does not only have a positive effect but also a negative effect on asset accumulation under the assumption of the bequest motive. That is, the positive effect means that longevity promotes asset accumulation during youth, with preparation for consumption during old age. On the other hand, the negative effect indicates that longevity may decrease the incentive to build up assets for leaving bequests. Whether the negative effect is larger than the positive effect depends on the relative size of the bequest of youth and old age. Moreover, Dynan, Skinner, and Zeldes (2002) construct a life cycle model adding medical uncertainty into the above model.

The study of Kalemli-Ozcan and Weil (2010) concerns retirement and mortality risk. According to this study, the decrease in mortality risk has two effects: the “horizon effect” and “uncertainty effect.” If mortality decreases, the probability of living up to the older age and expected consumption will increase. Therefore, a lower mortality risk has a positive effect on lifetime working hours. This is the horizon effect. However, under a higher mortality risk, people continue to work in their old age, and in this case lower mortality risk reduces the planned age of retirement. This is the “uncertainty effect.” This study shows that the “uncertainty effect” can dominate the “horizontal effect” from the life table in the last century. Moreover, Liang, Bennett, Sugisawa, Kobayashi, and Fukaya (2003) present a study about gender differences in mortality.

As stated above, many studies have been approaching the introduction of longevity or the bequest motive into the life cycle model, and these factors play an important role in understanding the saving behavior in recent ageing societies. This Chapter will identify the effect of longevity and the bequest motive on the assets of the elderly

person. As already explained, longevity could promote the behavioral effect and compositional effect on aggregate savings. The aim of this Chapter is to identify the saving behavior of the elderly person; the compositional effect should therefore be removed. Therefore, to remove the compositional effect, this Chapter will analyze the health situation of each elderly person by means of micro data. In the analysis, this Chapter will use the interaction dummy between the health status and each variable, and the effect of the health situation on assets will be analyzed.

This Chapter is organized as follows. In section 2-2, a life cycle model will be developed that includes the survival rate of an elderly person based on the model of Yaari (1965) and Kinugas and Mason (2007). In section 2-3, the effect of the health situation and bequest motive on assets of an elderly person will be analyzed by using the interaction dummy. In addition, this Chapter will remove the non-retired sample, in order to control for sample selection bias between the retired and non-retired samples. Last, section 2-4 concludes and outlines the policy implications of this Chapter.

3.2 Theoretical Model

The following life cycle model, including survival rate, will be explained. In this model, it is assumed that all individuals are elderly people, who face a mortality risk at the start of the senior period and necessarily die at the end of the second period. The following equation represents the utility function and budget constraints of individuals.

$$\mathrm{U}=\ln C_1^* + \frac{q_2}{(1+\rho)}\ln C_2^* \tag{3.1}$$

$$A_1=(1+r)A_0+Y_1 - C_1 \tag{3.2}$$

$$0 = (1+r)A_1+Y_2 - C_2 \tag{3.3}$$

where C_1^* and C_2^* represent consumption in the first and second period of senior hood, respectively; Y_1 and Y_2 represent the pension of the first and second Y_1 and Y_2 represent the pension of the first and second periods of seniorhood; ρ is the subjective discount rate; r is the interest rate; and q_2 is the survival rate at the end of the first period. Here, the logarithm of the utility function is taken and the bequest motive is excluded, for simplification of the problem.

Solving the utility function and budget constraints, optimal assets of the first period are obtained (see Appendix C and D).

$$A_1 = \frac{q_2(1+r)}{1+\rho+q_2}A_0 + \frac{q_2}{1+\rho+q_2}Y_1 - \frac{1+\rho}{(1+r)(1+\rho+q_2)}Y_2 \quad (3.4)$$

The coefficients of A_0 and Y_1, which are positive, indicate that the assets of the youth period and pension benefits of the first period of seniorhood have a positive effect on the assets of the elderly person. On the other hand, the negative coefficient of Y_2 means that an increase in Y_2 weakens the necessity to save money in preparation for the future; therefore, A_1 will decrease. In addition, this Chapter identifies the effect of the survival rate, q_2, on A_1 as follows.

Proposition 1 *If q_2 increases, the coefficient of A_0, Y_1, and Y_2 on A_1 increases; therefore, A_1 also increases.*

Proof

$$\frac{dA_1}{dq_2} = \frac{(1+r)(1+\rho)}{(1+\rho+q_2)^2}A_0 + \frac{(1+\rho)}{(1+\rho+q_2)^2}Y_1 + \frac{1}{(1+r)(1+\rho+q_2)^2}Y_2 > 0 \quad (3.5)$$

Equation (3.5) shows that a higher survival rate increases asset accumulation in preparation for a future life. It is clear that the increase of q_2 also has a positive effect on the coefficient of each variable from (3.5). That is, the effect of each variable that promotes asset accumulation will become stronger, and the effect of the variable that restrains asset accumulation will weaken. In analysis, the interaction term of the health dummy and each variable is used to show the effect of survival rate on asset accumulation.

Although the bequest motive is excluded for simplification in the above model, the bequest motive is also an important factor for asset accumulation in ageing societies. Therefore, another life cycle model is explained, that includes the bequest motive based on the model of Skinner (1985). The utility function and budget constraints are as follows.

$$\mathrm{U}=\ln C_1^* + \frac{q_2}{(1+\rho)}\ln C_2^* + (1-q_2)\, k \ln A_1^* + \frac{q_2}{(1+\rho)} k \ln A_2^* \quad (3.6)$$

$$A_1 = (1+r)\, A_0 + Y_1 - C_1 \quad (3.7)$$

$$A_2 = (1+r)\, A_1 + Y_2 - C_2 \quad (3.8)$$

In this model, individuals get utility by leaving a bequest (A_1^* or A_2^*) for their children, and k is the weight parameter of bequest. The other parameters are equal to those of previous model. Solving the utility function and budget constraints, the optimal assets of first period are as follows (See Appendix C and D).

$$\frac{1}{A_1} = \frac{1}{(1-q_2)k}\ \frac{1}{(1+r)A_0+Y_1-A_1} - \frac{q_2(1+r)}{(1-q_2)(1+\rho)}\ \frac{1+k}{k}\ \frac{1}{(1+r)A_1+Y_2} \quad (3.9)$$

In addition, the relation between k and A_1 is shown as follows.

Proposition 2 *The weight parameter of bequest* k *positively affects assets of the first period,* A_1 *if* $q_2 < \frac{(1+\rho)}{(1+r)}\frac{C_2+A_2}{C_1}$

Proof: See Appendix C and D.

This indicates that the bequest motive may promote asset accumulation, but its effect depends on the survival rate of individuals. That is, unhealthy elderly people tend to save money for leaving bequests, but the bequest motive is not the main factor for asset accumulation of healthy elderly people. It is also empirically confirmed whether there is a difference in the effect of the bequest motive on asset accumulation between healthy and unhealthy people.

3.3 Empirical model and results

In this section, an empirical analysis about the assets of the elderly person is based on the previous life cycle model. First, the following regression equation and the robust standard error with ordered probit model are estimated.

$$Assets = \beta 1 Pension + \beta 2 Bequest + \beta 3\ House + \beta 4 Educ + \beta 5 Poverty + \beta 6\ Mcons + \beta 7 Nchild$$

(+) (+) (+) (+) (-) (+) (-)

In the analysis, the non-retired sample is removed and a distinction is made between the sample that has serious diseases and the sample that does not have serious diseases. Here, it is also discussed whether or not there is a difference between the saving behaviors of these two samples.

As for the variables of the model, Table 3.1 explains the definition of the dependent and independent variables, and Table 3.2 shows descriptive statistics. The dependent variable is the assets of an elderly person and his or her spouse, and assets are divided into four classes (1 = less than 1 million yen; 2 = between 1 and 5 million yen; 3 = between 5 and 20 million yen; 4 = 20 million yen or more). The data of all variables are provided by the 2006 Japanese AHEAD (Aging and Health Dynamics) survey. The original data of assets are discrete values; an ordered probit model was therefore used in the analysis.

Next, the definition of variables and interpretations are explained. First, the effect of public pension on the amount of elderly assets is explained. Here, public pension means Y_1 or Y_2 of the previous life cycle model. As for the relation between future income and asset accumulation, some empirical studies show that a higher future pension or income decreases the saving rate (Alessie, Angelini, and Santen, 2012; van-Schie, Donkers, and Dellaert, 2012). As already explained, future pension or income, Y_2 decreases asset accumulation, which is consistent with these studies. On the other hand, the present public pension, Y_1 will have a positive effect on asset accumulation. That is, if the present pension benefits increase, elderly people can cover living or medical expenses, and they will not tend to dissave assets.

Second, $Educ$ is the years of schooling, *House* is the dummy for owned house, and *Poverty* is the dummy for the poverty experience. These variables mainly refer to the assets of the youth period, A_0, and the years of schooling refer to the ability or parental assets during the youth period. The dummy of owned house is used as a variable about employment or living standard, because data about job or income during the youth period were not available. On the other hand, there is a possibility that the poverty experience decreases the assets during the senior period, because of the difficulty in employment or entering schools during the youth period.

Next, *Bmotive* refers to the extent of the bequest motive for their children (1 = do not have the bequest motive at all; 2 = do not have bequest motive; 3 = have bequest motive; 4 = have strong bequest motive). If elderly people have a bequest motive, they tend to increase their assets in the same way as assumed by the previous life cycle model. In addition, *Mcons* refers to the consciousness of preparing for medical or nursing expenses by oneself; if the consciousness is strong, the elderly person tends to increase assets. *Nchild* represents the number of children. If there are many children, parents can expect a stable life during seniorhood through economical or physical support from children. Therefore, there is a possibility that people who have many children do not save as actively.

Next, empirical results and interpretations are explained. Table 3.3 shows the results of the model, divided into the healthy and unhealthy samples. First, pension and the years of schooling had significant positive effects on the assets in both the healthy and unhealthy sample. If an elderly person has enough pension benefits to cover living expenses, they will not tend to dissave their assets. The years of schooling refer to the ability or employment status during the youth period; therefore, it will also increase assets during the senior period. The dummy of owned house implies assets or economic

status at young period, and had a positive effect on the healthy sample. However, it did not have a significant effect on the unhealthy sample. Moreover, the experience of poverty and the number of children had a negative (but not significant) effect on both the healthy and unhealthy samples.

Next, people who have a bequest motive will save money in preparation for leaving assets for children. According to the results, the extent of the bequest motive had a negative (but not significant) effect on the healthy sample; however, it had a positive and significant effect on the unhealthy sample. Therefore, there is a possibility that the difference exists in saving behavior between the healthy and unhealthy sample. Healthy people tend to save money in preparation for future living or medical expenses. On the other hand, unhealthy people tend to save money in preparation for leaving a bequest. This result is consistent with Proposition 2, which shows that the bequest motive positively affects asset accumulation under a sufficiently low survival rate.

To see the effect of health status on the assets of the elderly, additional analysis was conducted by using the interaction term of the health dummy and each variable. Table 3.4 shows the model and results of the empirical analysis, and the health dummy refers to whether or not the people have serious diseases. First, the bequest motive had a positive and significant effect, and the interaction term of a bequest and the health dummy had a negative significant effect on the assets of the elderly. The former indicates that elderly people who have a bequest motive save more money to this end. The latter indicates that healthy people save less money in preparation for a bequest compared to unhealthy people. This result is consistent with Proposition 2.

Second, the interaction dummy of pension and education had a positive significant effect on the assets. As for the owned house dummy, it did not have a significant effect; however, the interaction dummy had a positive, significant effect. According to the previous life cycle model, there is a positive relationship between the survival rate and the coefficient of each variable. That is, this result indicates that the health status positively affects asset accumulation through the increase in the positive effect of each variable.

3.4 Conclusion

The conclusion to this Chapter and its political implications are outlined here. First, public pension had a positive effect on the amount of assets of the elderly person. Horioka (2010b) explains that the reduction of social security benefits is a reason for the

rapid decrease of the elderly saving rate. This result is consistent with the explanation of Horioka (2010b). Therefore, public pension funds are important for the stable economic condition of elderly people. Second, according to empirical results, the consciousness of preparing for future medical or nursery expenses increases the assets of the elderly person. From seeing this result, there is a possibility that future uncertainty prevents optimal consumption by the elderly person. Therefore, from the perspective of the effective use of the elderly's assets, a policy that removes future uncertainty will also be important.

Last, this Chapter showed that a difference exists in the saving behavior of healthy and unhealthy people by the interaction dummy pertaining to health status. This is the main finding of this Chapter. This difference particularly pertains to the results of the bequest motive. The latter had a positive effect on assets, but the interaction dummy of the bequest motive and health dummy had a negative effect. This indicates that the unhealthy elderly person saves more money than the healthy person. According to Proposition 2, the bequest motive promotes asset accumulation under a sufficiently low survival rate. Therefore, the empirical result is consistent with theoretical model. On the other hand, the interaction dummy for other variables had a positive effect, and this is consistent with the previous life cycle model. This result indicates that healthy people tend to save more money compared to unhealthy people. Therefore, based on these results, the health status of the elderly person should be taken into consideration in the development of policy concerning household assets or saving behavior. However, there is a possibility that endogeneity exists between health status and bequest motive. We would like to treat the endogeneity as a future issue.

Table 3.1 Definition of variables

Name	Definition
Assets	Assets of the elderly person (1 = < 1 million yen; 2 = 1 million yen ~ 5 million yen; 3 = 5 million yen ~20 million yen; 4 =< 20 million yen)
Pension	The allowance of public pension
Mcons	The consciousness of preparing for medical expense by oneself
Educ	The years of schooling
House	The dummy for owned house
Bmotive	The extent of the bequest motive (4 = have strongly bequest motive; 3 = have bequest motive; 2 = do not have bequest motive; 1 = do not have bequest motive at all)
Poverty	The dummy for the experience of poverty
Nchild.	Number of children

Table 3.2 Descriptive Statistics

	Average	Variance	Standard deviation	Mode
Assets	2.95	3.07	1.75	2
Pension	4.07	3.85	1.96	5
Educ	9.80	7.03	2.65	8
House	0.69	0.21	0.45	1
Bmotive	2.45	1.13	1.07	3
Mcons	4.46	1.03	1.01	5
Poverty	0.16	0.14	0.37	0
Nchild	2.30	1.19	1.09	2

Table 3.3 Empirical results of the healthy sample and the unhealthy sample

Dependent variable	Assets (healthy sample)		Assets (unhealthy sample)	
	Coefficient	Robust Std. error	Coefficient	Robust Std. error
Pension	0.26***	0.03	0.25***	0.05
Educ	0.10***	0.02	0.08***	0.03
House	0.36***	0.12	0.16	0.16
Poverty	-0.24	0.16	-0.16	0.21
Mcons	0.16***	0.06	0.11*	0.06
Bmotive	-0.05	0.05	0.15**	0.07
Nchild	-0.03	0.05	-0.10	0.07
Cut1	1.87	0.41	1.59	0.47
Cut2	2.83	0.42	2.49	0.48
Cut3	3.37	0.43	3.03	0.49
Cut4	3.89	0.43	3.67	0.51
Cut5	4.32	0.44	4.16	0.51
Cut6	4.83	0.46	4.51	0.52
Sample size	418		230	
Pseudo R2	0.13		0.10	
Log likelihood	-652.08		-364.93	

*, ** and *** indicate significance at 10%, 5% and 1% levels.

Table 3.4 Empirical results by health dummy

	Model 1	Model 2	Model 3
Pension	0.22*** (0.03)	0.25*** (0.03)	0.26*** (0.03)
*Pension*health*	0.06* (0.04)		
Educ	0.09*** (0.02)	0.09*** (0.18)	0.07*** (0.02)
*Educ*health*			0.04** (0.02)
House	0.29*** (0.01)	0.10 (0.14)	0.29*** (0.09)
*House*health*		0.32* (0.17)	
Bmotive	0.10* (0.06)	0.10* (0.05)	0.13** (0.06)
*Bmotive*health*	-0.13** (0.06)	-0.11** (0.05)	-0.17** (0.07)
Mcons	0.14*** (0.04)	0.14*** (0.04)	0.14*** (0.04)
Poverty	-0.19 (0.13)	-0.21 (0.13)	-0.20 (0.13)
Nchild	-0.06 (0.04)	-0.06 (0.04)	-0.06 (0.04)
Cut1	1.74 (0.30)	1.74 (0.30)	1.74 (0.30)
Cut2	2.67 (0.31)	2.67 (0.30)	2.67 (0.31)
Cut3	3.22 (0.32)	3.21 (0.32)	3.21 (0.32)
Cut4	3.78 (0.32)	3.78 (0.32)	3.78 (0.32)
Cut5	4.22 (0.33)	4.22 (0.33)	4.22 (0.33)
Cut6	4.68 (0.33)	4.68 (0.34)	4.68 (0.34)
Sample size	648	648	648
Pseudo R2	0.12	0.12	0.12
Log likelihood	-1019.97	-1019.54	-1019.16

Notes: 1. Coefficient values are shown on the left side, and robust standard errors are shown in parentheses.

Chapter 4

Determinants of educational attainment in an ageing society

4.1 Introduction

Recently, both educational attainment and life expectancy have increased globally. For educational attainment, the tertiary enrollment ratio has reached 30% in the past five years. Life expectancy at birth has also risen above 70 years since the 2000s. Many studies have discussed the relationship between life expectancy and educational attainment, starting from that of Ben-Porath (1967). Ben-Porath (1967) showed that increasing life expectancy raises lifetime working hours and the benefits from education, while schooling time then rises owing to the increase in the return to education. Kalemli-Ozcan (2000, 2002) also showed a positive correlation between the decline in mortality and educational investment. Therefore, longevity is an important factor for educational attainment. The quality–quantity trade-off is also important for educational attainment. The decline in fertility promotes education by raising educational investment per child. Prettner et al. (2012) found a negative correlation between the fertility rate and education by using panel data on educational attainment, controlling for the fixed effect, fertility rate, lagged per capita GDP, and lagged population. In this chapter, we identify the effect of longevity and fertility on education by using country-level panel data. We add the adult mortality rate into the model of Prettner et al. (2012) and use adult mortality as a variable that represents lifetime working hours. The adult mortality rate is more important than life expectancy for identifying the effect of lifetime working hours on education.

In terms of the relationship between education and economic growth, educational investment plays an important role, with many studies theoretically and empirically showing the positive effect of educational attainment on economic growth (Mankiw et al., 1992; Lee and Mason, 2010; Prettner et al., 2012). These studies focus on the economic growth driven by higher education by analyzing the decline in fertility in developed countries. The negative correlation between education and the fertility rate

suggests that the quality–quantity trade-off between education and the fertility rate is important for economic development in developed countries[7]. The remainder of this chapter is organized as follows. Section 4.2 introduces previous studies of the relationship between education and life expectancy starting from Ben-Porath (1967). Section 4.3 explains the data and empirical model, and the results are presented in Section 4.4. Lastly, Section 4.5 concludes and outlines the policy implications of this study.

4.2 Previous research

Theoretical and empirical studies have discussed the relationship between life expectancy and educational attainment, starting from the study of Ben-Porath (1967) (Kalemli-Ozcan, 2000, 2002; Hansen and Lonstrup, 2012; Cervellati and Sunde, 2013; Leker and Ponthiere, 2015; Sánchez-Romero et al., 2016). The argument of Ben-Porath is that increased life expectancy, which leads to increasing lifetime working hours, induces individuals to invest more in education. Kalemli-Ozcan (2000) showed that the decline in mortality has positively affected educational investment. According to Kalemli-Ozcan (2000), such a positive correlation means that investment in education leads to higher educational returns under the longer lifetime period. In addition, Kalemli-Ozcan (2002) argued that the decline in the mortality rate reduces precautionary demand for children and increases educational investment by parents.

On the contrary, some studies argue that the Ben-Porath mechanism cannot explain the positive relationship between lifetime working hours and educational investment. Cervellati and Sunde (2013) theoretically and empirically showed that an increase in lifetime labor is not a necessary condition for longer life expectancy to increase education, using an age-specific survival rate. That is, lifetime working hours may not be a factor behind higher educational investment and the survival rate during prime working age is important for explaining the Ben-Porath mechanism. Hansen and Lonstrup (2012) theoretically showed that life expectancy increases educational investment but promotes early retirement, using the three-period lifecycle model, which is not consistent with the Ben-Porath mechanism. In addition, Sánchez-Romero et al. (2016) theoretically showed that a decline in mortality increases educational attainment

[7] Minamimura and Yasui (2016) shows that mortality decline promotes the replacement of physical capital accumulation by human capital.

and promotes early retirement if the income effect dominates the substitution effect. They also showed that a decline in mortality after retirement induces education because individuals finance their consumption and expenses after retirement by income earned through educational investment during the working period.

Leker and Ponthiere (2015) developed a three-period OLG model based on human capital accumulation, the survival rate, and bargaining power between the parent and child. In the model, educational investment is determined by intra-family bargaining power between parents and children. They showed that individuals educate themselves to benefit from a higher future income, whereas parents are motivated to educate their children because they expect greater support from educated children. According to Leker and Ponthiere (2015), parental preference for children's education promotes educational investment: if parental preference for children's education is higher, the bargaining power of the parent has a positive effect on educational investment.

Among empirical studies of education, Jayachandran and Lleras-Muney (2009) showed that a 70% reduction in female maternal mortality risk increases female life expectancy by 1.5 years and increases female literacy by 2.4% in Sri Lanka. They used the rapid decrease in maternal mortality between 1946 and 1953 in Sri Lanka to identify the effect of a longer horizon on education and exclude other health effects on education. In addition, Sun et al. (2012) analyzed the relationship between the mortality rate and illiteracy rate by using a difference-in-differences analysis and cross-province data in China. The results showed that a decline in mortality lowers the illiteracy rate and increases average schooling years.

Many studies use college availability as an instrumental variable of educational attainment. First, some studies use the presence of a college in the country as an instrumental variable of college attendance (Card, 1993; Carneiro et al., 2011; Doyle and Skinner, 2015). Card (1993) shows that the presence of four-year colleges in the area where men grew up leads to higher educational attainment and earnings. Carneiro et al. (2011) and Doyle and Skinner (2015) also use the presence of a four-year college in the country of residence at 14 years, and these studies show that the college availability has a positive effect on education. On the other hand, Currie and Moretti (2003) uses the number of colleges as an instrumental variable of schooling. They use the number of two- and four-year colleges as the proxy for college openings.

Based on the foregoing, the present study analyzes educational attainment as a factor that promotes economic development. From these previous studies, the correlation between education and life expectancy is an important factor for educational

attainment that is worth discussing. In addition, educational attainment is a particularly important factor for economic development in ageing or low fertility societies. Prettner et al. (2012) used panel data on educational attainment, controlling for the fixed effect, fertility rate, lagged per capita GDP, and lagged population, finding a quality–quantity trade-off between education and fertility. We analyze the average years of education by adding the survival rate at 65 years into the model of Prettner et al. (2012). In this chapter, we also use the adult mortality rate to identify the positive effect of lifetime working hours in addition to the fertility rate.

4.3 Data and empirical model

Here, we explain the empirical model and data. We conduct an empirical analysis on the effect of life expectancy on educational attainment based on the model of Ben-Porath (1967) or Hansen and Lonstrup (2012). In addition, we use country-level panel data taken from the World Development Indicators and education statistics on five years (1990, 1995, 2000, 2005, and 2010). The panel data set is unbalanced. The empirical model is a fixed or random effect model, and we decide whether the model is a fixed or random effect model by using the Hausman test.

Next, we explain the empirical model and define the variables. The definition and descriptive statistics of each variable are shown in Table 4.1 and Table 4.2. Our empirical model is shown as follows. Here, plus or minus means the sign of the hypothesis:

$$\text{Log } Educ \text{ 25–29 years} = \beta 1\ Survival \text{ (or log } Lifeex) + \beta 2\ Fertility + \beta 3\ Educ65\text{-years}$$
$$(+) \qquad (-) \qquad (+)$$
$$+\beta 4 \log GDP + \beta 5\ Capacity \text{ 25–29 years}$$
$$(+) \qquad (+)$$

$$\text{Log } Educ \text{ 30–34 years} = \beta 1\ Survival \text{ (or log } Lifeex) + \beta 2\ Fertility + \beta 3\ Educ \text{ 70-years}$$
$$(+) \qquad (-) \qquad (+)$$
$$+\beta 4 \log GDP + \beta 5\ Capacity \text{ 30–34 years}$$
$$(+) \qquad (+)$$

We chose 25–29 years and 30–34 years as age categories for the independent variable. There is a possibility that some individuals are enrolled in educational institutions, even in the latter half of 20s in the developed countries. Therefore, identifying the trend of educational attainment by the early 30s is more important, particularly in the developed countries. *Educ* 25–29 years and *Educ* 30–34 years mean the average years of total education at 25–29 years and 30–34 years,

respectively. Second, *Survival* and *Lifeex* mean the survival rate at 65 years and life expectancy at 0 years, respectively. *Fertility* is the total fertility rate, and *Educ* 65-years and *Educ* 70-years mean the average years of total education at more than 65 years and more than 70 years, respectively. *GDP* is per capita GDP. In addition, *Capacity* 25–29 years (30–34 years) is the ratio of the lagged 15 years (20 years) size of enrollment in educational institutions and population at 25–29 years (30–34 years).

Next, we explain the hypothesis of our empirical model. First, *Survival* or log *Lifeex* is expected to have a positive effect on education because longevity leads to longer lifetime working hours and thus a higher educational return. According to the Ben-Porath mechanism, lifetime working hours affect education; hence, we use the survival rate at 65 years (i.e., in the retirement period). In addition, the adult mortality rate is expected to promote educational investment to finance consumption after retirement, in line with the explanation of Sánchez-Romero et al. (2016). In the analysis, we analyze average years of schooling at 25–29 years and 30–34 years. We use the survival rate at 65 years as a variable to represent whether individuals survive to retirement age. However, if the share of primary industry such as agriculture is large, individuals are working in industries unaffected by retirement age. Therefore, we also analyze OECD countries to check the robustness of the effect of adult mortality on education. In addition, we use life expectancy at birth as a robustness check.

The fertility rate is expected to have a negative effect on educational investment because the number of children decreases educational investment per child. *Educ* 65-years and *Educ* 70-years mean parental preference for children's education. Leker and Ponthiere (2015) showed that parents who have a preference for child education promote educational investment in their children. Per capita GDP is expected to promote educational attainment because of rising income. *Capacity* 25–29 years and *Capacity* 30–34 years mean the availability of education (primary, secondary, and tertiary education). We use the ratio of the size of enrollment and population of the cohort aged 10–14 years. According to Currie and Moretti (2003), the higher capacity of educational institutions promotes educational attainment.

4.4 Empirical results

Next, we explain the empirical results and interpretations. We take the 10-year lag of each variable except *Educ* 65-years and *Educ* 70-years, and our empirical model is based on that of Prettner et al. (2012). The empirical results are shown in Table 4.3 and

Table 4.4. First, we explain the results for all the countries in the world. The survival rate had a positive effect on schooling in all models. This finding is consistent with the Ben-Porath mechanism, that is, longer lifetime working hours increase the educational return and educational investment. In addition, the longer lifetime may promote education to finance consumption after retirement. Further, life expectancy at 0 years also had a positive effect on education. We used life expectancy at 0 years to check the robustness of the results. Although we should use the adult mortality rate to test the Ben-Porath effect, retirement age may not affect the educational investment of people working in agriculture in developing countries.

Second, the fertility rate had a negative effect on schooling in all samples.[8] This result indicates the quality–quantity trade-off between fertility and education. That is, the number of children decreases educational investment per child, which is consistent with Prettner et al. (2012). In addition, both *Educ* 65-years and *Educ* 70-years had a positive effect on educational attainment. This finding indicates that parental preference for child education promotes educational attainment, consistent with Leker and Ponthiere (2015). GDP per capita had a positive and significant effect on schooling at 25–29 years in all countries and a positive, but not significant effect in the case of 30–34 years. Hence, an increase in household income promotes educational investment.

The capacity of educational institutions also had a positive effect on education. This variable is measured as the ratio of the size of enrollment and population of the cohort, and we use it to represent the availability of educational institutions. This result is consistent with Currie and Moretti (2003). In addition, we analyze OECD countries to check the robustness of the effect of adult mortality on education. According to the results, the survival rate and life expectancy had a positive effect on schooling except at 25–29 years. However, in OECD countries, GDP had a negative effect on schooling (not significant).

4.5 Conclusion

In this chapter, we analyzed the determinants of educational attainment, taking into consideration the adult mortality rate, fertility rate, and parental education. We showed that the adult mortality rate positively affects educational attainment, whereas the

[8] Although there is a possibility that the interaction effect between fertility and income exists, we would like to treat this as a future issue.

fertility rate has a negative effect. The former indicates that the higher survival rate at retirement promotes educational investment by increasing the educational return through longer lifetime working hours. In addition, individuals finance consumption and expenses by saving lifetime income induced by higher educational attainment; hence, longer life expectancy may promote education through lifecycle behavior. The latter indicates that the increase in the number of children decreases educational investment per child, highlighting the quality–quantity trade-off between education and fertility.

From our results, educational investment will become more important in ageing or low fertility societies. Some previous studies have shown that educational attainment promotes economic growth, while the decline in fertility promotes educational investment per child. Therefore, the positive effect of the decline in fertility on education is an important growth mechanism in low fertility societies. In ageing societies, population ageing is a reason for lower economic growth. However, in ageing societies that have a higher educational return through a longer lifetime working period, education is also an important factor. In addition, taking account of the longer retirement period, education is more important from the perspective of preparing for uncertain future income or expenses.

Table 4.1 Definition of the variables

Variable name	Variable definition
Educ 25–29 years	Log of the average years of total education (25–29 years)
Educ 30–34 years	Log of the average years of total education (30–34 years)
Survival	Survival rate at 65 years (10-year lag)
Lifeex	Log of life expectancy at birth (10-year lag)
Fertility	Total fertility rate (10-year lag)
Educ 65- years	Log of the average years of total education (older than 65 years)
Educ 70- years	Log of the average years of total education (older than 70 years)
GDP	Log of GDP per capita (constant 2011 US dollars) (10-year lag)
Capacity 25–29 years	15-lagged enrollment / population 25–29 years
Capacity 30–34 years	20-lagged enrollment / population 30–34 years

Source: World Development Indicators

Table 4.2 Descriptive statistics

World				
	Mean	Standard deviation	Max	Min
Educ 25–29 years	9.26	3.09	1.39	14.70
Educ 30–34 years	8.98	3.23	1.18	14.57
Educ 65- years	4.96	3.33	0.14	13.40
Educ 70- years	4.84	3.30	0.13	13.28
Survival	69.62	15.57	22.24	88.64
Lifeex	67.62	10.27	31.72	81.16
Fertility	3.36	1.92	1.15	7.63
GDP	13741	16991.62	251.58	81732.45
Capacity 25–29 years	2.15	0.64	0.32	4.25
Capacity 30–34 years	2.07	0.66	0.22	4.74
Obs.	273	273	273	273
OECD				
	Mean	Standard deviation	Max	Min
Educ 25–29 years	12.02	1.18	8.50	14.70
Educ 30–34 years	11.95	1.28	7.57	14.57
Educ 65- years	8.19	2.46	2.78	13.40
Educ 70- years	8.03	2.53	2.60	13.28
Survival	82.05	4.74	69.24	88.64
Lifeex	75.86	2.76	68.01	81.16
Fertility	1.77	0.46	1.15	4.02
GDP	29908	15834.34	4784.84	81732.45
Capacity 25–29 years	2.60	0.30	1.52	3.27
Capacity 30–34 years	2.45	0.28	1.45	3.20
Obs.	94	94	94	94

Table 4.3 Empirical results (World)

Independent variable	Log *Educ* 25–29 years		Log *Educ* 30–34 years	
Survival	0.003(1.90)*		0.005(2.69)***	
Log *Lifeex*		0.37(2.48)**		0.44(2.22)**
Fertility	-0.04 (-3.64)***	-0.04(-3.06)***	-0.05(-3.23)***	-0.05(-2.88)***
Log *Educ* 65 years	0.19(7.84)***	0.18(7.83)***		
Log *Educ* 70 years			0.10(3.36)***	0.10(3.53)***
Log *GDP*	0.04(2.56)**	0.04 (2.50)**	0.05(1.46)	0.05(1.65)
Capacity 25–29 years	0.13 (5.84)***	0.13(5.75)***		
Capacity 30–34 years			0.10(3.49)***	0.10(3.29)***
Constant	1.20(7.78)***	-0.14(-0.23)	0.05(1.46)	-0.34(-0.42)
R-sq				
within	0.54	0.54	0.48	0.47
between	0.83	0.83	0.84	0.85
overall	0.83	0.84	0.84	0.85
Obs.	273	273	273	273
Hausman	Random effect	Random effect	Fixed effect	Fixed effect
Chi^2(p)	3.98 (0.55)	5.37(0.37)	16.89(0.00)	16.00(0.01)

Notes: 1. Coefficient values are shown on the left side and t-values are shown in parentheses.

2. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

3. We used data on 105 countries.

Table 4.4 Empirical results (OECD)

Independent variable	Log *Educ* 25–29 years		Log *Educ* 30–34 years	
Survival	0.005(1.54)		0.006(2.17)**	
Log *Lifeex*		0.55(1.46)		0.82(2.35)**
Fertility	-0.04 (-1.84)*	-0.04(-1.71)*	-0.07(-2.95)***	-0.06(-2.71)***
Log *Educ* 65 years	0.19(6.55)***	0.19(6.31)***		
Log *Educ* 70 years			0.17(6.02)***	0.16(5.77)***
Log *GDP*	-0.03(-1.40)	-0.03 (-1.32)	-0.03(-1.22)	-0.03(-1.28)
Capacity 25–29 years	0.06 (2.29)**	0.06(2.10)**		
Capacity 30–34 years			0.09(3.21)***	0.08(2.96)***
Constant	2.001 (10.69)***	-0.02(-0.01)	1.87(9.58)***	-1.16(-0.87)
R-sq				
within	0.45	0.45	0.56	0.56
between	0.66	0.66	0.71	0.71
overall	0.46	0.46	0.55	0.54
Obs.	94	94	94	94
Hausman	Random effect	Random effect	Random effect	Random effect
Chi^2(p)	2.44(0.79)	2.82(0.73)	4.44 (0.48)	3.66 (0.60)

Notes: 1. Coefficient values are shown on the left side and t-values are shown in parentheses.

2. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

3. We used data on 31 OECD countries.

Chapter 5

Conclusion

The purpose of this study is to identify the determinants of marital status, saving behavior among the elderly, and educational attainment, all under the societal conditions of low fertility and aging. In a low-fertility and aging society, these issues closely and interdependently relate, and so we conducted some theoretical and empirical analyses of them. First, we conducted an empirical analysis of the interrelationships among marital status, fertility rate, and other socioeconomic factors in Japan. Our empirical model is based on the theory of Becker (1960, 1974), and we make use of a simultaneous equation that includes marital status and fertility, in conjunction with the two-stage least squares method.

The results show that marital status has a positive effect on fertility rate, as expected. This result indicates that a decreasing marriage rate since the 1990s has led to a fertility decline in Japan. As for male employment status, the male regular employment rate has also had a positive effect on both marital status and fertility rates: the results indicate that an increase in the number of male nonregular workers has since the 2000s reduced both the marital status and fertility rates. Taking into account the negative effect of marital status on fertility, improvements in the male employment status are more important. In addition, we used *convenience store* as a variable, to indicate comparative advantages in household product activity between men and women; this is based on the methodology of Becker (1974). Convenience stores, in particular, reduce the necessity for single men's household products, and so the variable *convenience store* is expected to affect those conditions that underpin Becker's theory. The number of convenience stores was found to have a negative effect on male marital status, and so the results showed that a change in lifestyle is also a reason for the decline in the rate of marital status.

Co-residence between unmarried adult children and parents has been increasing since the 2000s, particularly in Japan. The co-residence rate has had a negative effect on male marital status, and this indicates that the necessity for marriage has declined on account of parental supports for single men. In analyses of the co-residence rate, parental assets were found to have a positive effect on the co-residence rate, and so it is

thought that children depend on parental assets and tend not to marry. On the other hand, the results also showed that co-residence was also promoted even in cases where parental assets had decreased. Following the bubble economy of the early 1990s, the parents of many younger people have become financially poor; therefore, it is thought that parents have grown to rely on the support of their children, and that the co-residence rate has increased for this reason. Therefore, to eliminate economic barriers to marriage among youth, in addition to providing supports that allow younger generations to be more independent, Japan needs to provide financial supports or nursing benefits to elderly households.

According to these results, the assets of elderly people affect the marital status or livings standard of younger people, and asset accumulation among elderly people is expected to have a large influence on saving-rate trends; this would be the case, in particular, in aging societies such as Japan. In Chapter 3, we develop two period life-cycle models that include the survival rate and bequest motives; we also conduct empirical analyses of asset accumulation among elderly people, based on a life-cycle model. Data are at the micro level and pertain to elderly people in Japan, and we use the health status of elderly people as a variable that pertains to the survival rate in the senior years (i.e., aged 65 or more). According to the results, the sample is divided into a healthy subsample and an unhealthy subsample. In additional analyses, we use the interaction term of the health dummy and each variable, as well as other variables, to determine the effect of health status on asset accumulation. Our results theoretically and empirically show that health status and bequest motives promote asset accumulation. The results also show that while unhealthy people save money for bequests, among healthy people, the bequest motive is not an important determinant factor vis-à-vis asset accumulation. This finding is consistent with the theoretical model, and it indicates that healthy people save more money for future consumption or medical expenses than for bequests.

However, there is the possibility that future uncertainty in this way obstructs optimal consumption among elderly people. Therefore, from the perspective of increasing consumption among elderly people, policy is needed that removes future uncertainty and promotes consumption among this subsection of the population. Public pensions have had a positive effect on asset accumulation, and this result is consistent with the explanation offered by Horioka (2010b). This result aligns with the assertion that the reduction of public pension funds has led since the 2000s to a lower saving rate among elderly households, and that the stability of public pension funds is critical to

viable economic conditions among elderly people. In terms of robustness, there is an endogeneity issue between health status and asset accumulation, and it very much needs to be addressed in the future.

Educational attainment is also an important issue with regards to economic growth, and many studies discuss the relationship between these two factors. In addition, both the average years of schooling and life expectancy have increased globally in recent years. In Chapter 4, we undertake an empirical analysis of educational attainment by using country-level panel data that focus on the effects of longevity and fertility on educational attainment. We take a 10-year lag for each variable to determine the effect in the schooling decision-making period, and our empirical model is based on that of Prettner et al. (2012). We add to this model the adult mortality rate, which acts as a variable that represents lifetime working hours, as Ben-Porath (1967) explains.

According to our results, the average number of years of schooling among elderly individuals positively affect educational attainment among younger individuals. Indeed, there is a multiplier effect in education between older generations and younger generations, and so educational investment is critical to educational attainment among younger generations. As for the effects of longevity and fertility on education, first, a lower adult mortality rate has been found to have a positive effect on educational attainment; this suggests that longer lifetime working hours promotes the demand for educational investment. The reduced adult mortality rate is also expected to extend the length of "senior hood," and so there is the possibility that educational investment is promoted so as to prepare for future uncertainty. Second, the results also show that the fertility rate has a negative effect on educational attainment; this finding is consistent with the hypothesis of there being a quality–quantity tradeoff between education and fertility. This indicates that in a low-fertility society—like Japan—an increase in human capital per child is more important to economic growth. Therefore, particularly in low-fertility and aging societies, the supply of public education should be increased, the scholarship system improved, or both, to correspond to higher demand for educational investment.

Although we explain the possibility that a decline in fertility promotes economic growth through an increase in human capital, over the long term, the fertility decline is an important problem in terms of economic growth. In addition, education is found to have negative effect on marital status, among women and men alike; therefore, education may promote a decline in fertility, through a decline in marital status. Well-educated women will hesitate to get married, as marriage tends to increased

housework burden reduced work hours among women. Therefore, the provision of childcare and/or employment supports for career-oriented women will be important in schooling-oriented societies such as Japan.

As for education among men, Kitamura and Miyazaki (2011) show that education reduces the marriage rate among men in their twenties to early thirties, but that education promotes marriage in the late thirties. As we analyzed only subjects aged 20–39 years, there is the possibility that more highly educated men delay marriage during their schooling period, but "catch up" later on. However, it is thought that lowering the age at first marriage is important, even in the case of men. According to Ota (2012), increased education levels caused job scarcity among graduates, by increasing the number of incompetent students, and it is expected that since the 2000s, a decrease in employment rate among university graduates has affected male marital status. Therefore, we should develop employment supports for university students and reduce supply–demand mismatches in employment between graduates and firms. Finally, while educational investment is an important factor, coping with the negative effects of education on marital or fertility decline is more important, particularly in developed countries like Japan.

Appendix A. Empirical results by fixed effects (without 2SLS)

	Married	FMarried	Con	Fertility	Flabor	Co-R	FCo-R
Married			-2.46***(-3.71)				
FMarried				0.94***(4.31)			
Con	-0.02***(-2.90)	-0.02 (-1.49)			0.05 (0.60)	0.36* (1.83)	0.40 (1.03)
Fertility					-0.46***(-3.54)		
Flabor	-0.13***(-5.65)	-0.11***(-4.77)	-0.81***(-4.08)	-0.58***(-11.99)			1.01** (2.36)
Co-R	-0.04***(-5.48)						
FCo-R		-0.02***(-5.70)		-0.03***(-3.15)			
Labor	0.26*** (6.05)	0.24***(6.71)	1.29***(3.15)	0.56***(6.29)		-2.42***(-9.44)	
Edu	-0.16***(-4.49)					2.88***(4.43)	
FEdu		-0.16***(-5.53)		-0.16** (-2.30)			4.99***(7.50)
Wage	0.11 (1.37)	0.10 (1.20)					
FWage	-0.09 (-1.20)	0.07 (0.80)					
Road			-0.13**(-2.40)				
Residence			-2.33***(-5.84)				
LRS			0.01 (0.14)				
Nursery				-0.07 (-0.92)			
Three-generation				0.02 (0.32)	1.20***(12.77)		
FPW					-0.31 (-1.44)		
PI					0.52**(2.43)	-1.13**(-2.08)	-2.10**(-1.88)
Assets						-13.14***(-3.05)	-10.12 (-1.22)
Assets 2						1.57***(3.06)	1.20 (1.21)
Housing					5.57***(7.10)		
Constant term	-1.35*** (-2.99)	-1.95***(-3.98)	6.63***(3.37)	0.41 (1.50)	0.44 (0.19)	38.08***(4.40)	46.39**(2.66)
Hausman test	Random effect	Fixed effect	Random effect	Fixed effect	Fixed effect	Fixed effect	Fixed effect
R-sq							
with in	0.77	0.94	0.19	0.83	0.94	0.88	0.83
between	0.54	0.45	0.59	0.22	0.61	0.0005	0.17
overall	0.57	0.57	0.59	0.30	0.25	0.12	0.23

Notes: 1. Coefficient values are shown on the left side, and t-values are shown in parentheses.

2. * ,**, and*** indicate significance at 10% , 5%, and 1% levels, respectively.

3. The Hausman test of fixed-effect 2SLS determines fixed effect or random effect.

Appendix B. Empirical results fixed effects 2SLS (Robustness check)

	Married	FMarried	Con	Fertility		Flabor
Married			-3.88(-3.10)***			
FMarried				2.24(9.79)***		
Con	-0.09 (-1.68)*	-0.03 (-0.57)				
Fertility						-0.35(-2.00)**
Flabor	-0.10(-2.60)***	-0.12(-3.30)***	-0.89(-3.53)***	-0.53(-7.46)***	-0.76(-8.94)***	
Labor	0.29(4.62)***	0.24(4.83)***	1.64(3.41)***	0.35(3.25)***	0.88(7.82)***	
Edu	-0.41(-6.19)***					
FEdu		-0.25(-8.72)***			-0.58(-8.67)***	
Wage	0.03(0.23)	0.09(0.89)		-0.09(-0.42)	0.03(0.11)	
FWage	-0.003(-0.04)	0.02(0.30)		0.01(0.04)	0.07(0.37)	
Road			-0.11(-2.04)**			
Residence			-2.25(-4.82)***			
LRS			-0.06(-0.53)			
Three-generation				0.06(1.06)	0.004(0.07)	1.19(12.85)***
FPW						-0.29(-1.36)
Housing						5.74(7.29)***
PI						0.49(2.33)**
Constant term	-1.72(-2.11)**	-1.84(-2.68)***	5.28(2.00)**	2.22 (1.76)*	-1.37(-1.05)	0.37((0.16)
Hausman test	Fixed effect	Fixed effect	Random effect	Fixed effect	Fixed effect	Fixed effect
Chi^2 (p)	44.20(0.00)	13.61(0.03)	7.20(0.30)	123.69(0.00)	123.74(0.00)	295.68(0.00)
R-sq: with in	0.70	0.92	0.18	0.75	0.70	0.94
between	0.49	0.36	0.61	0.28	0.25	0.61
overall	0.47	0.46	0.60	0.32	0.29	0.24
Sample size	141	141	141	141	141	141

Notes: 1. Coefficient values are shown on the left side, and t-values are shown in parentheses

2. * ,**, ***and indicate significance at 10%, 5% , and 1% levels, respectively.

3. In the bottom line of the table, chi-square values are presented, and their p-values are shown in parentheses

Appendix C. Solution of optimal consumption and assets

The utility function and lifetime budget constraints are shown as follows.

$$U=\ln C_1^* + \frac{q_2}{(1+\rho)} \ln C_2^* \quad (3.1)$$

$$A_1=(1+r)A_0+Y_1 - C_1 \quad (3.2)$$

$$0 = (1+r)A_1+Y_2 - C_2 \quad (3.3)$$

The Lagrangian function is written as

$$L= \ln C_1^*+\frac{q_2}{(1+\rho)}\ln C_2^*+\lambda \{(1+r)^2 A_0 + (1+r)(Y_1 - C_1) + Y_2 - C_2\} \quad (3.10)$$

Solving the first-order conditions and using budget constraints, optimal consumption is obtained. The optimal consumptions C_1^* and C_2^* are shown as follows.

$$C_1^* = \frac{(1+\rho)(1+r)}{1+\rho+q_2} A_0 + \frac{1+\rho}{1+\rho+q_2} Y_1 + \frac{1+\rho}{(1+r)(1+\rho+q_2)} Y_2 \quad (3.11)$$

$$C_2^* = \frac{(1+r)^2}{1+\rho+q_2} A_0 + \frac{(1+r)}{1+\rho+q_2} Y_1 + \frac{1}{1+\rho+q_2} Y_2 \quad (3.12)$$

Substituting C_1^* and C_2^* into budget constraints, the assets of the first period are obtained:

$$A_1 = \frac{q_2(1+r)}{1+\rho+q_2} A_0 + \frac{q_2}{1+\rho+q_2} Y_1 - \frac{1+\rho}{(1+r)(1+\rho+q_2)} Y_2 \quad (3.4)$$

Appendix D. Solution of optimal consumption and assets (including the bequest motive)

The Lagrangian function is shown as follows.

$$L=\ln C_1^* + \frac{q_2}{(1+\rho)}\ln C_2^* + (1-q_2)\, k \ln A_1^* + \frac{q_2}{(1+\rho)} k \ln A_2^* + \lambda_1\{(1+r)\, A_0 + Y_1 - C_1 - A_1\} + \lambda_2\{(1+r)^2 A_0 + (1+r)(Y_1 - C_1) + Y_2 - C_2 - A_2\} \quad (3.13)$$

where λ_1 and λ_2 are Lagrangian multipliers, and k refers to the bequest motive.

The first-order condition is shown as

$$\frac{1}{C_1} = \lambda_1 + (1+r)\, \lambda_2 \quad (3.14)$$

$$\frac{q_2}{(1+\rho)}\frac{1}{C_2} = \lambda_2 \quad (3.15)$$

$$(1 - q_2)\, k\, \frac{1}{A_1} = \lambda_1 \quad (3.16)$$

$$\frac{q_2}{(1+\rho)}\, k\, \frac{1}{A_2} = \lambda_2 \quad (3.17)$$

From the budget constraint and first order condition, the following equation is obtained.

$$\frac{1}{A_1} = \frac{1}{(1-q_2)k}\,\frac{1}{(1+r)\,A_0 + Y_1 - A_1} - \frac{q_2(1+r)}{(1-q_2)(1+\rho)}\,\frac{1+k}{k}\,\frac{1}{(1+r)\,A_1 + Y_2} \quad (3.9)$$

Taking the derivative of $\frac{1}{A_1}$, following equation is obtained.

$$\frac{dA_1}{dk} = \frac{\frac{1}{(1-q_2)k^2}\left\{\frac{1}{(1+r)\,A_0 + Y_1 - A_1} - \frac{q_2(1+r)}{(1+\rho)((1+r)\,A_1 + Y_2)}\right\}}{\frac{1}{A_1^{\,2}} + \frac{1}{(1-q_2)k\,\{(1+r)\,A_0 + Y_1 - A_1\}^2} + \frac{1+k}{k}\frac{q_2(1+r)^2}{(1-q_2)(1+\rho)\{(1+r)\,A_1 + Y_2\}^2}}$$

Here, the denominator is positive, but ambiguous. Therefore, $\frac{dA_1}{dk} > 0$ if

$\frac{1}{(1+r)\,A_0 + Y_1 - A_1} - \frac{q_2(1+r)}{(1+\rho)((1+r)\,A_1 + Y_2)} > 0$, or, $q_2 < \frac{(1+\rho)}{(1+r)}\frac{C_2 + A_2}{C_1}$.

Appendix E Sample countries

Here is the list of the countries included in the analysis:

Albania, Algeria, Argentina, Austria, Bahrain, Bangladesh, Barbados, Belgium, Benin, Botswana, Brazil, Bulgaria, Burundi, Cameroon, Canada, Central African Republic, Chile, China, Colombia, Congo, Dem. Rep., Congo, Rep., Costa Rica, Cote d'Ivoire, Cuba, Cyprus, Czech Republic, Denmark, Ecuador, Egypt, El Salvador, Estonia, Fiji, Finland, France, Gabon, Greece, Guatemala, Honduras, Hong Kong, Hungary, Iceland, Indonesia, Iraq, Ireland, Israel, Italy, Japan, Jordan, Kenya, Korea, Rep. Kuwait, Kyrgyz Republic, Lao PDR, Latvia, Lesotho, Liberia, Lithuania, Luxembourg, Malawi, Malaysia, Mali, Malta, Mauritania, Mauritius, Mexico, Moldova, Mongolia, Morocco, Nepal, Netherlands, New Zealand, Nicaragua, Niger, Norway, Pakistan, Panama, Paraguay, Peru, Philippines, Poland, Portugal, Qatar, Romania, Russian Federation, Rwanda, Senegal, Sierra Leone, Singapore, Slovenia, Spain, Swaziland, Sweden, Switzerland, Thailand, Togo, Tunisia, Turkey, Uganda, Ukraine, United Arab Emirates, United Kingdom, United States, Venezuela, Zambia, and Zimbabwe

The list of OECD countries is as follows:

Austria, Belgium, Canada, Chile, Czech Republic, Denmark, Finland, France, Greece, Hungary, Iceland, Ireland, Italy, Japan, Korea, Rep., Luxembourg, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Spain, Sweden, Switzerland, Turkey, United Kingdom, and United States

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