

Aging and Asset Demand in Korea

Chang-Gyun Park[†]

2005. 3. 7.

The paper examines the effect of aging on demand for various categories of assets and projects the long-term trend in demand for assets based on the estimated age effect and official population projection for the next 50 years. It is now a well-known assertion that changes in demographic structure convoluted with life-cycle pattern of individual saving decision may result in significant fluctuations in financial market. Aging is surely a major change in demographic structure. The main findings of the analyses are that demands for both total and financial assets are expected to increase continuously until 2030 and the proportion of risky assets in total financial portfolio is expected to decrease continuously again until 2030. Though our analyses produce a reasonable time series patterns of demand for assets, interpretation should be done with some caution. The panel data used in the analysis shows somewhat characteristic patterns different from those found in other countries such as the United States. The most striking feature is that the accumulation of financial assets remains at a remarkably low level in all age groups. Another notable trait of asset holdings in Korea is that the proportion of stock holding individuals is very low and shows the usual inverted U-shape except for a huge jump for the very old (70 or older). If we were to attribute those abnormal patterns of asset holding to backwardness of financial market, projection of future demand for assets should be performed cautiously not to jump at a hurried conclusion entirely based on historic data. The policy implications, therefore, should be drawn based on characteristic feature of asset market in Korea. Low proportion of financial assets in total assets means high proportion of real assets, especially residential properties. While one can explain abnormally low accumulation of financial assets by high housing price and lack of long-term mortgage system, the estimated age profile of asset holdings does not seem to fit into typical age profile found in other countries. Various policy measures should be taken to help individuals transform into more balanced portfolios based on stability and liquidity to assure adequate cash flow to finance old-age consumption.

[†] Fellow, Department of Macroeconomic and Financial Policies, Korea Development Institute,
E-mail: cp19@kdi.re.kr

1. Introduction

The rise in income accompanying economic development and advances in medical technology have led to a dramatic drop in the death rate and an increase in average life expectancy in most countries. As a result, many have become aged societies. Korea is no exception. In 2000, Korea has already entered the phase of being an aging society. By 2019, Korea is expected to become an aged society, and a super aged society by 2026.

It has been shown by European countries and Japan, which became aged society before Korea, that aging brings about important changes in many aspects of economy such as growth, labor, and public finance. International organizations led by the OECD and the World Bank are researching ways to address its impact, having already made significant progress¹. There also has been much discussion to address the impact of aging on financial market involving public and private pensions. In the case of public pensions, research has been focused on long-term solvency and pension reform. Private pensions grow rapidly during the early stages of aging, so research has been focused on improving the efficiency and transparency of the capital market where private pensions are invested in (OECD[2000]).

Though aging significantly impacts the structure of the population, it is quite surprising to find that there has been little research conducted on the impact of demographic change on the asset market. The US and European countries experienced a slow aging process over a long period of time, allowing them to gradually implement measures for aged society. On the other hand, Korea is experiencing unprecedented rapid aging process. Yet, research is lacking on the asset market, on which the change in demographic structure is sure to make a large impact. This study attempts to help fill this gap by looking at the future development of asset market in Korea in the age of rapidly changing population structure².

The most important implication of the life cycle income hypothesis is that a person's position in the life cycle is closely related to his savings and asset holding. Irregular pattern of income forces economic agents who prefer smooth consumption to transfer income across time. Thus, people in early stage of life cycle save income earned during working ages to accumulate various assets, financial or physical, later liquidating them to finance consumption after retirement. In this way, people attempt to maximize utility over their lifetime. Lifetime utility can be maximized by equating appropriately discounted expectations of marginal utility across time. The life cycle income hypothesis developed by Modigliani and Ando [1963] and other related studies have made

¹ See OECD [1998, 2000] and World Bank [1994].

² Kim [2002] discusses the recent trends in asset holding by Korean households. The paper, however, does not discuss issues related to aging and demographic change.

continuous theoretical and empirical progress, and has now become one of the most widely accepted theories in economics³.

If the life cycle income hypothesis for an individual is extended to the entire society, it can be expected that both aggregate demand for assets and the price of assets should be intricately related to its demographic structure. The progression of aging reduces the number of workers that accumulate assets, while the number of elderly who are using their assets for consumption increases. This leads to a drop in relative demand for assets, and ultimately, a fall in total quantity of assets held and assets price. Moreover, the elderly are, on average, known to be more averse to risk than the others, so the proportion of risky assets in their portfolios will fall, which has a profound implication on the overall composition of asset portfolio.

The paper attempts to project the future path of demand for various financial assets and riskiness of society's overall portfolio in the context of Korea's rapidly aging society.

In section 2, we briefly discuss the theoretical and empirical researches done on the relationship between demographic structure and asset market. Section 3 starts with a detailed explanation on Poterba [2001]'s empirical strategy to decompose individual asset holding into age effect and cohort effect and to separately identify the effect of demographic change on the asset market. Afterwards, the Korea Household Panel Study (KHPS), also known as Daewoo Panel, and the Korea National Statistical Office's official population projections are employed to predict demand for various assets in Korea.

2. Literature

The interest in relation between demographic structure and asset demand was initiated not by academic literature but by market experts⁴. In identifying the cause of the US's unprecedented economic boom in the early 1990's, they paid attention to the fact that it was the period in which the baby boomers born after World War II in their 50's and 60's were entering active stage of saving in life cycle. The baby boomer generation was vastly larger than the previous generation, and had entered their prime saving age in the early 1990's. As a result, the demand for various assets, stocks in particular, tremendously increased, which naturally explains the stock market boom in the early 1990's. It is difficult to admit the validity of explanation offered by the market experts in the sense that they ignore everyday staple in modern financial economics such as future payoffs and stochastic discount factor in determining the value of an asset and totally depend on demand and supply framework. However, the explanation has been well accepted and enjoyed a wide range of support among market participants. The actual motive behind emphasizing the connection between the

³ For an excellent and detailed exposition of intertemporal utility optimization, see Deaton [1992].

⁴ For example, Sterling and Waite [1998] and Dent [1998].

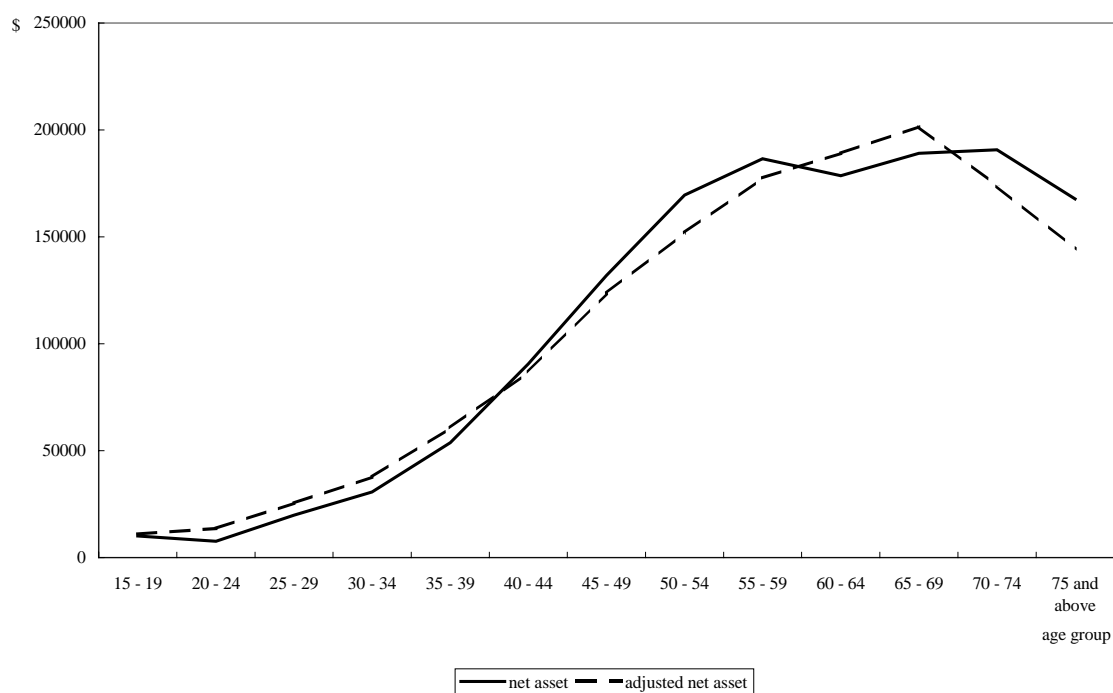
demographic structure and asset market was to promote so-called Meltdown Hypothesis claiming that a market crash would be brought about by the withdrawal of capital from the stock market as the baby boomers begin to liquidate their assets to finance their consumption. The Meltdown Hypothesis offers a clear hypothesis on the future path of asset demand and price. One can theorize that as aging progresses, it will cause the number of those accumulating assets to be gradually outnumbered by those liquidating their assets, bringing about a decrease in asset demand and price in the long run.

The above claim has been accepted by many researchers in academic field, and produced many ongoing researches. The research attempting to directly link up changes in the asset market to changes in population structure can be divided into two strands of research programs.

The first group actively accepts the conjecture of the market experts and emphasizes the direct link between the demographic structure and asset market. Studies such as Yoo [1994a], Abel [1999, 2001], Brooks [2000] set the mold for such theories. They use the overlapping generation model to embed the effect of changes in the demographic structure on the asset market into the framework of general equilibrium model. Yoo [1994a] calibrates the effect of the retirement of baby boomers on the price and demand of assets by utilizing Auerbach-Kotlikoff type overlapping generation model where many generations in different stages of life cycle coexist at all times. The results of the model confirm the previous conjecture that an increase in the youth population causes a rise in asset demand and price, and their retirement in turn brings a decrease in demand and price. The model shows that when the supply of assets (capital) is elastic rather than inelastic, changes in the demographic structure have a weaker effect on the price and demand of assets. Abel [1999] uses an analytic approach to analyze the demographic structure and asset market relationship. The most important finding of the study is that while a temporary increase in population strengthens the demand for asset and exerts an upward pressure on price, it has a mean reverting tendency leading the economy to previous state. As with Yoo [1994a], this study shows the theoretical validity of the market experts' conjecture, though through different course of events. Brooks [2000] conducts a simulation study in which economic agents are populated in four-periods overlapping generation model with risky assets (stocks) and safe assets (bonds). The model simulates the effect of changes in the demographic structure had on the price and relative demand of the two assets along with the size of risk premium. Brooks [2000] brings a population increase into the model by assuming population increase rate higher than normal is realized for two successive periods. The results show that the baby boomer's entrance into the labor market bring about an increase in demand and price for both risky and safe assets. On the other hand, when the baby boomers retire, the price and demand for both assets fall. These results are essentially the same as those in Yoo [1994a] or Abel [1999]. However, by distinguishing between two different types of assets, Brooks (2000) finds that the risk premium drops rapidly when the baby boomers enter the market and rise again as they retire.

The other strand of researches on the relation between the demographic structure and asset market focuses on analyzing micro data at the individual or household level to show the relation between age and asset holdings. Yoo [1994b], Poterba and Samwick [1997], Bertantino [1998] and Poterba [2001] are examples of such studies. The main result of these empirical studies mostly supports the above theoretical studies, but Poterba [2001] merits a special attention as it offers very interesting empirical evidence on the relation between the demographic structure and asset. Utilizing data from the Survey of Consumer Finances, Poterba [2001] showed that an individual's asset holdings followed the hump shape predicted by the Permanent Income-Life Cycle Income hypothesis. However, the decumulating of assets after the retirement, typically 65 in US, was too slow to be justified by precautionary savings or bequest motive. Pointing out extremely gradual slope of the age-asset holding curve, Poterba [2001] expressed a skeptical view on the possibility of the baby boomer's retirement causing a plunge in asset prices. [Figure 1] shows net asset holdings by age group calculated from the Survey of Consumer Finances in 1995. The solid line shows the average net asset holdings by age group, and the dotted line shows the adjusted average asset holdings, fixed to various problems discussed in the next section.

[Figure 1] Average net asset holdings by age group in the USA



Note: 1) Net asset = (net financial asset + estimated housing price) – (outstanding mortgage balance)

2) Adjusted net asset is net asset holding after controlling for cohort effect. For further detail, refer to the discussion in section 3 or Poterba[2001].

Source: Poterba[2001]

Most noticeable feature in [Figure 1] is that there is a small but steady increase in asset holdings even after the generally recognized retirement age of 65. It is unsure whether this continued accumulation is from interest or capital income of existing assets, or from continued participation in the labor market. Regardless, the amount is too great to speculate that it is reserved savings to finance future consumption by an economic agent with remaining life expectancy of 20 years or less. Poterba [2001] hypothesizes that the reason for the de-cumulation of assets being slower than the standard models may be found in the bequest motive. If the progeny's utility is included in one's own utility function, the motive to leave an inheritance to future generations helps greatly to explain the strangely large amount of accumulated assets after the retirement. However, there are many empirical and theoretical evidences that challenge the efforts to use the bequest motive in explaining the high level of asset accumulation by the elderly. On the empirical side, there is insufficient evidence to support that the bequest motive is strong enough to cause the observed excessive asset accumulation. Theoretically, Abel [2001] shows that even if the parameters for the utility function and production function are configured to incorporate bequest motives into the model explicitly, it is not necessary that the retirement of baby boomers or aging society result in a drop in asset demand. Other attempts to explain high asset holdings by the elderly include savings from precautionary motives to cope with uncertainty about remaining life expectancy or medical costs.

Up to now, we have mostly focused on changes in the demographic structure and its impacts on aggregate asset demand and return, without much attention being given to the relative differences in asset demands and rates of returns across different types of assets in terms of riskiness. However, it is not difficult to find researches studying the relation between age profile and riskiness of portfolios. Samuelson [1989, 1990] was able to derive a relation between age profile and the proportion of risky assets in a portfolio by imposing some restrictions on utility function and distribution of asset returns. Bakshi and Chen [1994] propose the utility function in (1) which specify the degree of risk aversion to depend on age. This specification of utility function in (1) allows a natural correspondence between age profile and optimal portfolio choice.

$$U(C_t, M_t) = \frac{C_t^{1-\gamma-\lambda M_t}}{1-\gamma-\lambda M_t} \quad (1)$$

where C_t is consumption, M_t is age and $(\gamma+\lambda M_t)$ is the coefficient of relative risk aversion, with older economic agents being more risk averse, thus, favoring safer assets over risky ones. Unfortunately, equation (1) imposes an *ad hoc* restriction on relation between age and average riskiness of assets held rather than explains the phenomenon with a sound economic reasoning.

Many efforts have been taken to provide a theoretical foundation to (1). If an individual can freely change his supply of labor depending on asset returns [Bodie, Merton, and Samuelson (1992)], or the objective of asset accumulation is not just for consumption smoothing but as precautionary measures [Kimball (1993)], or the riskiness of non financial assets such as real estate, human capital increases

with age, a rational economic agent will lower the ratio of risky assets in his portfolio. Extending theoretical results at the individual level to the aggregate one, we can expect that projected change in the demographic structure may result in a less risky aggregate portfolio.

3. Empirical Analysis

3.1. Empirical model and data: Poterba [2001]'s projected asset demand

Studies that shed some light on the link between population structure and asset holdings began to emerge in the early 90's when surveys such as the USA's Survey of Consumer Finances or the UK's Household Expenditure Survey were conducted on regular basis. Early researches mainly consisted of cross-sectional analysis of the correspondence between age profile and asset holdings. As mentioned before, Yoo [1994b] and Bergantini [1998] are examples. However, as Shorrocks [1975] points out, asset holding by an individual is determined by not only age profile but also by the economic conditions he has been experienced. This limits the usefulness of cross-sectional analysis. An individual will have higher incomes at the peak than at the trough, which makes it likely that he will hold more assets out of income obtained at the peak assuming smooth consumption path is preferred. This kind of time effect is not just temporary. It also leaves permanent effects on the asset holdings of all cohort members. For example, the assets held by an individual at 40 years old can be separated into two categories: first, assets saved to pursue smooth consumption based on the fact that the individual is now 40 years old and second, assets accumulated based on a series of shocks occurred to income and consumption until the individual reaches 40. The former is called age effect and the latter cohort effect in literature. Therefore, it is a very important to separate an individual's accumulated assets by the age effect and cohort effect and to project asset demand based only on age effect since we are interested in the relation between demographic structure and asset holdings. [Table 1] displays the average asset holdings by age group for 1995 and 1998 constructed from the Daewoo Panel. The average total assets of a 34 year old in 1995 was about 24,005,600 won, and the average for a 37 year old was 30,524,500 won. One could expect that the 34 year old in 1995 would have an average of 30,520,000 won in total assets in 3 years. However, a 37 year old in 1998 ends up with average asset holding of 26,727,600 won. This huge difference could be simply due to statistical noise, but it is more likely to indicate that there exists a serious identification problem in a study with cross sectional data as it cannot distinguish between the cohort and age effects in asset holdings.

Poterba [2001] suggested the following specification to solve the identification problem when repeated cross-sectional or panel data set is available.

$$A_{at} = \delta_a + \beta_t + \gamma_{t-a} \quad (2)$$

[Table 1] Average asset holdings by age group

(unit: 10,000 Won)

	1995		1998	
	Total Assets	Financial Assets	Total Assets	Financial Assets
15 – 19	62.13	13.85	70.73	11.05
20 – 24	439.48	78.84	327.37	71.21
25 – 29	1169.29	387.03	1169.40	237.77
30 – 34	2400.56	964.16	1513.60	635.61
35 – 39	3052.45	1056.38	2672.76	717.46
40 – 44	3673.99	944.54	3550.01	749.98
45 – 49	3923.63	679.84	3629.59	782.76
50 – 54	3377.74	678.74	3219.70	553.29
55 – 59	2813.68	419.25	4346.70	529.45
60 – 64	2591.54	501.25	2825.57	421.17
65 – 69	2972.32	398.41	3059.95	312.35
70 – 74	2782.13	211.23	2240.80	168.86
Above 75	1460.94	187.64	1682.47	169.66
overall	1742.56	423.35	1978.54	374.29

Note: Refer to the next section for more detailed information on the definition of total assets and financial assets
 Source: Reconstructed statistics from the Daewoo Panel in 1995 and 1998.

where A_{at} is the amount of assets held by an individual of age a in year t , δ_a is the common factor applied to all individual of age a irrespective of time (age effect), β_t is the common factor applied to all individual living in year t irrespective of age (time effect), and finally γ_{t-a} is the accumulated time effect shared by all individuals experiencing the same economic shocks (cohort effect). Examining equation (2), one can immediately recognize that it is impossible to identify the three parameters separately. The cohort effect is a linear combination of the age effect and time effect. However, if repeated cross sectional or panel data is available, we can separate two of the three effects by imposing some restrictions on (2).

Poterba [2001] proposed that we take the strategy to give up identification of time effect by treating the effect as a stochastic error and separately identify age and cohort effect according to the following specification.

$$A_{ht}^i = \sum_{j=1}^m \delta_j^i AGE_{jht} + \sum_{k=1}^l \gamma_k^i COHORT_{kht} + \varepsilon_{ht}^i \quad (3)$$

where A_{ht}^i is the amount of asset i held by individual h at time t , AGE_{jht} is the dummy for age group j to which individual h belongs at time t , $COHORT_{kht}$ is the dummy for cohort k to which individual h belongs at time t , and ε_{ht}^i is the statistical error term with mean zero and a finite

variance. In addition, δ^i is the parameter vector of demand for asset i due to age effect and γ^i due to cohort effect. All explanatory variables in (3) consist of dummy variables. Hence, the absence of the constant term in (3) implies that the estimated coefficient on each explanatory variable is interpreted as the average amount of asset held individuals belonging to each age and cohort group. The average amount of asset i held by an individual belonging to age group j and cohort group k is given by $(\delta_j^i + \gamma_k^i)$.

After separating cohort effect from the observed asset holdings, one can examine the true relation between demographic structure and asset demand by combining the estimated coefficients from (3) and a certain scenario on population change.

$$PAD_t^i = \sum_{j=1}^m \hat{\delta}_j^i P_{jt} \quad (4)$$

where PAD_t^i is the projected demand for asset i at time t , $\hat{\delta}_j^i$ is the average demand for asset i due to age effect of age group j and P_{jt} is the projected size of age group j at time t .

We employed annual data from 1994 to 1998 extracted from Daewoo Panel to estimate age effects in (3). Subsequently, to derive projected asset demand from (4), we combine the estimated age effects and population projection announced by Korea National Statistical Office.

The Daewoo Panel has relatively detailed information on family and individual income, spending, assets and debt. However, there are slight changes in categorization and definition by year, and its classification system does not properly serve for the purpose of this study. Therefore, we use a different classification system defined in [Table 2].

<Table 2> Definition of variables

Variable	Items in the Daewoo Panel study
Deposit	Demand deposit and savings deposit
Insurance	Monthly payments × number of payments
Stock	Value of total stock held
Bonds	Government bonds and corporate bonds
Financial Assets	Savings, insurance, Stock, Bonds, and others
Physical Assets	Estimated value of house and other real estate
Total Assets	Financial Assets and tangible assets
Debt	Debt from various sources
Net Financial Assets	Financial asset – debt
Net assets	Total asset – debt

Financial assets, total assets, and net financial assets as defined in [Table 2] will be main focus of the analysis. All variables were re-nominated in year 2000 price to account for inflation effect.

As mentioned before, the study requires information regarding financial assets, tangible assets, and debt at individual level. Therefore, household information must be converted into individual information. The reason this study did not use the individual information included in the Daewoo Panel report and instead converted the household information into individual information is because individual data set simply missed too much information on asset holdings to be a reliable source. Another serious problem with individual data in the Daewoo Panel study is that there exists a high probability of reporting zero asset holdings by housewives. In cases of households consisted of married couple, decisions regarding asset holding should be considered as a joint decision, rather than an individual one. Thus, we take a different route to obtain information on asset holdings at individual level by dividing data on households under specific rules.

We assign the assets and debt of a household to its members with income according to (5). This was done under the assumption that those directly involved in the accumulation of assets and debt would be those earning an income. Spouses were treated equally to the head of the household even if they did not have income.

$$A_{P_1} = A_H \times \frac{AGE_{P_1}}{AGE_H} \quad (5)$$

where A_{P_1} is asset or debt assigned to household member P_1 , A_H is asset or debt held by household, AGE_{P_1} is the age of household member P_1 , AGE_H is the sum of ages of all household members with income. The descriptive statistics of individual asset holdings calculated by (5) are reported in the Appendix.

[Table 3] shows official statistics on Korea's population structure from 1980 to 2050 projected by the Korea Statistical Office. Korea's current population is approximately 47 million. This will steadily rise and peak in 2025 at 51 million, and then slowly decline to mid 1990's level at 44,300,000 in 2050. A low birth rate coupled with an increase in the elderly population will cause the current median age of 33 to rise to 40 in 2015, then reaching 50 in 2037, and finally 53.8 in 2050. The rapid aging will result in a sharp rise in burden of supporting the elderly. Currently at 10%, it will rise to 20% in 2020, then to 30% in 2027, until finally reaching 62.5% in 2050. The burden to support economically non-active population will remain steady at 40% until 2020 with a rapid decrease in the proportion under the age of 14. Afterwards, it will rise quickly to 60% in 2034 and 80% around 2050.

14 age groups and 17 cohort groups are specified. Age group 1 represents ages 14 and under, and groups are divided in 5 year blocks from there. Group 13 represents ages 70-74, and the final

[Table 3] Change in demographic structure

Year	Population	Under 14 (%)	Over 65 (%)	Youth support burden	Elderly support burden	Aging index	Median Age	Mean Age
1980	38123775	34	3.8	54.6	6.1	11.2	21.8	25.9
1990	42869283	25.6	5.1	36.9	7.4	20	27	29.5
2000	47008111	21.1	7.2	29.4	10.1	34.3	31.8	33.1
2010	49594482	17.2	10.7	23.9	14.8	62	37.5	37.5
2020	50650260	13.9	15.1	19.6	21.3	109	42.8	41.9
2030	50296133	12.4	23.1	19.1	35.7	186.6	47.7	45.6
2040	48204474	11.5	30.1	19.6	51.6	263.2	50.9	48.8
2050	44336997	10.5	34.4	19	62.5	328.4	53.8	51

Note: 1) youth support burden = [(population aged 14 and below) / (population aged between 15 and 64)]*100
 2) elderly support burden = [(population aged 65 and above) / (population aged between 15 and 64)]*100
 3) aging index = [(population aged 65 and above) / (population aged 14 and below)]*100

Source: Korea office of statistical studies homepage, <http://kosis.nso.go.kr/>

group represents ages 75 and above. The population born between 1901 and 1905 belongs to cohort 1, and new cohorts are defined in five-year blocks. Cohort 16 represents the population born between 1976 and 1980, while the final cohort is the group born after 1981.

3.2. Empirical results and projected asset demand

1) Characteristics of asset holding patterns by age group

[Table 4] shows the simple results on average asset holdings by age group without considering separation of the age effect and cohort effect. The main characteristic in [Table 4] is that asset holdings by age groups closely follow the pattern predicted by the simple life-cycle model. As seen in [Figure 2], Korea's over 65 population de-cumulates assets far quicker than their US counterpart. Especially, the rapid decline in asset holdings for those aged 70 years and older is something to note. In the case of the US, there have been many attempts to explain why the elderly accumulate a large amount of assets that is hardly predicted by the simple life cycle model. There have been explanations that it is because of a need to leave an inheritance to children, or that it is a precautionary measure for medical costs etc. Poterba [2001] offers a viewpoint that the bequest motive and precautionary motive are not enough to explain the large assets holdings of the elderly. If such arguments are applied to Korea's asset accumulation patterns, the effect of the bequest motive or precautionary motive can be easily explained Korea's case.

[Table 4] Average asset and debt holdings by age group: 1997 Daewoo Panel

Age	Total Assets	Financial Assets	Debt	Net Assets	Net financial assets
15 – 19	54.59 (287.31)	7.74 (70.02)	4.57 (40.31)	50.02 (271.36)	3.17 (76.37)
20 – 24	583.93 (1428.04)	95.38 (268.28)	54.91 (199.00)	529.02 (1336.92)	40.47 (260.66)
25 – 29	1549.42 (2493.23)	301.51 (600.17)	160.76 (443.33)	1388.66 (2367.32)	140.75 (712.28)
30 – 34	2945.83 (3299.18)	1032.33 (1364.50)	271.11 (569.03)	2674.72 (3193.70)	761.22 (1400.40)
35 – 39	3868.14 (3810.85)	1164.46 (1408.94)	557.84 (995.51)	3310.30 (3638.66)	606.62 (1659.04)
40 – 44	5224.90 (7231.93)	1185.51 (1634.75)	661.35 (1476.43)	4563.54 (7138.16)	524.16 (2215.29)
45 – 49	5461.69 (6165.14)	1032.28 (1306.82)	627.58 (1266.93)	4834.11 (5828.74)	404.70 (1701.45)
50 – 54	4960.99 (5961.09)	775.25 (1852.05)	397.64 (752.17)	4563.35 (5796.91)	377.61 (1906.38)
55 – 59	4785.56 (6362.08)	573.36 (810.42)	562.44 (1193.80)	4223.12 (6130.93)	10.93 (1432.86)
60 – 64	4219.06 (5846.31)	539.47 (998.54)	384.95 (986.55)	3834.11 (5510.22)	154.52 (1249.80)
65 – 69	3726.89 (6139.39)	310.67 (885.71)	247.23 (907.61)	3479.66 (5616.07)	63.44 (1279.40)
70 – 74	3267.83 (5997.81)	246.25 (579.74)	202.96 (1027.28)	3064.87 (6099.95)	43.29 (1190.88)
75 and above	2437.48 (6941.76)	327.84 (2045.45)	94.93 (426.83)	2342.55 (6860.72)	232.91 (1985.86)
Overall	2562.73 (4934.05)	497.29 (1149.45)	270.80 (826.25)	2291.93 (4679.87)	226.49 (1290.10)

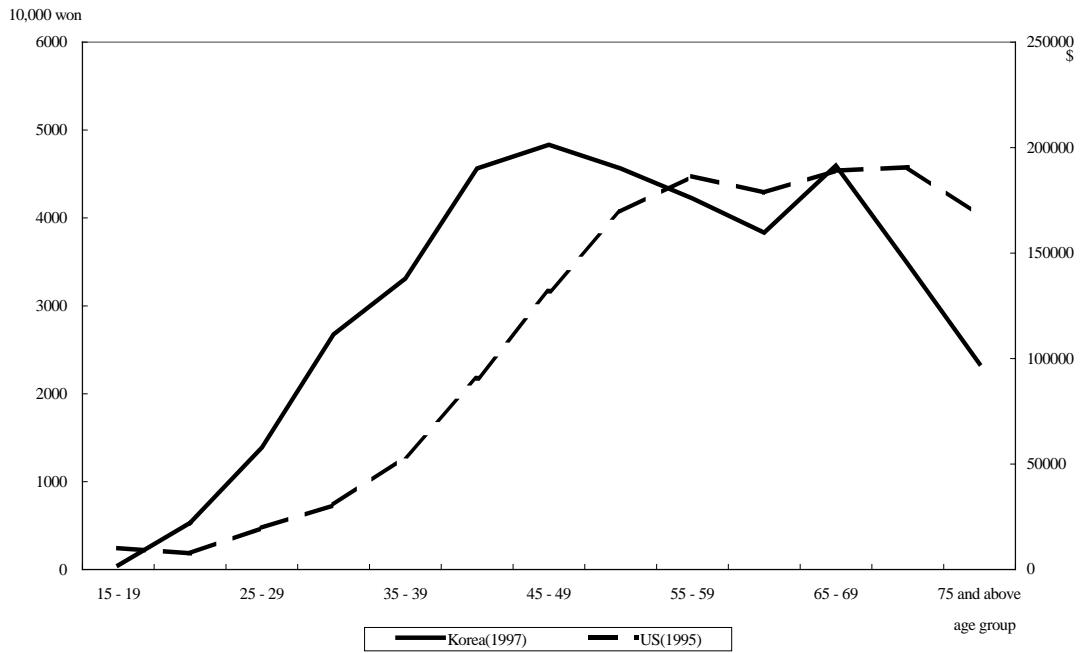
Note: 1) All numbers are in 10,000 won.

2) For definitions on various assets, refer to the previous section.

3) Numbers on parenthesis are standard deviation.

Second, Korea is differs from the US in that holdings of net financial assets begin to decline after peaking at 30-35 years of age. The difference can be explained as part of Korea's particular economic environment. Unlike the US, Korea has an underdeveloped mortgage system, even though there is a strong preference for home ownership. Individuals amass a great amount of financial assets through savings or bequest from relatives beginning in their late 20's to late 30's in order to purchase a home. Then, in their late 30's to early 40's they use their accumulated assets and money financed by short-term balloon mortgage to purchase a house. Thus, there is a steady rise in net financial assets after the age of 20, but a sharp decline after the late 30's. This pattern is easily visible in [Figure 3]. After declining in the late 30's, net financial assets turnaround to rise again in the early 60's. This phenomenon is to be caused by the retirement pay. In the US, the mortgage

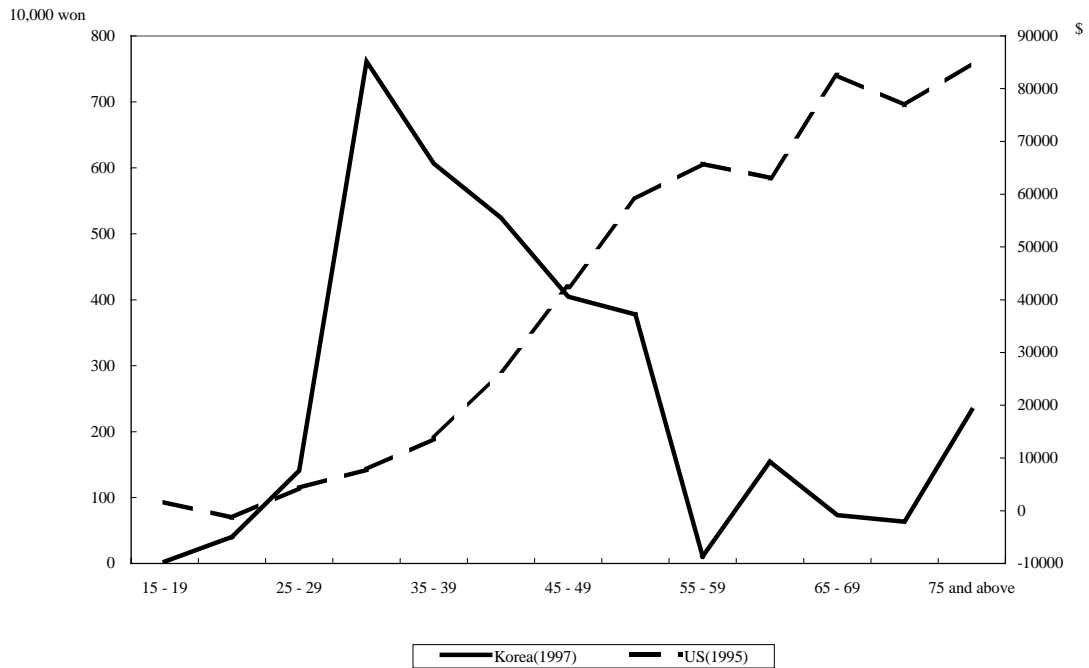
[Figure 2] Average net asset holdings by age group



Note: Net asset is the difference between total asset and debt.

Source: Korean statistics from Daewoo Panel (1997), US statistics from Survey of Consumer Finances (1995).

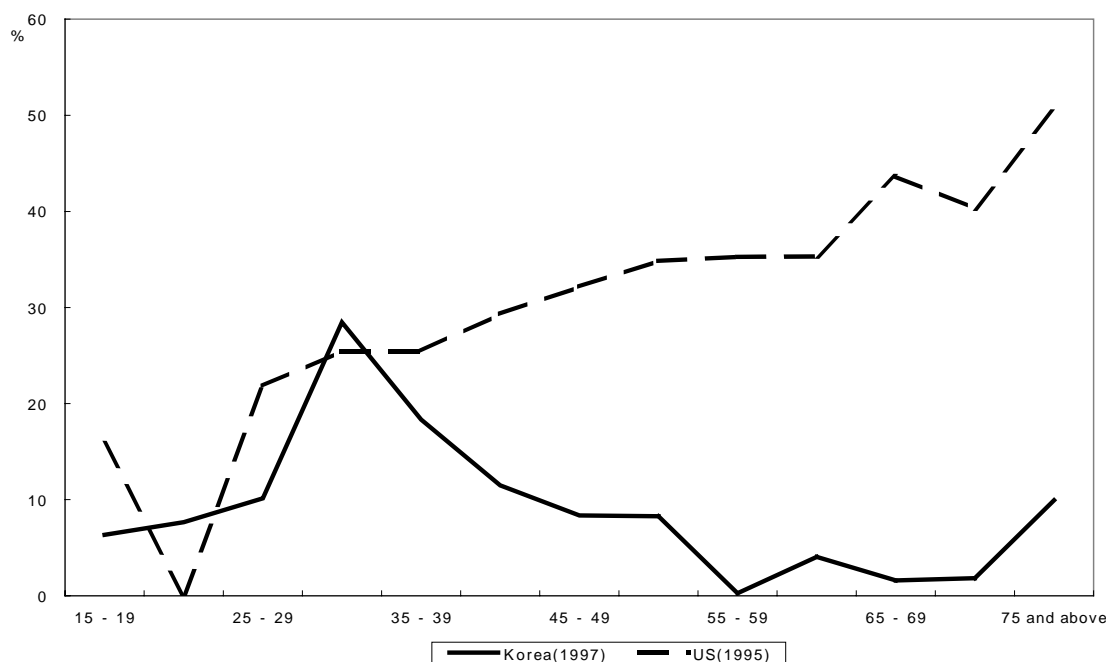
[Figure 3] Average net financial asset holdings by age group: Korea and US



Note: Net financial asset is the difference between total financial asset and debt.

Source: Korean statistics from Daewoo Panel (1997), US statistics from Survey of Consumer Finances (1995)

[Figure 4] Ratio of net financial asset holdings by age group: Korea and US



Note: Ratio of net financial asset is the ratio between net financial asset and net asset.

Source: Korean statistics from Daewoo Panel (1997), US statistics from Survey of Consumer Finances (1995)

system can be used to acquire a home with a relatively small amount of financial assets. Therefore, we can observe a steady rise in net financial assets without the sudden rise in financial debt stemming from

The third characteristic of asset accumulation path by Korean households is the small share of financial assets especially in old age groups. As seen in [Figure 4], net financial assets in Korea make up a similar portion of total net assets as in the US in early stage of life cycle. However the weight of net financial asset decreases as age increases, falling below 10% after 50's. The assets held by people over 60 consist mainly of physical assets that are most likely residential buildings.

If we conjecture the future state of asset market by taking into consideration these characteristics with Korea's rapidly progressing aging, re-aligning institutional arrangement in financial market to assure adequate cash flow for the elderly could be seen as major issue that need to be addressed sooner rather than later. The support given to the elderly mainly comes from family members and relatives, but this foundation is slowly corroding. Also, with the social safety net for the poor not functioning effectively, it is risky for the elderly to maintain a portfolio with overly heavy emphasis on illiquid residential buildings. It is difficult to explain the exact reason why physical assets comprise such a large proportion of the elderly's portfolios. However, we can deduce that extremely high housing prices compared to income and lack of a long-term mortgage system in Korea both play a part. A smooth transfer from physical assets to financial assets is important for not only

improving efficiency of resource allocation, but also securing smooth income stream for the elderly. The low proportion of financial assets in overall portfolio may simply reflect the fact that asset market in Korea is still underdeveloped compared to the US. If the same asset holding patterns persist with continued aging, the asset market may shrink drastically in the near future.

Since the characteristics of individual asset holdings discussed here have been based on one-year sample, one should be cautious to avoid the mistake of hasty generalization by acknowledging them as accurate snap shot of asset market in Korea or utilizing them to predict future development of asset market. Accurate description of the true picture calls for more cautious discussion based on distinguishing age effect from cohort effect in individual asset holdings.

2) Age effect versus cohort effect

[Table 5] and [Table 6] show the result of analysis using (4) to separate cohort effect from age effect in individual asset demand. On the other hand, [Figure 5] through [Figure 8] compares asset demand due to age effect and actual asset holdings in 1997⁵.

Those under the age of 50 in 1997 held more total and net assets than the age effect would predict, and those above that age held less total and net assets than the age effect would suggest. In other words, those born before 1950 are effected by a negative cohort effect in 1997, holding less total and net assets than required by the age effect. The demand for total and net assets due to the age effect resembles the US pattern in [Figure 1] rather than actually observed pattern. Taking just the age effect in consideration, the Korean elderly population holds much more assets than expected by the simple life-cycle model. However, the large proportion of physical assets in the portfolio tells us a different story. [Figure 8] shows that the elderly demand for net financial assets due to age effect matches the actual holdings quite closely. So as seen in [Figure 5] or [Figure 6], the slow decrease in asset demand due to age effect in the elderly reflects the high proportion of physical assets in their portfolios, and that these assets are not easily transferred into financial assets even near death. It is notable that the negative cohort effect caused actual holdings of financial assets to be lower than required by age effect for an individual aged 55 in 1997, later the same phenomenon is observed for total or net assets. Compared to other categories of assets, net financial assets are accumulated much faster than predicted by age effect. However after age 40, there occurs a large change in the asset holding pattern as asset demand due to age effect drops below actual asset holdings. The lack of a developed mortgage system may be why the pattern of net financial asset holdings resembles [Figure 8]. In the absence of a well-functioning mortgage market, the main route through which housing is obtained is a continuous accumulation of financial assets beginning in the late 20's to early 40's. This is in most of the cases accompanied by a supplementary loan with the house as collateral when

[Table 5] Asset and debt holdings by age effect

Age group	Total assets	Financial assets	Debt	Net assets	Net financial asset
15 – 19	43.49 (165.55)	2.96 (57.35)	1.47 (175.35)	40.53 (230.75)	1.49 (179.78)
20 – 24	192.99 (231.38)	42.84 (80.16)	29.40 (245.09)	163.59 (322.51)	13.44 (251.28)
25 – 29	757.78 (276.64)	152.98 (95.83)	86.28 (293.03)	671.50 (385.60)	66.70 (300.43)
30 – 34	1926.04 (341.44)	633.64 (118.28)	218.05 (361.67)	1707.98 (475.91)	415.59 (370.80)
35 – 39	2857.15 (367.11)	691.36 (127.17)	153.80 (388.85)	2703.35 (511.69)	537.56 (398.67)
40 – 44	4078.00 (390.82)	761.75 (135.39)	97.54 (413.97)	3980.45 (544.74)	664.20 (424.42)
45 – 49	4824.54 (423.45)	752.18 (146.69)	172.25 (448.54)	4652.29 (590.23)	579.94 (459.87)
50 – 54	5397.65 (462.63)	679.92 (160.27)	240.64 (490.04)	5157.00 (644.84)	439.28 (502.42)
55 – 59	7187.30 (496.12)	722.57 (171.87)	378.92 (525.51)	6808.38 (691.52)	343.65 (538.78)
60 – 64	7156.46 (524.57)	780.30 (181.72)	686.03 (555.64)	6470.43 (731.17)	94.27 (569.68)
65 – 69	7722.40 (553.21)	755.71 (191.65)	618.14 (585.99)	7104.26 (771.10)	137.57 (600.79)
70 – 74	6904.55 (518.08)	574.57 (174.19)	574.23 (522.34)	6330.32 (700.71)	0.34 (535.17)
75 and above	6083.53 (635.32)	629.78 (220.09)	447.25 (672.96)	5636.28 (885.53)	182.53 (689.95)
Sample size	38873	38873	38873	38873	38873
R^2	0.3154	0.1625	0.0089	0.1509	0.0027

Note: The numbers in parentheses are standard errors.

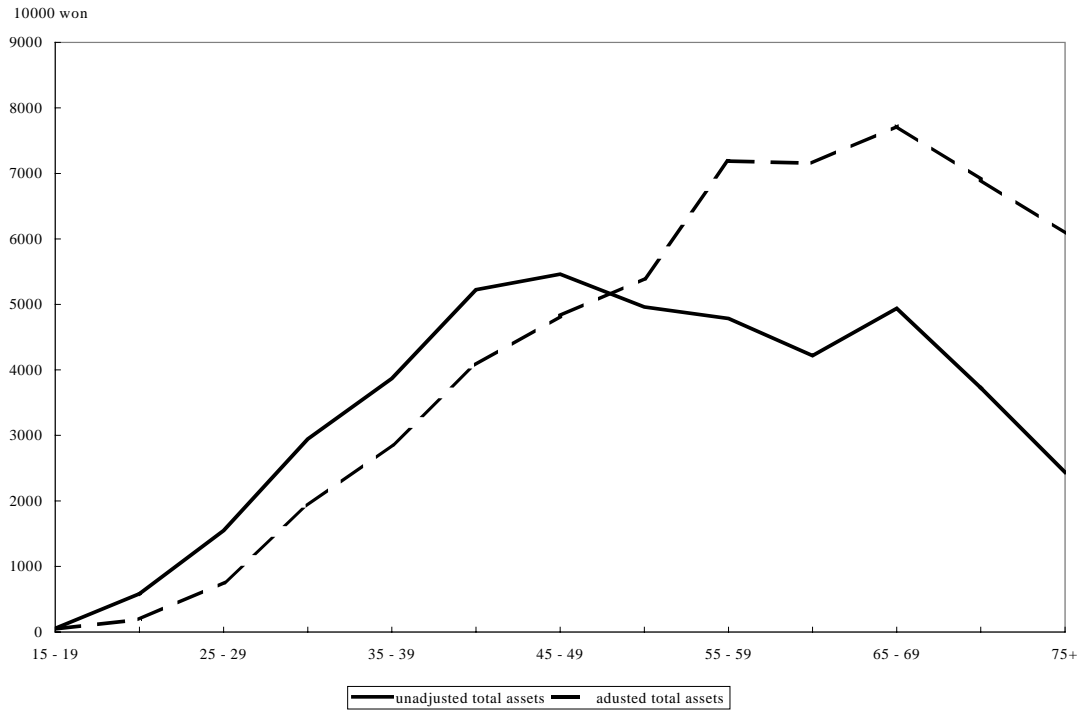
⁵ This implies that we choose the year 1997 as comparison group.

[Table 6] Asset and debt holdings by cohort effect

Birth year	Total assets	Financial assets	Debt	Net assets	Net financial asset
1905 and before	-6009.31 (926.21)	-629.19 (320.86)	-446.56 (981.09)	-5562.75 (1291.00)	-182.63 (1005.86)
1906 – 1910	-5347.01 (727.51)	-602.90 (252.02)	-382.68 (770.61)	-4964.33 (1014.04)	-220.22 (790.07)
1911 – 1915	-4118.31 (676.13)	-457.59 (234.23)	-411.42 (716.18)	-3706.89 (942.42)	-46.17 (734.27)
1916 – 1920	-3695.27 (654.57)	-303.09 (226.76)	-350.03 (693.35)	-3345.24 (912.37)	46.94 (710.86)
1921 – 1925	-3750.74 (599.13)	-301.90 (207.55)	-345.87 (634.62)	-3404.87 (835.09)	43.97 (650.65)
1926 – 1930	-3582.95 (559.69)	-340.81 (193.89)	-367.21 (592.85)	-3215.74 (780.12)	26.40 (607.82)
1931 – 1935	-3634.91 (530.07)	-329.69 (183.63)	-295.11 (561.47)	-3339.81 (738.83)	-34.59 (575.65)
1936 – 1940	-3440.34 (501.77)	-105.36 (173.82)	50.67 (531.50)	-3491.01 (699.39)	-156.03 (544.92)
1941 – 1945	-1208.57 (470.29)	16.23 (162.92)	139.68 (498.16)	-1348.25 (655.52)	-123.45 (510.74)
1946 – 1950	-525.29 (430.71)	69.81 (149.21)	305.20 (456.23)	-830.49 (600.34)	-235.39 (467.75)
1951 – 1955	315.83 (397.49)	272.01 (137.70)	574.65 (421.04)	-258.82 (554.05)	-302.64 (431.68)
1956 – 1960	671.15 (371.16)	442.69 (128.58)	628.86 (393.15)	42.29 (517.34)	-186.17 (403.08)
1961 – 1965	702.03 (347.26)	412.41 (120.30)	483.36 (367.83)	218.66 (484.02)	-70.95 (377.12)
1966 – 1970	682.50 (293.88)	281.37 (101.81)	62.85 (311.29)	619.64 (409.62)	218.52 (319.15)
1971 – 1975	311.22 (245.08)	60.20 (84.90)	20.77 (259.60)	290.45 (341.61)	39.43 (266.16)
1976 – 1980	130.75 (179.76)	18.78 (62.27)	11.28 (190.41)	119.47 (250.56)	7.50 (195.22)
1981 and after	16.25 (98.80)	-0.02 (34.22)	1.25 (104.65)	15.00 (137.71)	-1.27 (107.29)

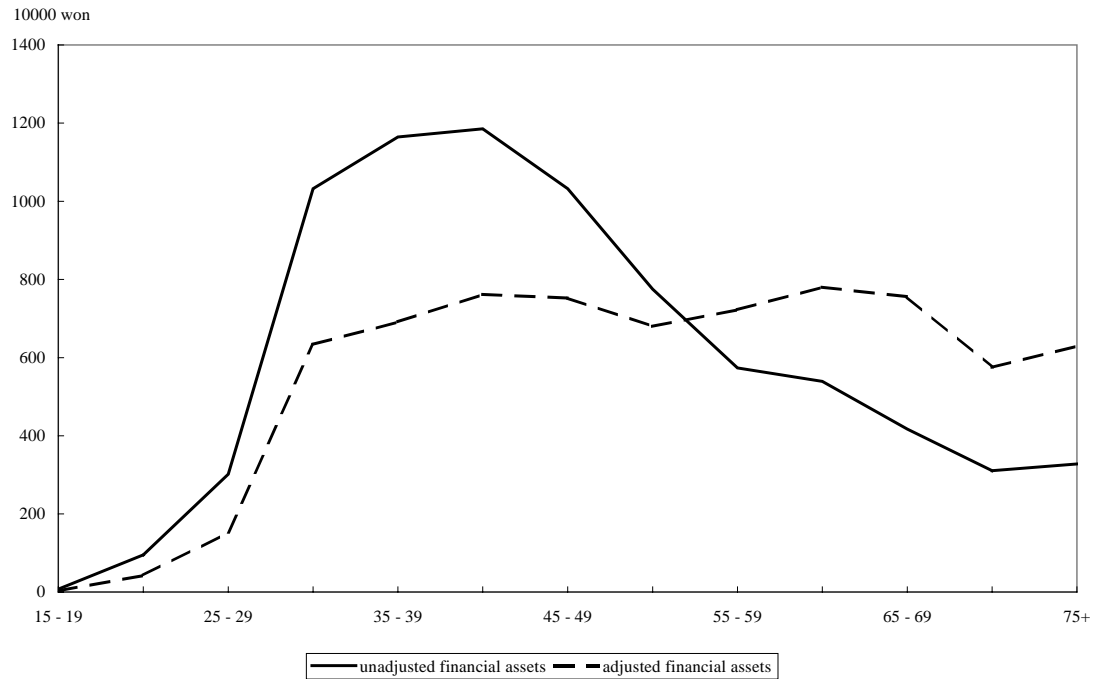
Note: The numbers in parentheses are standard errors.

[Figure 5] Total assets held by age group: actual and age effect



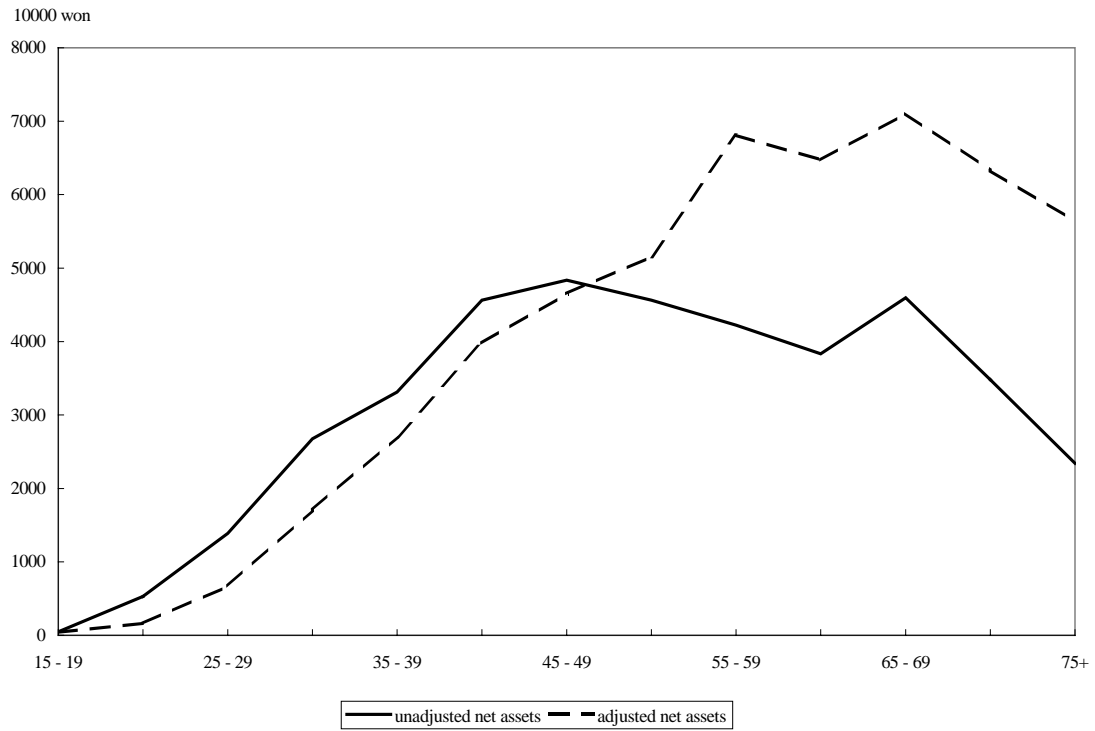
Note: 1) Unadjusted total asset is calculated based on 1997survey.
 2) Adjusted total asset curve is total asset holdings due to age effect from [Table 5].

[Figure 6] Financial assets held by age group: actual and age effect



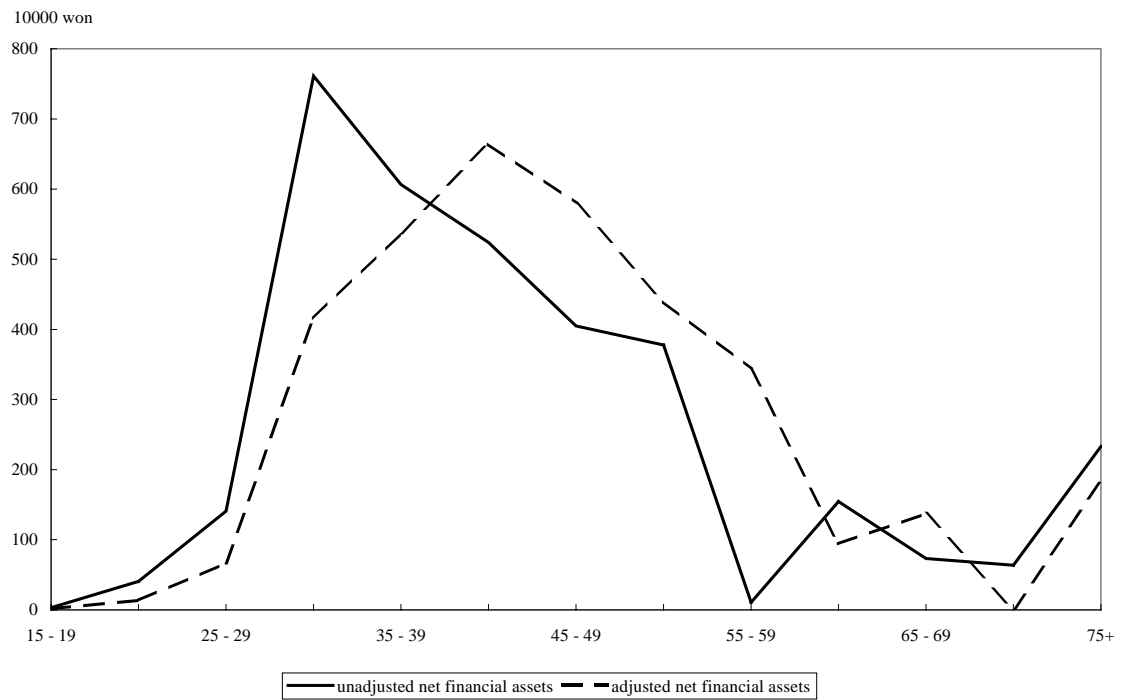
Note: 1) Unadjusted financial asset is calculated based on 1997survey.
 2) Adjusted financial asset curve is total asset holdings due to age effect from [Table 5].

[Figure 7] Net assets held by age group: actual and age effect



Note: 1) Unadjusted net asset is calculated based on 1997survey.
 2) Adjusted net asset curve is total asset holdings due to age effect from [Table 5].

[Figure 8] Net financial assets held by age group: actual and age effect



Note: 1) Unadjusted net financial asset is calculated based on 1997survey.
 2) Adjusted net financial asset curve is total asset holdings due to age effect from [Table 5].

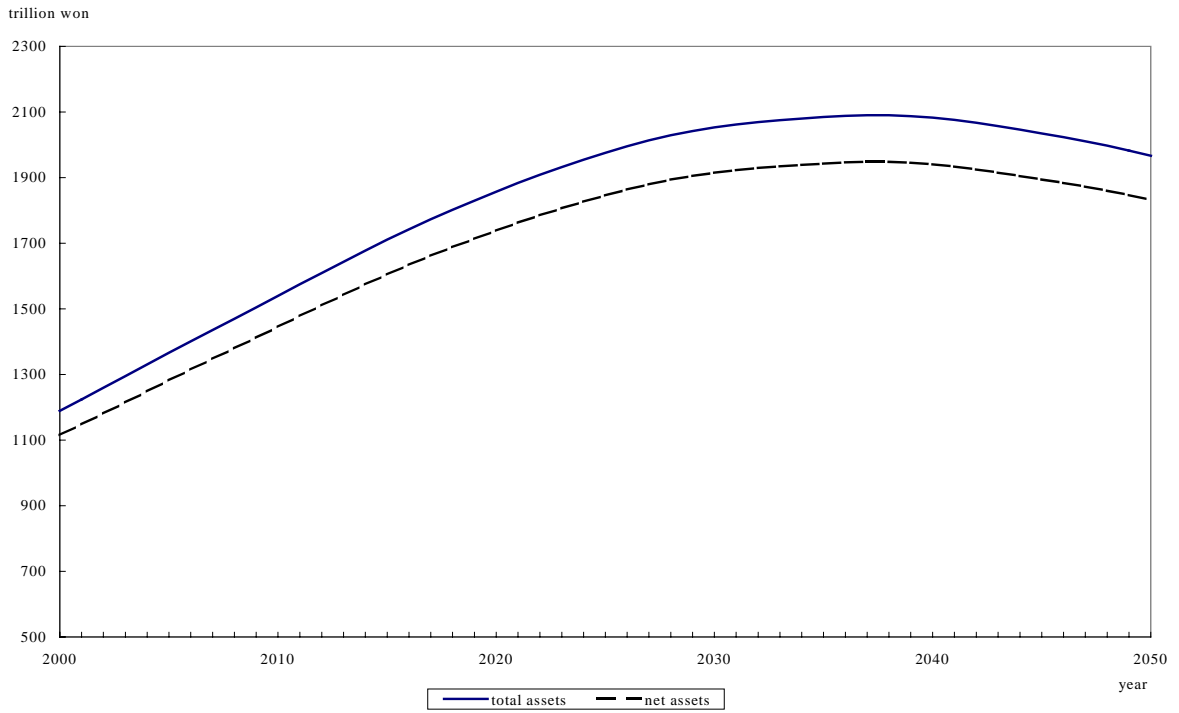
the house is actually purchased, resulting in more debt. As a result, there is a steady rise in net assets but a sharp decline in financial assets in the late 30's.

A noticeable feature in the cohort effect shown in [Table 6] is that the size differs greatly by cohort. The cohort effects reported in [Table 6] can be divided into three groups. First, if we look at the mid 1990's, the individuals in the late 30's and early 40's born after 1956 have a very strong positive cohort effect. The next group, which was born between 1946 and 1955, has a negative cohort effect in net assets and net financial assets, causing them to fall behind the asset demand required by age effect. However, the size of the cohort effect remains just 10~20% of actual amount of assets accumulated. The third group of individuals born before 1945 have a negative cohort effect in financial assets and net assets, and the size of the cohort is 50~200% of the actual asset holdings, falling far behind the requirements of the age effect. We can conclude that with the Korean War as the base, those born before and after have a different negative or positive cohort effect. Even amongst those born before the war, there is a considerable difference in the size of the cohort effect between those who entered the labor market before and after the rapid economic development began in the 1970's. This tells us that we must pay careful attention to the cohort effect in predicting the direction of the asset market in the context of demographic change. Those born after 1956 have yet to reach 50 years of age, and will account for largest aging proportion the next 30 years. The fact that this group holds more assets than expected by the age effect means that their generation enjoyed a positive cohort effect and accumulated a relatively large amount of assets. As mentioned before, it is natural to conclude that those born after the Korean War enjoyed a more positive cohort effect than those before. However, when the group who entered the labor market during the period of rapid development and accumulated assets start to enter old age and begin to convert their physical assets to financial assets, a tremendous shock to the asset market can be expected. Though we cannot measure the size of the shock statistically, it would be difficult to try to predict it without paying adequate attention to the shocks already endured by the generation born after 1965.

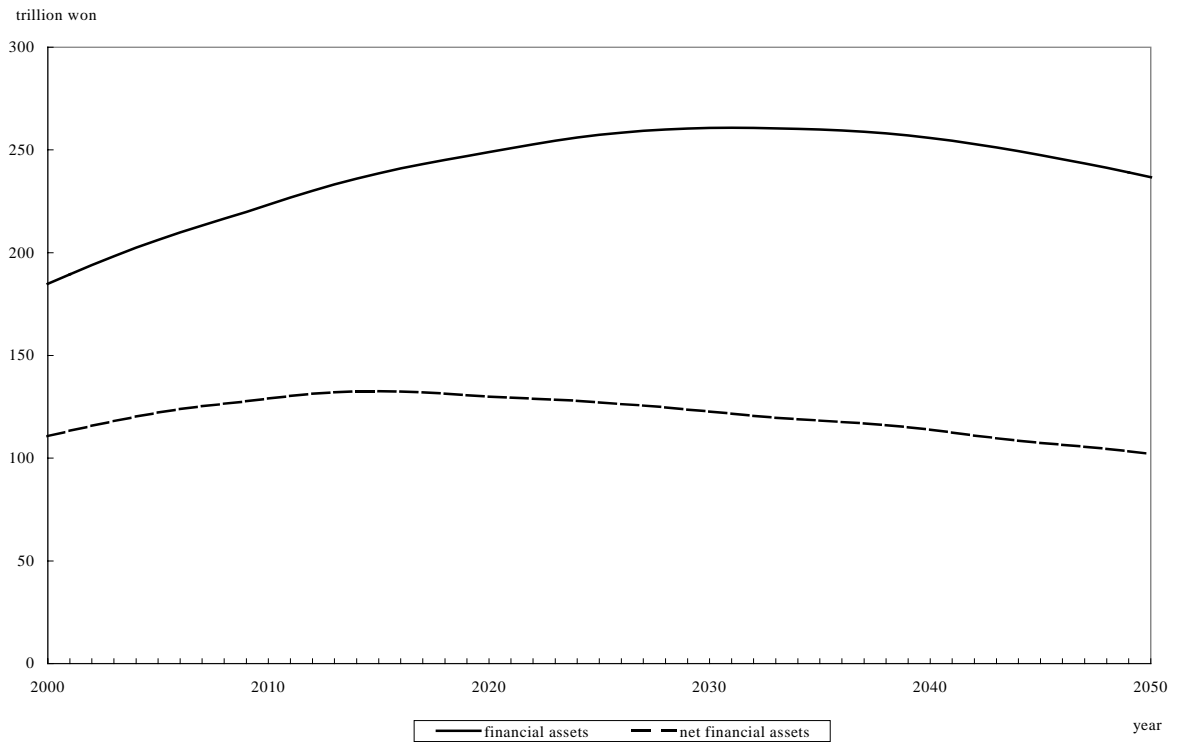
3) Projected asset demand

[Figure 9] and [Figure 10] show the projected asset demand based on the age effect reported in [Table 7]. Before embarking on the detailed discussion, we must warn that there are great limitations in interpreting this study's results in predicting the actual size of the asset market in future. The period in which the samples used in this study were collected covers the 1990's, while the period to be projected covers the present to 2050. Needless to say, these are two very different periods. Accordingly, this study mainly tries to deduce the meaning of the change in the demographic structure (aging) on the asset market. Yet, there are good reasons in questioning whether data from a period where aging process is still in infancy can convey useful information for obtaining the period when aging has taken place in full scale. This paper attempts to overcome these problems by

[Figure 9] Projected demand for total and net assets



[Figure 10] Projected demand for financial and net financial assets



decomposing asset holdings by those affected by the age effect and by the cohort effect, and using the age effect only to project the future time path of demand for asset following a shift in demographic trend. Still, the possibility exists that economic agents will change their behavior patterns with the progression of aging, so there will be unavoidable problems with using historic data to make projections. The sample used in this group was collected over 5 years to distinguish the age effect and cohort effect, and one individual cannot change age groups more than once. As (3) shows, the method to clearly identify the cohort effect and age effect is to allow individuals to change groups many times by having a sample over a long period of time with widely fluctuating independent (dummy) variables. Unfortunately, we do not enjoy that kind of luxury from the sample in the paper due to short time window the data set covers.

According to [Figure 9], total and net asset demand rises steadily after 2000 and both peak in 2037, then gradually fall to 2025 level in 2050. The Korea National Statistical Office's projection estimates that Korea's population will peak at about 50,680,000 people in 2023 and gradually fall, but total demand for total and net assets will still rise at a slow rate until 2037. The occurrence where total assets and net assets demand rise despite a decrease in population can be intuitively predicted from the peaking of asset demand due to age effect at age 65~69 and the rise in the aged population displayed in [Figure 5] and [Figure 7]. The demand for financial assets rises similarly and peaks at 2031. The demand patterns for financial assets by age shown in [Figure 6] differ from the typical hill shape implied by the life-cycle income hypothesis. As with total asset and net asset demand, demand for financial assets does not decrease as age increases meaning that aging drives demand even after the population starts to decrease. One thing to point out about financial asset demand is that the scale of asset demand reported in [Figure 10] differs greatly from that at the macro level. According to the quarterly statistics on flow of funds released by the Bank of Korea, total private financial asset holdings at the end of 2002 was 798.5 trillion won, 4.1 times more than the 193.9 trillion won in predicted by the study. This problem is not particular to this study only, but a problem shared with most studies. It is a general phenomenon that the degree of disparity of individual asset holdings is much higher than the disparity of individual income. The right tail of distribution function for individual asset holdings is extremely skewed. If a sample is taken from this type of distribution, the probability that a sample will be taken from an individual with extremely large asset holdings is virtually nil unless the sample size is truly big enough. Needless to say, interpreting statistical analyses that are very sensitive to outliers must be done with great caution. The Daewoo Panel reports that the average financial asset holdings of individuals was 4,970,000 won in 1997, making the total holdings about 228 trillion won if multiplied by the population. Even this number corresponds to just about 30% of the figure reported in flow of funds by the Bank of Korea. However, the differences between macro indicators and samples should not be used to dismiss the validity of important implications from the paper. "Survey on Household Income and Consumption"

conducted by the Korea National Statistical Office shows that the average total financial assets holdings for households was 24,408,000 won in 2000. The statistics implies 291 trillion won in total financial assets savings for the whole society, just 36% of the flow of funds figures and very close to the data in the Daewoo Panel report used in this study. Besides it can be noted that asset holdings are concentrated on a few select individuals whom most surveys are more likely to fail to sample. It serves little purpose to decompose the assets of these few individuals into age and cohort effect to examine the effect of demographic change on asset market. Therefore, we can consider this 60~70% of the total financial assets that are not covered by the sample used in the paper following an exogenous growth path that does not need to be considered for the purpose of the paper.

Finally, while demand for total assets, financial assets, and net assets continues to rise even after the population starts to decrease, demand for net financial assets reaches its peak around year 2015 when the population still increases. This phenomenon is predicted in the patterns of net financial asset holdings in [Figure 10]. The demand for net financial assets peaks at the age between 40~44 and then, sharply falls. In this way, demand for net financial assets slowly declines even in 2015 when the population is projected to be rising, and drops sharply in 2040 to 2000 levels as a result of aging.

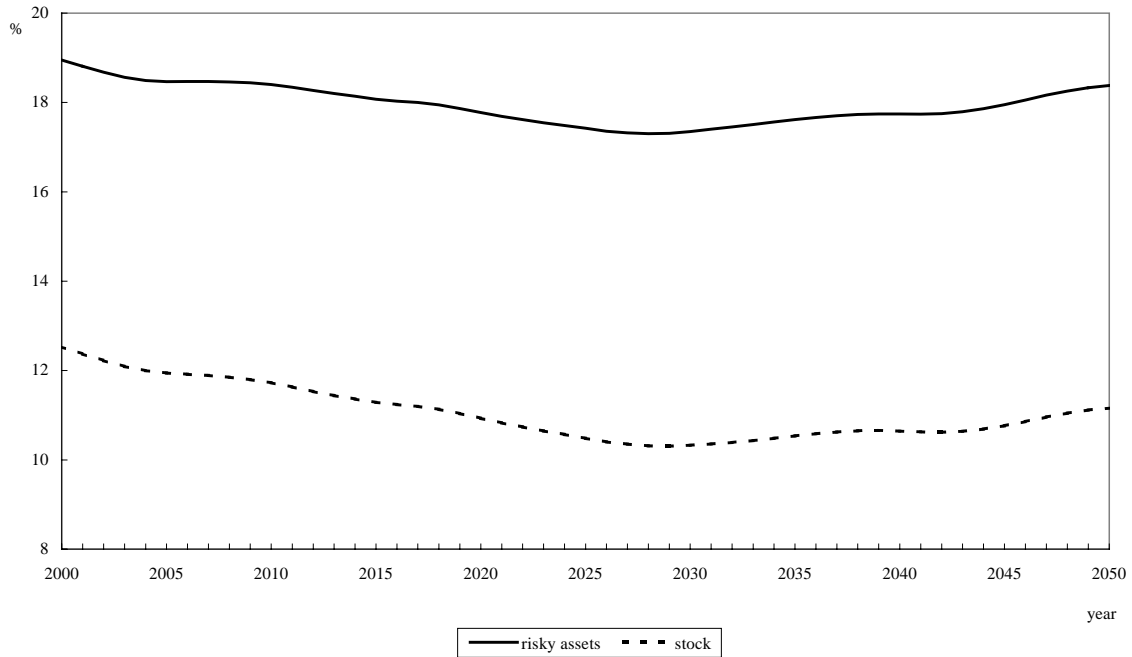
Though it is predicted that total demand for assets will start to decline in 2030, per capita demand for assets excluding total financial assets is projected to rise even in 2050. The per capita demand for assets in [Table 7] appears to be the result of complex interaction between relatively high asset demand from the elderly and population aging.

[Table 7] Per capital projected asset demand

Year	Total asset	Financial asset	Debt	Net asset	Net financial asset
2005	2818.499	425.5957	173.5411	2644.863	252.0546
2010	3104.403	450.3519	190.2491	2914.05	260.1028
2015	3397.692	473.955	210.6599	3186.938	263.2951
2020	3666.603	491.4689	234.858	3431.665	256.6108
2025	3900.675	508.1097	256.9785	3643.623	251.1312
2030	4081.649	518.3684	274.4671	3807.113	243.9013
2035	4212.214	525.4071	286.3733	3925.778	239.0338
2040	4320.587	530.7161	294.4908	4026.033	236.2253
2045	4378.143	532.5208	301.2714	4076.809	231.2494
2050	4435.41	533.9322	303.7608	4131.588	230.1714

Note: All numbers are in 10,000 won.

[Figure 11] Projected proportion of risky assets and stock



Note: 1) Risk assets include stocks and bonds.

2) The figure depicts time path of the ratio between risky assets (or stocks) and financial assets.

To check the change in riskiness in society's total assets portfolio, stocks and bonds are classified as risky assets and the proportion of their demand out of total financial assets is projected. According to [Figure 11], the proportion of risky assets in the financial assets portfolio in 2000 is about 19%, and is expected to slowly decline to 17.3% in 2028 before turning around. The decrease during the first half of the period considered in the paper mainly stems from the increase in the elderly population who have the tendency to prefer safer assets than the younger ones. On the other hand, the increase in the second half is the result of a rising demand for bonds that make up approximately a third of all risky assets, and the increase in the proportion of stock. The percentage of stocks increases despite progress of aging because demand for stock rises greatly in the 75 and above group to the same level as the 35-39 years group, who shows the greatest appetite for stocks and decrease demand for stocks slowly afterward. The decline in total population combined with progress of aging makes the 75 and above group a large proportion of the population, and the large increase in their demand for stocks will cause risky assets to take a greater part of the total assets in the portfolio.

In this paper, we focus on Poterba [2001]'s argument on using projections on asset demand in predicting the impact of changes in the demographic structure on the asset market. The demand for net assets defined as total assets, financial and physical, and minus debt will ultimately decrease. The demand for net financial assets will fall even faster, and the prediction is based on the specific structure of housing finance in Korea.

4. Conclusion

Theory predicts relatively clearly that change in the demographic structure, and asset demand, price, and composition are all closely interrelated. This study attempted to analyze the effect of aging, a change in Korea's demographic structure, on the asset market in the future.

We find four main features related to the issue in the paper. First, Korea's elderly population holds much less assets than those of the US, and holds much less than is posited by the age effect. According to the study, in Korea individuals steadily increase asset accumulation to peak at the early 50's, but ultimately shows a declining pattern. In contrast, in the US and other western countries accumulation of total assets steadily rises with age to peak at 70's and then decreases slightly⁶. Explanations for this difference may include high educational spending on children, marriage expenses, etc in Korea. If real estate holdings, which make up most of the assets of the elderly, cannot be easily liquidized, there is sure to be major difficulties in securing income for the elderly as their population rises sharply. Second, financial assets make up a very small part of an individual's total assets, which is shown most clearly in 40-50 year olds. Koreans actually hold a higher portion of financial assets than other developed countries up to their mid 30's, but this declines rapidly in the late 30's. In the retirement phase during the 60's, the percentage of financial assets held hover around a meager 5%. With long-term mortgage market in its infancy, a disproportionately high income to house price ratio, and high expectations on capital returns, the high individual demand for houses have been keeping the proportion of financial assets low. With the late 30's being the period for purchasing a home, it explains the sharp decrease in the portion of financial assets. Third, aging is ultimately bound to reduce the demand for assets. In the early stages of aging where the median and mean age is in the 30s or possibly 40s, there will be a large population in their prime saving age, and a small proportion who have retired and are trying to address income problems from their decrease in assets. So at first, more of the population will be accumulating assets than de-cumulating them, leading to a general increase in asset holdings. When aging becomes more severe, the elderly will start to outnumber those in their prime working age, and total assets will decrease. The decrease in total assets and net assets will start in 2037, whereas financial assets will start in 2031, and net financial assets much more quickly in 2015. Fourth, the progression of aging will cause a continuous decrease in the portion of risky assets in total asset portfolio until 2030, before turning around and slowly rising. The decline is due to an increase in the more risk-averse elderly population, while the increase that comes later is due to the preference of the older population (over 75) for risky assets, stocks in particular.

⁶ See Poterba [2001] for US, Banks and Tanner [2002] for UK and Alessie, Hochguertel, and Soest [2002] for Dutch cases.

References

- Abel, Andrew B. "Precautionary saving and accidental bequests," *American Economic Review*, Vol. 75, 1985, pp.777-91.
- Abel, Andrew B., "The Effects of a Baby Boom on Stock Prices and Capital Accumulation in the Presence of Social Security," Wharton School mimeograph, University of Pennsylvania, 1999.
- Abel, Andrew B., "Will Bequests Attenuate the Predicted Meltdown in Stock Prices When Baby Boomers Retire?," *Review of Economics and Statistics*, Vol. 83, 2001, pp.589-595.
- Alessie, Rob., Stefan Hochguertel, and Arthur Van Soest, "Household Portfolios in the Netherlands," in L. Guiso, Michael Haliassos, and Tullio Jappelli (eds.) *Household Portfolio*, Cambridge, The MIT Press, 2002.
- Bakshi, Gurdip, and Zhiwu Chen, "Baby Boom, Population Aging, and Capital Markets," *Journal of Business*, Vol. 67, 1994, pp. 165-202.
- Banks, James. and Sarah Tanner, "Household Portfolios in the United Kingdom," in L. Guiso, Michael Haliassos, and Tullio Jappelli (eds.) *Household Portfolio*, Cambridge, The MIT Press, 2002.
- Bodie, Zvi, Robert C. Merton, and William F. Samuelson, "Labor Supply Flexibility and Portfolio Choice in a Lifecycle Model," *Journal of Economic Dynamics and Control*, Vol. 16, 1992, pp.427-449.
- Brooks, Robin, J., "Asset Market and Saving Effects of Demographic Transitions," unpublished doctoral dissertation, Yale University, Department of Economics, 1998.
- Brooks, Robin, J., "Life Cycle Portfolio Choice and Asset Market Effects of the Baby Boom," International Monetary Fund mimeograph, 2000.
- Campbell, John Y., Andrew W. Lo, and A. Craig MacKinlay, *The Econometrics of Financial Markets*, Princeton, Princeton University Press, 1996.
- Davies, J. B., "Uncertain lifetime, consumption, and dissaving in retirement," *Journal of Political Economy*, Vol. 89, pp.561-578, 1981.
- Guiso, L., Michael Haliassos, and Tullio Jappelli, *Household Portfolio*, Cambridge, The MIT Press, 2002.
- Kim, J., "Trends in household asset holdings in Korea", *Jaerungnonjip*, Vol. 17, 2002, *in Korean*.
- Kimball, Miles S., "Standard Risk Aversion," *Econometrica* Vol. 61, 1993, pp.589-611.
- Kotlikoff, L., "Health expenditures and precautionary saving," in *What Determines Saving?*, Cambridge, MIT Press, 1988.

- Organisation for Economic Co-operation and Development, *Maintaining Prosperity in an Aging Society*, OECD, 1998.
- Organisation for Economic Co-operation and Development, *Reforms for an Aging Society*, OECD, 2000.
- Poterba, James, and Andrew Samwick, "Stock Ownership Patterns, Stock Market Fluctuations, and Consumption," *Brookings Papers on Economic Activity*, Vol. 2, 1995, pp.295-371.
- Poterba, James, and Andrew Samwick, "Household Portfolio Allocation Over the Lifecycle," in S. Ogura, T. Tachibanaki, and D. Wise (eds.), *Aging Issues in the U.S. and Japan*, Chicago, University of Chicago Press, 2001.
- Samuelson, Paul A., "A Case At Last for Age-Phased Reduction in Equity," *Proceedings of the National Academy of Sciences*, Vol. 86, 1989, pp.9048-9051.
- Samuelson, Paul A., "Long Run Risk Tolerance When Equity Returns Are Mean-Regressing: Pseudoparadoxes and Vindication of Businessman's Risk," in W. Brainard, W. Nordhaus, and H. Watts (eds.) *Macroeconomics, Finance, and Economic Policy: Essays in Honor of James Tobin*, Cambridge: MIT Press, 1990.
- Shorrocks, Anthony F., "The Age-Wealth Relationship: A Cross-Section and Cohort Analysis," *Review of Economics and Statistics*, Vol. 57, 1975, pp.155-163.
- World Bank, *Averting the Old Age Crisis*, Oxford, Oxford University Press, 1994.
- Yoo, Peter S., "Age Dependent Portfolio Selection," Federal Reserve Bank of St. Louis working paper no. 94-003A, 1994a.
- Yoo, Peter S., "Age Distributions and Returns of Financial Assets," Federal Reserve Bank of St. Louis working paper no. 94-002B, 1994b.
- Yoo, Peter S., "Population Growth and Asset Prices," Federal Reserve Bank of St. Louis working paper no. 97-016A, 1997.

Appendix: Descriptive statistics: individual asset holdings

Year	1994	1995	1996	1997	1998
Sample size	8256	9493	9455	9315	9381
	Average				
Age	32.94	33.37	33.87	34.56	35.24
Total assets	1560.22	1742.56	2624.24	2562.73	2416.44
Financial assets	355.29	423.35	622.88	497.29	457.13
Debt	166.28	259.51	272.36	270.80	545.74
Net assets	1393.94	1483.05	2351.88	2291.93	1870.69
Net financial assets	189.02	163.84	350.53	226.49	88.61
Stock	18.38	13.68	150.02	15.88	12.72
Bonds	0.45	0.98	1.66	0.58	6.75
Deposits	78.16	116.15	130.74	133.26	122.27
Insurance	41.50	53.65	74.74	72.38	56.45
	Standard deviation				
Age	20.92	21.53	21.74	21.70	21.90
Total assets	2796.36	3377.86	5684.16	4934.05	5366.62
Financial assets	833.50	902.34	2690.62	1149.45	1188.46
Debt	718.93	844.63	1058.93	826.25	9889.55
Net assets	2729.90	3219.28	5501.20	4679.87	10738.08
Net financial assets	1014.24	1099.34	2830.40	1290.10	9673.09
Stock	355.71	177.87	2421.53	214.56	118.93
Bonds	10.81	21.96	68.06	13.91	212.83
Deposits	273.38	434.47	427.14	579.21	788.57
Insurance	181.40	191.10	464.83	466.02	176.44

Note: All numbers are in 10,000 won.