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Korea's Aging Population and Household Saving Rate: Evidence for an Extended Life Cycle Income Hypothesis

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- Key word: saving, population, aging, household, Korea
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ABSTRACT

Korea is entering the class of aging population nations. This paper investigates the extent demographic factors and the aging population affect the saving rate, using an extended life-cycle/permanent-income hypothesis on saving. The results of the tests with Korean household survey data from 1977 to 2002 reveal that real saving rates increase when the duration of lifetime and per household real disposable income rise, and decrease when the growth rate of income and net worth-to-GDP ratio rises. The growth rate of per household real disposable income has negative effects, suggesting that households calculate their life cycle income in a forward looking manner. The elasticities with respect to a change in the lifetime horizon and the growth rate of per household income are 0.58 and -0.03, respectively. A one percent rise in the net worth to GDP ratio reduces the saving rate by 0.3 percent. A one percent rise in per household income increases it by 0.33 percent. The younger-age and the elder-age dependency ratios have insignificant effects on the household saving rate behavior. When Korean life expectancy rises, the private saving rate declines modestly and the government saving rate declines substantially. The economy's real net saving rate declines from 33 percent in 2002 to 30 percent by the year 2030.

I. Introduction

As life expectancy increases, the old -age population has been growing rapidly in Korea. As a result, Korea is entering the class of "aging population nations". The aging of a population raises some important issues and challenges ahead that need to be addressed. It raises microeconomic issues of health care, housing, and other related services for the purpose of improving the welfare of the elderly. It also raises some macroeconomic issues for any nation, in particular, their implications for government budgets, productivity, economic growth, financial markets, and foreign exchange markets.[1] So far, it appears that the aging of the population has not affected the social, political, and economic conditions of Korea. However, as the aging population increases, it is expected to have a significant impact on the economy.

The growth per head in an economy depends on the saving rate and productivity conditions. Hence, one of the central questions we need to answer is how much demographic factors affect the nation's saving rate. In light of the importance of the saving rate, one of the focuses of this paper is on the effect of demographic factors including life expectancy on the household saving rate, using an extended life-cycle / permanent-income hypothesis. We attempt to test the life cycle hypothesis with Korean household survey data from 1977 to 2002. We also test whether age dependency ratios would have an effect on the household saving. Then, we estimate the effect on Korea's national saving rate of increased lifetime expectancy.

Following this introductory section, section II discusses the age profile of the population and labor force in Korea. The old -age dependency ratio and the two aging population indices show an upward trend in Korea. Section III presents the saving rate choice of individual consumers under the intertemporal -utility -maximization rule. Section IV sets up the econometric specification of the life -cycle hypothesis of saving rate behavior. Section V presents the data bases. Section VI discusses the empirical results obtained using annual data on Korean households from 1977 to 2002. Section V examines the effects of the dependency ratio on the household saving rate. Section VI discusses the effects of improvements in life expectancy in Korea on the saving rates. Section VII offers a summary and some concluding remarks.

[1] For research on the implications, and other related issues, see Cutler, Potterba, Sheiner and Summers (1990), De Serres and Pelgrin (2002), Kohl and O'Brien (1998), Masson and Tryon (1990), and Turner,Giorno, De Serres, Vour'h and Richardson (1998). For descriptive analyses of aging in Korea, see Bang Hong Ki (2003), Korea Development Bank (2003), Lee Eun Mi (2002), and Lee Hae Hoon (2002).

Ⅱ. The Age Profile of the Population and Labor Force

1. Population

The population of Korea was estimated to be 25 million in 1960 and the male and female populations were 12.5 and 12.4 million, respectively (see Table 1). The population growth rate declined from 2 percent per year in the 1960s to less than one percent per year in the 1990s. The growth rate of Korea's population in the year 2002 was about 0.6 percent. The life expectancy in Korea increased greatly, from about 55 years in the 1960s to 75 years in the 1990s. In recent years, the life expectancy of females was 8 years longer than that of males . Currently life expectancy is growing at 0.7 percent per year.[2]

The proportion of the population under the age of 14 steadily declined from 43 percent in the 1960s to 21 percent in 2002. The proportion of the population between ages 15 and 64 , which is the economically active population, rose from 54 percent in the 1960s to 71 percent in the year 2002 (see Table 2).

The share of the elderly or aged population, i.e., those 65 and older, rapidly increased from 3.4 percent in the 1960s to 8 percent in the year 2002.[3] As a result of longer life expectancy and a lower total fertility rate, the proportion of the elderly population above 80 increased from 0.3 percent in the 1960s to 1.2 percent in 2002.

The elderly dependency ratio is defined as the ratio of the elderly population to the economically active population. The Korean elderly dependency ratio increased from 6.3 percent in the1960s to 11.1 percent in the year 2002 and has been rising at an increasing rate(see Table 3). In recent years, the elderly dependency ratio grew at more than 4 percent per year. Korea has experienced a rise in the elderly dependency ratio almost equal to that of other OECD countries.

In Korea, the elderly population has been rising while the younger population has been decreasing since 1960. The ratio of the elderly population to the population under 15 increased from about 7.9 percent in the 1960s to 38.5 percent in 2002. The ratio has grown at an increasing rate from a negative 0.6 percent rate in 1960 to 5.9 percent rate in 2002. Although the ratio is called in the literature an index of the aging population, it reflects more appropriately how many elderly per-

[2] For descriptions of aging population phenomena in Korea, see Lee, Eun Mi (2002) and Bang (2003).

[3] The share of the elderly population is lower than the average share of OECD countries of about 13 percent.

< Table 1> Population and Life Expectancy by Sex

year	Population (1000persons)			Life Expectancy (years)			Growth Rate (%)					
							Population			Life Expectancy		
	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female
1960	24989	12544	12445	52.4	51.1	53.7						
1965	28373	14279	14094	60.1	58.1	61.6	2.54	2.59	2.49	2.74	2.56	2.74
1970	31435	15780	15655	63.2	59.8	66.7	1.93	1.85	2.01	0.52	0.04	1.01
1975	34678	17445	17233	64.6	61.4	68.0	2.04	2.09	1.99	0.45	0.52	0.39
1980	37407	18549	18858	66.3	63.0	69.9	1.56	1.26	1.86	0.78	0.43	1.09
1983	39910	20129	19781	67.9	63.8	72.2	1.47	1.46	1.49	0.79	0.44	1.12
1984	40406	20375	20031	68.2	64.1	72.5	1.24	1.21	1.26	0.40	0.51	0.43
1985	40806	20576	20230	68.4	64.5	72.8	0.99	0.98	0.99	0.40	0.51	0.43
1986	41214	20772	20442	69.1	65.1	73.4	0.99	0.95	1.04	0.95	1.02	0.83
1987	41622	20960	20662	69.8	65.8	74.0	0.99	0.90	1.07	0.96	1.03	0.83
1988	42031	21155	20876	70.3	66.3	74.6	0.98	0.93	1.03	0.75	0.80	0.70
1989	42449	21357	21092	70.8	66.8	75.1	0.99	0.95	1.03	0.76	0.80	0.70
1990	42869	21568	21301	71.3	67.3	75.5	0.98	0.98	0.99	0.63	0.67	0.55
1991	43268	21775	21493	71.7	67.7	75.9	0.93	0.96	0.90	0.63	0.67	0.56
1992	43663	21979	21684	72.3	68.2	76.4	0.91	0.93	0.88	0.75	0.74	0.64
1993	44056	22177	21879	72.8	68.8	76.9	0.90	0.90	0.90	0.76	0.75	0.64
1994	44453	22376	22077	73.2	69.2	77.2	0.90	0.89	0.90	0.49	0.58	0.33
1995	45093	22705	22388	73.5	69.6	77.4	1.43	1.46	1.40	0.49	0.59	0.33
1996	45545	22939	22606	74.0	70.1	77.8	1.00	1.03	0.97	0.58	0.70	0.46
1997	45991	23170	22821	74.4	70.6	78.1	0.97	1.00	0.95	0.58	0.71	0.46
1998	46430	23396	23034	75.0	71.1	78.7	0.95	0.97	0.93	0.77	0.81	0.70
1999	46858	23617	23241	75.6	71.7	79.2	0.92	0.94	0.89	0.78	0.81	0.70
2000	47275	23831	23444	76.1	72.3	79.8	0.89	0.90	0.87	0.77	0.81	0.70
2001	47343	23835	23508	76.7	72.9	80.3	0.14	0.02	0.27	0.77	0.81	0.70
2002	47640	23984	23656	77.3	73.5	80.9	0.63	0.62	0.63	0.77	0.81	0.70

Note: Some life expectancy figures are not available. The figures are made by a linear interpolation between two bench mark year figures. For life expectancy, refer to www.nso.go.kr.

Sources: Korea Statistical Office, *Major Statistics of Korean Economy*; Economic Planning Board, *Korean Economic Yearbook*, 1984.

<Table 2> Population by Age

year	Total	(in thousand)							Shares of Age Group(%)						
		0~14	15~64	65~80+	65~69	70~74	75~79	80+	0~14	15~64	65~80+	65~69	70~74	75~79	80+
1960	24989	10687	13458	844	379	255	126	84	42.8	53.9	3.4	1.5	1.0	0.5	0.3
1965	28373	12279	15121	937	426	265	162	84	43.3	53.3	3.3	1.5	0.9	0.6	0.3
1970	31435	13241	17153	1040	435	316	175	114	42.1	54.6	3.3	1.4	1.0	0.6	0.4
1975	34678	13208	20263	1206	543	325	204	134	38.1	58.4	3.5	1.6	0.9	0.6	0.4
1980	37407	12656	23305	1445	620	425	229	171	33.8	62.3	3.9	1.7	1.1	0.6	0.5
1982	39326	12886	24878	1560	659	460	254	187	32.8	63.3	4.0	1.7	1.2	0.6	0.5
1983	39910	12801	25496	1614	674	475	270	195	32.1	63.9	4.0	1.7	1.2	0.7	0.5
1984	40406	12592	26140	1673	691	489	288	205	31.2	64.7	4.1	1.7	1.2	0.7	0.5
1985	40806	12305	26759	1741	712	506	308	215	30.2	65.6	4.3	1.7	1.2	0.8	0.5
1986	41214	12030	27383	1800	739	518	317	226	29.2	66.4	4.4	1.8	1.3	0.8	0.5
1987	41622	11746	27998	1876	774	536	328	238	28.2	67.3	4.5	1.9	1.3	0.8	0.6
1988	42031	11487	28583	1962	817	554	341	250	27.3	68.0	4.7	1.9	1.3	0.8	0.6
1989	42449	11261	29135	2053	866	571	353	263	26.5	68.6	4.8	2.0	1.3	0.8	0.6
1990	42869	11078	29648	2144	904	596	368	276	25.8	69.2	5.0	2.1	1.4	0.9	0.6
1991	43268	10948	30108	2212	919	620	386	287	25.3	69.6	5.1	2.1	1.4	0.9	0.7
1992	43663	10833	30547	2283	935	647	403	298	24.8	70.0	5.2	2.1	1.5	0.9	0.7
1993	44056	10727	30968	2363	958	681	415	309	24.3	70.3	5.4	2.2	1.5	0.9	0.7
1994	44453	10581	31421	2450	989	721	421	319	23.8	70.7	5.5	2.2	1.6	0.9	0.7
1995	45093	10537	31901	2656	1048	767	459	382	23.4	70.7	5.9	2.3	1.7	1.0	0.8
1996	45545	10411	32360	2775	1098	790	483	404	22.9	71.1	6.1	2.4	1.7	1.1	0.9
1997	45991	10292	32792	2908	1158	812	514	424	22.4	71.3	6.3	2.5	1.8	1.1	0.9
1998	46430	10217	33162	3051	1221	838	552	440	22.0	71.4	6.6	2.6	1.8	1.2	0.9
1999	46858	10202	33452	3205	1288	872	588	457	21.8	71.4	6.8	2.7	1.9	1.3	1.0
2000	47275	10233	33672	3371	1366	911	614	480	21.6	71.2	7.1	2.9	1.9	1.3	1.0
2001	47343	9860	33903	3579	1465	967	632	515	20.8	71.6	7.6	3.1	2.0	1.3	1.1
2002	47640	9792	34074	3773	1534	1029	657	553	20.6	71.5	7.9	3.2	2.2	1.4	1.2

Note: The figures between the beginning and end periods are estimated by linear interpolations.
Sources: Korea Statistical Office, *Major Statistics of Korean Economy*; Economic Planning Board, *Korea Economic Yearbook*, 1984, for 1960-80 figures.

<Table 3> Dependency Ratios and Index of Aging

Year	Young Age Dependency Ratio	Growth rate%	Elderly Dependency Ratio	Growth rate %	Index of Aging	Growth rate%
1960	79.41		6.27		7.90	
1965	81.21	0.49	6.20	-0.21	7.63	-0.70
1970	77.19	-1.36	6.06	-0.39	7.85	0.97
1975	65.18	-3.71	5.95	-0.43	9.13	3.28
1980	54.31	-3.89	6.20	0.86	11.42	4.75
1982	51.80	-2.36	6.27	0.56	12.11	2.92
1983	50.21	-3.12	6.33	0.95	12.61	4.06
1984	48.17	-4.14	6.40	1.10	13.29	5.24
1985	45.98	-4.65	6.51	1.64	14.15	6.29
1986	43.93	-4.57	6.57	1.03	14.96	5.59
1987	41.95	-4.61	6.70	1.91	15.97	6.52
1988	40.19	-4.30	6.86	2.41	17.08	6.71
1989	38.65	-3.90	7.05	2.62	18.23	6.52
1990	37.37	-3.38	7.23	2.59	19.35	5.98
1991	36.36	-2.72	7.35	1.58	20.20	4.30
1992	35.46	-2.50	7.47	1.71	21.07	4.22
1993	34.64	-2.35	7.63	2.08	22.03	4.43
1994	33.67	-2.82	7.80	2.16	23.15	4.99
1995	33.03	-1.93	8.33	6.56	25.21	8.49
1996	32.17	-2.63	8.58	2.95	26.65	5.59
1997	31.39	-2.48	8.87	3.36	28.25	5.83
1998	30.81	-1.85	9.20	3.68	29.86	5.53
1999	30.50	-1.02	9.58	4.05	31.42	5.07
2000	30.39	-0.35	10.01	4.39	32.94	4.75
2001	29.08	-4.40	10.56	5.30	36.30	9.70
2002	28.74	-1.20	11.07	4.78	38.53	5.97

Note: Young age dependency ratio is the ratio of 14 age and under to ages of 15~64 years population. Elderly dependency ratio is the ratio of 65 age and above to ages of 15~64 years population. Index of aging is the ratio of the elderly population to the population under age 14 years.

sons would be cared by one young person.

People now expect to live longer than in earlier years. This is clearly confirmed by the figures given in Table 4. In 1981, the people 1-4 year old are expected to live 67.1 more years, and there are no age groups higher than the 80~84 age group. In 1999, the 1-4 old age group is expected to live 75.6 years more. The age group of 85~89 is expected to live 5 more years.

As shown in Table 5, about 28 percent and 9 percent of the population in 1970 completed the primary and middle school education, respectively. About 2 percent of the population completed tertiary education. In 1995, about 17 percent and 16 percent of the population achieved the primary and middle school education, respectively. Those educated in university and graduate schools are 16 percent of the total population. In 2000, the table shows that the education level of the population is higher. The population who completed tertiary schools is about 1.2 percent of the population.

2. Labor Force

As the age composition of the population varies, the age composition of the Korean labor force changes in a similar manner. As revealed in Table 6, the share of the younger age groups tends to decline, while the share of older age groups tends to rise. Hence, the Korean labor force in recent years has more elderly people.

The rate at which people participate in economic activity is calculated by two different methods. The first method is the traditional measure used in the literature dealing with the issues of aging and is defined as the ratio of those actively working to the population 15 years old and more. The second method we suggest here is the ratio of the active working labor force to the total population and this measure incorporates the population under the age of 15 years. The rate of population participation by the first method, as indicated in the table, is 54 percent in 1960 and 60 percent in the year 2002, increasing at a very low rate. The participation rate measured by the second method is 30 percent in 1960 and 48 percent in the year 2002, and it increased at a higher rate than the first measure. This is due to a decreasing trend of the population under the age of 15 years.

In 1981, 56 percent of the employed in Korea were graduates of primary school or less, while only 10 percent of them were graduates of university and higher education. (see Table 7). In 2001, the graduates of primary school and under decreased to 13 percent of the employed, while graduates of university and higher institutions increased to 25 percent of the employed. If we take into account the numbers of the students currently enrolled at university and higher institutions, the

<Table 4> Abridged Life by Age (in Years)

Age	Time	Total	Male	Female	Time	Total	Male	Female
0 year old	1981	66.19	62.28	70.54	1999	75.55	71.71	79.22
1~4	1981	67.11	63.09	71.57	1999	75.01	71.16	78.69
5~9	1981	63.71	59.67	68.21	1999	71.15	67.3	74.82
10~14	1981	59.1	55.05	63.6	1999	66.24	62.4	69.9
15~19	1981	54.35	50.31	58.84	1999	61.31	57.48	64.96
20~24	1981	49.75	45.75	54.18	1999	56.47	52.67	60.07
25~29	1981	45.2	41.25	49.55	1999	51.65	47.91	55.19
30~34	1981	40.64	36.75	44.92	1999	46.85	43.16	50.32
35~39	1981	36.12	32.28	40.31	1999	42.09	38.46	45.48
40~44	1981	31.72	27.98	35.77	1999	37.41	33.87	40.68
45~49	1981	27.51	23.93	31.31	1999	37.41	33.87	40.68
50~54	1981	23.51	20.14	27	1999	28.47	25.28	31.25
55~59	1981	19.72	16.64	22.86	1999	24.21	21.26	26.67
60~64	1981	16.18	13.43	18.86	1999	20.16	17.51	22.21
65~69	1981	12.97	10.62	15.13	1999	16.35	14.06	17.96
70~74	1981	10.12	8.22	11.74	1999	12.83	10.96	14.02
75~79	1981	7.6	6.2	8.76	1999	9.76	8.32	10.57
80~84	1981	5.37	4.62	6.19	1999	7.23	6.18	7.73
85~89					1999	5.29	4.56	5.55
90~94					1999	3.82	3.4	3.94
95 & over					1999	2.74	2.57	2.79

Source: National Statistical Office, Abridged Life Tables, 1999 from www.nso.go.kr, 05/01/03.

employed who were educated at university and higher will be substantially higher. In addition, the workers 25~39, the younger group of laborers, educated at higher education institutions, are more than the elderly group of workers aged 40 years and over.

<Table 5> Educational Attainment of Population by Age

Year / Age		15~19	20~24	25~29	30~34	35~39	40~44	45~49	50~54	55~59	60+	Total
1970	Primary School	4.82	3.75	3.68	3.91	3.24	2.34	1.75	1.12	0.75	0.70	28.14
	Middle School	1.77	2.02	1.60	1.27	0.87	0.60	0.43	0.25	0.11	0.13	9.10
	High School	0.55	2.10	1.51	1.26	0.85	0.43	0.25	0.12	0.07	0.06	7.21
	Jr.College	0.00	0.13	0.14	0.12	0.10	0.07	0.06	0.04	0.02	0.03	0.72
	University and Higher	0.00	0.19	0.49	0.51	0.37	0.20	0.10	0.05	0.02	0.02	1.96
1995	Primary School	0.02	0.05	0.11	0.35	0.78	1.12	1.44	1.72	1.90	3.46	10.97
	Middle School	0.13	0.30	0.54	1.19	1.97	1.83	1.49	1.10	0.79	0.82	10.17
	High School	1.28	5.38	5.54	5.32	4.80	3.03	1.97	1.22	0.83	0.77	30.14
	Jr.College	0.01	0.68	0.86	0.64	0.42	0.18	0.08	0.03	0.02	0.05	2.98
	University	0.00	0.79	2.34	2.40	1.70	0.99	0.68	0.46	0.34	0.42	10.06
	Graduate School	0.00	0.01	0.14	0.21	0.22	0.16	0.10	0.07	0.05	0.05	1.02
2000	Primary School	0.01	0.02	0.04	0.09	0.35	0.80	1.16	1.42	1.57	4.06	9.54
	Middle School	0.07	0.11	0.21	0.42	1.08	1.79	1.63	1.29	0.92	1.22	8.75
	High School	0.91	2.85	4.48	4.97	4.84	4.26	2.64	1.67	1.01	1.29	2.89
	Jr.College	0.01	0.98	1.39	1.27	0.95	0.63	0.29	0.16	0.09	0.15	6.20
	University	0.00	0.56	2.04	2.19	1.94	1.25	0.69	0.47	0.32	0.47	9.93
	Graduate School	0.00	0.01	0.14	0.22	0.24	0.23	0.15	0.09	0.06	0.07	1.20
	Master	0.00	0.01	0.13	0.19	0.19	0.17	0.11	0.07	0.04	0.05	0.97
	Doctor	0.00	0.00	0.00	0.02	0.05	0.06	0.04	0.02	0.01	0.02	0.23

Note: The figures in the cells are the shares of the numbers of population(6 years & over) completed their education by age groups to total population, (%). They do not cover the population under school attendance, not completed, and never attending.
Sources: National Statistical Office, *Korea Statistical Yearbook*, 2002; *1995 Population and Housing Census Report; 1970 Population and Housing Census.*

<Table 6> Labor Forces by Age (in 1000 persons)

	Population Total	Population 15&Older	Active Population	Age Shares %										Participation Rate	
				15~19	20~24	25~29	30~34	35~39	40~44	45~49	50~54	55~59	60+	1st Method	2nd Method
1960	24,989	14,302													
1966	29,160	16,476	8957	13.4	11.6	13.7	13.9	12.0	10.8	8.9	7.1	4.8	3.8	54.4	30.7
1970	31,435	18,193	10062	14.0	10.6	11.4	14.0	12.9	11.1	9.9	6.6	4.9	4.4	55.3	32.0
1975	34,678	21,469	12193	12.5	11.7	12.3	12.4	13.3	11.4	8.7	7.4	5.4	4.9	56.8	35.2
1980	37,407	24,750	14431	8.3	13.7	12.8	12.6	12.4	12.2	10.6	7.2	5.4	5.0	58.3	38.6
1985	40,806	28,500	15592	4.6	12.0	16.1	13.7	12.7	11.3	10.8	8.0	5.3	5.7	54.7	38.2
1986	41,214	29,183	16116	4.3	12.0	16.0	14.4	12.5	10.8	10.6	8.3	5.2	5.9	55.2	39.1
1987	41,622	29,874	16873	4.4	11.1	15.9	14.9	12.6	10.7	10.6	8.3	5.2	6.2	56.5	40.5
1988	42,031	30,545	17305	3.8	10.7	15.6	15.5	12.3	11.0	10.5	8.8	5.6	6.3	56.7	41.2
1989	42,449	31,188	18023	3.7	10.5	15.1	15.5	11.8	11.3	10.1	9.1	6.0	6.7	57.8	42.5
1990	42,869	31,792	18539	3.4	10.8	14.4	15.4	12.3	11.4	9.9	8.9	6.4	6.9	58.3	43.2
1991	43,268	32,320	19048	3.3	11.1	14.0	15.2	12.9	11.3	9.6	8.9	6.7	7.1	58.9	44.0
1992	43,663	32,830	19426	3.0	11.0	13.4	15.2	13.5	11.0	9.4	8.9	6.8	7.7	59.2	44.5
1993	44,056	33,331	19803	2.6	11.0	13.6	15.8	14.6	10.8	9.2	8.2	6.6	7.5	59.4	44.9
1994	44,453	33,871	20326	2.4	10.9	13.6	15.2	15.0	10.8	9.5	8.0	6.7	8.0	60.0	45.7
1995	45,093	34,557	20797	2.1	10.5	13.5	14.7	15.1	11.7	9.5	8.0	6.5	8.4	60.2	46.1
1996	45,545	35,135	21188	2.0	10.1	13.6	14.0	15.1	12.4	9.7	7.8	6.5	8.7	60.3	46.5
1997	45,991	35,700	21604	2.0	9.6	13.8	13.4	14.8	12.9	9.7	7.9	6.8	9.2	60.5	47.0
1998	46,430	36,213	21456	1.9	8.1	13.4	13.3	16.0	13.7	10.0	7.8	6.7	9.1	59.2	46.2
1999	46,858	36,657	21634	2.0	7.8	12.8	13.0	15.6	14.5	10.2	8.0	6.5	9.5	59.0	46.2
2000	47,275	37,043	21950	2.0	7.6	12.6	12.5	14.9	14.8	11.2	8.4	6.3	9.8	59.3	46.4
2001	47,343	37,482	22417	1.8	8.3	13.1	13.8	14.6	14.5	11.0	7.8	5.7	9.3	59.8	47.4
2002	47,640	37,847	22877	1.5	8.4	12.5	13.8	14.1	14.6	11.5	8.0	5.8	9.7	60.4	48.0

Note: 1st method is active population / 15 years and older. 2nd method is active population / total population.
Sources: National Statistical Office, *Comprehensive Time Series Report on the Economically Active Population Survey*, 1963～1993; National Statistical Office, *Annual Report on the Economically Active Population Survey;* Economic Planning Board, *Major Statistics of Korean Economy*, 1978; Economic Planning Board, *Major Statistics of Korean Economy*, 1984.

<Table 7> Educational Attainment of Labors in All Industries by Age

Year \ Age	~19	20~24	25~29	30~34	35~39	40~44	45~49	50~54	55~59	60+	Total
1981											
Middle School and Lower	11.6	17.2	6.9	5.9	5.1	4.4	2.7	1.5	0.5	0.3	56.2
High School	1.8	2.9	7.8	4.9	2.9	1.9	1.0	0.5	0.2	0.1	31.5
Jr.College	0.0	0.4	0.9	0.5	0.3	0.2	0.1	0.1	0.0	0.0	2.5
University and Higher	0.0	0.3	2.3	2.4	1.8	1.4	0.8	0.5	0.2	0.1	9.8
2001											
Middle School and Lower	0.1	0.2	0.2	0.5	1.1	2.6	3.1	2.6	1.6	1.4	13.4
High School	0.9	6.8	8.7	8.3	7.1	6.5	4.1	2.3	1.3	0.9	46.9
Jr.College	0.0	2.6	4.5	3.2	1.8	1.4	0.6	0.2	0.1	0.1	14.5
University and Higher	0.0	0.8	5.2	6.5	5.1	3.6	1.8	1.0	0.6	0.6	25.2

Note: The figures in the cells are the shares of age groups in total labor for the year, (%).
Source: Ministry of Labor, *Survey Report on Wage Structure.*

Ⅲ. The Saving Rate under the Life-Cycle/ Permanent-Income Hypothesis

The saving rate plays an important role in determining the macroeconomic effects of an aging population.[4] As a foundation for the empirical work, we present a simple model of the saving rate under the life–cycle / permanent income theory (Friedman(1957) and Modigliani and Brumberg (1954)). [5]

Consider an individual who lives for T periods and where there are perfect capital markets. His / her utility is

$$U = u(C_t) \quad u'(\cdot) > 0, \qquad u''(\cdot) < 0, \tag{1}$$

where U(.) is the instantaneous utility function and C_t is consumption in period t. The individual has net wealth of W_{t-1} and labor income of Y_t. The individual's budget constraint is

$$\dot{W}_t = r_t W_{t-1} + Y_t - C_t \tag{2}$$

r_t is the interest rate. We assume that the consumer determines his consumption over his lifetime by maximizing his utility. We set the lagrangian for his utility maximization problem subject to the budget constrain as:

$$L = \int_0^{\infty} [U(C_t) + \lambda_t \left(\dot{W}_t - r_t W_{t-1} - Y_t + C_t \right)] \, e^{-\rho t} \, dt \tag{3}$$

The first-order conditions are

$$u'(C_t) = \lambda_t \qquad \frac{\dot{\lambda}_t}{\lambda_t} = (\rho - r_t) \tag{4}$$

ρ is time rate of discount. From (4), the time path of consumption is described by

[4] The secction III and IV of this paper are similar to Kwack (2003a). The life cycle hypothesis together with neo-classical growth theory is close to the growth model of Ramsey (1928).

[5] I follow, more or less, the descriptions of Romer (1996, chapter 7). For further details, see Barro and Sala-I-Martin (1995, pp.60-66), and Weil (1989).

$$\frac{\dot{C}_t}{C_t} = \frac{1}{\theta}(r_t - \rho), \quad \theta = -\frac{u''(c)C_t}{u'(c)}) \tag{5}$$

Let us assume that the consumer has time-additive isoelastic preferences given by

$$U_t = \frac{C_t^{1-\theta}}{1-\theta}, \qquad \theta > 0 \tag{6}$$

Equilibrium per capita consumption from (5) and (6) obeys the familiar first-order Euler condition

$$\frac{\dot{C}_t}{C_t} = \frac{1}{\theta}(r_t - \rho) \tag{7}$$

In the long-run equilibrium, consumption is constant. This case arises when the time rate of discount equals interest rate. For simplicity and without loss of generality, we assume that the individual's time rate of discount and interest rate are equal and are zero, as done by Romer (1996, p. 310).[6] When the interest rate and the discount rate are not equal, the assumption would have only modest effects on the analysis in this section.

Under the assumption of zero interest rates. the budget condition over his lifetime is written in a discrete form:

$$C_t = \frac{1}{T}\left(W_0 + \sum_{\tau=1}^{T} Y_\tau \right) \tag{8}$$

W_0 is his initial net worth.

The individual's saving in period t is the difference between income and consumption. Saving is high (low) when income is high (low) relative to its permanent-income or life-cycle income. Thus, saving is utilized to smooth the path of consumption over the consumer's lifetime. Saving is described by

$$S_t = \left(Y_t - \frac{1}{T}\sum_{\tau=1}^{T} Y_\tau \right) - \frac{1}{T} W_0 \tag{9}$$

[6] Our presentation below follows the description by Romer (1996) of the life cycle hypothesis, until the specification of life cycle /permanent income..

The saving rate, st, is St / Yt, that is,

$$s_t = \left(1 - \frac{1}{TY_t}\left(\sum_{\tau=0}^{T} Y_{t+\tau}\right)\right) - \frac{W_0}{TY_t} \tag{10}$$

We consider three alternative schemes for forming the individual's expectation as to his future income. The first scheme, forward-looking, is that he expects his income to grow at the current rate of growth, g, until he retires at t+ω:

$$\sum_{\tau=0}^{T} Y_{t+\tau} = Y_t \sum_{\tau=0}^{\omega} (1+g)^{\tau} = Y_t \left(\frac{1-(1+g)^{\omega}}{-g}\right) \tag{11}$$

According to the binomial theorem,

$$(1+g)^{\omega} = 1 + \omega g + \frac{\omega(\omega-1)}{2!} g^2 + \frac{\omega(\omega-1)(\omega-2)}{3!} g^3 + .. \tag{12}$$

Substitution of $(1+g)^{\omega}$ in (11) by the second order approximation of equation (12) yields:

$$\sum_{t=1}^{T} Y_t = Y_t(\omega + \frac{\omega(\omega-1)}{2} g) \tag{13}$$

In the second scheme the consumer expects his income to remain at the same level, g=0, and thus,

$$\sum_{t=1}^{T} Y_t = Y_t \omega \tag{14}$$

In the third scheme, adaptive expectation, the consumer expects his income to rise at the current rate of growth, g, as it did in the past.[7] The adaptive expectation approach can be written in a simple expositional

[7] This could be regarded as a habit-formed regressive expectation mechanism. For example, Bentzel and Berg (1983) assume that life cycle /Permanent income is a geometrically declining weighted average of past income. assuming that the value of the weight parameter is small enough to ignore the second term.

form as[8]:

$$\sum_{\tau=0}^{T} Y_{t+\tau} = Y_t \sum_{\tau=0}^{\omega} (1+g)^{-\tau} = Y_t \left(\frac{1-(1-g)^{\omega}}{g} \right) \tag{15}$$

The second order approximation of (1-g) leads (15) to write for the adaptive expectation case,

$$\sum_{t=1}^{T} Y_t = Y_t(\omega - \frac{\omega(\omega-1)}{2} g) \tag{16}$$

Combining of (8) and (9)-(14) leads to

$$s_t = (1 - \frac{\omega - \nu(\omega(\omega-1)/2)g}{T}) - \frac{W_0}{TY_t}, \qquad \nu = -1, 0, 1 \tag{17}$$

Equation (17) is our theoretical specification of the life cycle / permanent income hypothesis of individual household saving rate.[9] The properties of the saving rate given in (17) are:

$$\frac{\partial s}{\partial T} = (\omega - \nu\omega(\omega-1)g + \frac{A_0}{Y})T^{-2} = (1-s)T^{-1} > 0$$

$$\frac{\partial s}{\partial \omega} = -(1 - \nu\omega g + \frac{\omega}{2} g)T^{-1} < 0 \quad for \quad \nu = -1 \quad and \quad 0, \quad and \frac{\partial s}{\partial \omega} = ? \; for \quad \nu = 1.$$

$$\frac{\partial s}{\partial g} = \frac{\nu(\omega(\omega-1)/2}{T} < 0 \quad for \quad \nu = -1, \quad \frac{\partial s}{\partial g} = 0 \quad for \quad \nu = 0, \quad and \frac{\partial s}{\partial g} > 0 \quad for \quad \nu = 1.$$

$$\frac{\partial s}{\partial Y_t} = (A_0 / T)Y_t^{-2} > 0$$

$$\frac{\partial s}{\partial A_0} = -(TY_t)^{-1} < 0$$

The sign on a rise in life expectancy, T, is positive. The sign on the

[8] We utilize $\sum_{\tau=0}^{\omega} (1+g)^{-\tau} = (1-(1-g)^{\omega}) / g, \; g / (1+g) \approx g$

[9] The life cycle/permanent income hypothesis is better suited to explaining individual household savings behaviors than national saving which includes government saving and foreign saving.

expected length of earning periods is negative when v= -1(forward looking) and 0 (static), as shown by Modigliani and Sterling (1983). When v=1, it depends upon the magnitude of g and ω. The effect of a rise in the growth rate of income on the saving rate depends upon the formation of expectations. formations. This is consistent with the conclusion made by Farrell (1970) that the growth rate effects on aggregate saving are not necessarily positive. The effect of a rise in the growth rate of income on the saving rate is negative, when household forward looking expectation, v= -1. A rise in the growth rate of income leads to a rise in the life cycle or permanent income, and hence, it causes a lowering of the saving rate.[10] There is no growth rate effect when the expected income is the same as the present income. The growth rate effect is positive, when the adaptive expectation, v=1, is used. Modigliani and Blomberg (1954) presented a positive relationship. They assume that in each year, the consumer extrapolates his current income over his future earnings-span.[11] If one assumes that the income in the preceding period represents the life cycle / permanent income, the transitory income equals a change in the income, and, thus, it yields a positive growth rate effect.

Ⅳ. Econometric Specification

To cover the cases of fixed and variable saving rates, we assume that the amount saved is the sum of the α portion of current income and (1-α) portion of the transitory income which is the current income minus life-cycle income. The saving rate specification can be written:

$$s_t = \alpha + (1-\alpha)\left(1 - \frac{\omega - \nu(\omega(\omega-1)/2)g}{T}\right) - (1-\alpha)\frac{W_0}{TY_t}, \qquad (18)$$

If the coefficient α equals zero, (18) is the same as equation (17), a pure form of the life cycle hypothesis of the saving rate. If α equals one, the saving rate is constant.

The government has extensively regulated Korean financial markets, though in recent years its intervention has been greatly relaxed. Especially, loans by banks to individuals, were greatly restricted. Until recently, no significant creditor mortgage loans were available to con-

[10] Carroll and Weil (1994, pp. 168-172) showed the negative growth rate effect on the household saving rate. Tobin (1967) also showed the negative correlation between aggregate growth and savings. For a comprehensive discussion on growth and savings, see Carroll and Weil (1994). .

[11] See Modigliani (1986) for a summarized description of the life-cycle hypothesis. Modigliani (1966) presented a positive relationship. For a counter-argument, see Russell (1977).

sumers. Restrictions and imperfections in consumer loan markets are likely to raise household saving rates.[12] In light of this expectation, let us introduce a measure of the restriction on loans by banks to households. It is very hard to find appropriate measures of the capital market imperfections; for instance, the data on actual loans relative to the amount households are willing to borrow from banks is difficult to acquire. Outstanding loans of commercial banks to the household sector as a proportion of Korean gross domestic product (GDP) is considered here to be a proxy for such imperfections.[13] The information on net worth of an individual age group is unavailable.[14] We utilized the net worth of the household sector of the economy as reported by the Bank of Korea. In addition, the saving rate of individuals at a higher per capita income level would be higher than at a lower per capita income level. Hence, we introduce a per household real disposable income variable as a determinant of household savings behavior. The age interval is a period of five years beginning from 25 years up through 54 years . However, there are two distinct groups; 24 years old and below, and 55 years old and above. These two groups differ from the other groups in terms of the age interval. To capture the possible differential effects, let us introduce two dummy variables, i. e. D24, and D55 for the group aged 24 and below, and aged 55 years and above, respectively.

The proposed econometric specification takes into account the life-cycle saving rate hypothesis and the other determinants we have introduced- the imperfections in consumer loan markets, the per capita income level, and the two dummy variables. It is specified in a linear form:

$$s_j = \beta_{1j} + \beta_{2j} T_j + \beta_{3j} g_j + \beta_{4j} \frac{W}{GDP} + \beta_{5j} \frac{LB}{GDP} + \beta_{6j} Y_j + \beta_{7j} D24 + \beta_{8j} D55 \qquad (19)$$

In (19), for age group j, sj is real savings per unit of household real disposable income, Tj is the years of the lifetime horizon of the household, which is the nationwide average life expectancy minus the mean ages of age group j, gj is the growth rate of household real disposable income, and Yj is the household real disposable labor income.[15] W is real net worth of the household sector of the economy at the beginning of period; LB is real loans outstanding of commercial banks to the

[12] See Deaton (1991), Jappelli and Pagano (1989), and Zeldes (1989) for detailed discussions on the role of capital market imperfections.

[13] Bentzel and Berg (1983) and Collins (1994) use a similar credit-to-GDP ratio for the study of the saving rate in Sweden and Korea, respectively.

[14] The National Statistical Office, *Annual Report on the Family Income and Expenditure Survey* does not include net worth or asset holding information by ages. It seems no such data are available in Korea.

[15] Time subscript is dropped in the text.

household sector of the economy. To capture possible age differential effects, we introduce two dummy variables; D24 is the dummy variable for the 24 and under age group and D55 is the dummy variable for the 55 and older age group.

V. The Data Sources

Since our interest is the saving rate behavior of households in different age groups, let us consider eight different age groups, i.e, the ages of, 24 years & below, 25~29 years, 30~34 years, 35~39 years, 40~44 years, 45~49 years, 50~54 years, and 55 years & above, based on the breakdown used in the National Statistical Office, *Annual Report on the Family Income and Expenditure Survey*, and *Report on Population and the Housing Survey*. Since the mean ages of the group of 55 years and older are in the range of 58 to 60 years old, we regard this group as the age group of 55~64 years. [16]

The primary sources of the data are *Annual Report on the Family Income and Expenditure Survey*, *Major Statistics of the Korean Economy*, *Korea Statistical Yearbook* and www.nso.go.kr by the National Statistical Office (NSO); *National Account*, and *Flow of Funds Accounts in Korea* published by the Bank of Korea. The Korean average life expectancy data are from the NSO's *Major Statistics of the Korean Economy*, *Korea Statistical Yearbook* and www.nso.go.kr , while the mean ages of each individual age group are from the NSO's *Annual Report on the Family Income and Expenditure Survey*. The lifetime horizon of an age group is the difference between the Korean average life expectancy and the mean age of each individual age group. The nominal net worth of the individual sector and the loans of commercial banks to the individual sector are from the Bank of Korea's *Flow of Funds Accounts in Korea.* The household's real net worth is the nominal net worth of the individual sector divided by the implicit GDP price deflator and real bank loans are the bank loans outstanding divided by the implicit GDP deflator.

Computation of household nominal income, disposable income, consumption, and savings for different age groups was done using data from the National Statistical Office, *Annual Report on the Family Income and Expenditure Survey* and *Report on Population and Housing Survey*. [17] The real disposable income and consumption data are obtained by di-

[16] It would have been more informative if NSO's data were possible to break down further the age group of 55 years and older into several different age groups, for example, the ages of 55~59 years, 60~64 years, 65~69 years, and 70 years and older.

[17] Household income dataincludes regular income—labor income, business income, asset income and transfers—and non-regular income—retirement allowance and gifts. Household non-labor income is very small.

viding the nominal disposable income and consumption by the implicit GDP deflator and consumption deflator, respectively. Real saving is the difference between real disposable income and real consumption, and the saving rate is the ratio of real savings to real disposable income.

Ⅵ. Empirical Results

Before presenting the regression results, let us observe the real saving rates by age groups in Table 8. Table 8 shows the trend of household saving rates by age groups over time. The Korean household saving rates appear to be humped shaped.[18] The saving rates in the four age groups covering the ages from 30 to 49 years are higher, around 28 percent, while the saving rates for the younger and elderly groups, are lower, about 24 and 25 percent, respectively. The saving rate of the age group 55 & above is slightly higher than the saving rate of the age group 50~54, particularly in recent years. The higher saving rate, instead of more dissaving according to the life-cycle hypothesis, would be a reflection of Korean retirement plans to let retirees receive lump sum payment at the time of their retirement.[19] In addition, the persons in the ages 55 and older realize the need for more saving for the future, as they believe that their life expectancy is longer.[20]

Equation (19) was estimated with the pooled cross-age session time series annual data of the Korean household sector between 1977 and 2002. The preliminary regression finding is that the bank loans to the GDP ratio, LB/GDP, were found to be marginally significant.[21] Regressions were run with and without this variable. We found that the esti mated equations had low Durbin-Watson statistics. This is not surprising, as our equations are likely to miss some factors affecting the behavior of household saving rates. However, the overall results are very satisfactory.

Table 9 presents four regressions. The saving rate of a one year time lag was tried to estimate a rate of adjustment of the saving rate. The

[18] Hump phenomenon also is reported to have occurred in Japan. See Horioka (1990), and Takayama and Kitamura (1994).

[19] The lump sum payment is a legal option. See Hyun and Cho (2000) for Korean the corporate retirement system. For a description of the Korean retirement system, see Bang (1998).

[20] In the presence of lifetime uncertainty, individuals want to undertake precautionary wealth accumulation. In this case, the saving rate would not be negative among retirees. See Abel (1985), Caballero (1991), Hayashi and Ando (1988) and Yaari (1965). Additional explanations include a bequest motive. See Bernheim, Shleifer and Summers (1985).

[21] The variable with a lag of one year was tried , but did not yield significant coefficient estimates. Also, the consumer loans by financial institutions yielded very insignificant coefficient estimates. Collins (1994, p.249) used the growth in domestic credit to GDP as an indicator of consumer credit constraints. She reported no significant relationship between the national saving rate and this variable.

<Table 8> Real Saving Rates by Age Groups (%)

	1985	1990	1995	2000	2002
Under 25	20.32	17.75	27.63	16.39	28.35
25～29	28.64	24.44	28.89	25.71	25.83
30～34	29.68	26.81	32.47	27.22	28.68
35～39	27.21	23.23	27.15	24.48	28.44
40～44	21.58	17.35	27.27	24.22	26.61
45～49	17.95	14.31	26.45	21.55	28.18
50～54	20.35	17.39	30.07	17.23	26.68
55 & over	17.80	22.41	29.26	23.94	28.47
Average	24.89	21.57	28.97	23.67	27.71

<Table 9> Household Saving Rates Equations

Eq. No.	9.1	9.2	9.3	9.4
constant	10.3	10.1	4.77	22.7
	[8.67]	[8.64]	[4.16]	[24.3]
T	0.45	0.45	0.31	
	[13.3]	[13.2]	[9.51]	
g	-0.13	-0.13	-0.03	-0.11
	[5.91]	[5.96]	[1.41]	[3.82]
W / GDP	-13.6	-14.5	-11.9	8.83
	[4.27]	[4.77]	[4.62]	[2.62]
LB / GDP	-4.81			
	[0.91]			
YD	0.51	0.51	0.36	-0.11
	[5.19]	[5.15]	[4.21]	[0.95]
D24	-7.62	-7.62	-5.19	-2.61
	[8.74]	[8.76]	[6.64]	[2.44]
D55	7.26	7.23	4.87	-1.39
	[7.75]	[7.73]	[5.86]	[1.51]
s(-1)			0.44	
			[9.12]	
Adj R2	0.55	0.55	0.68	0.17
SEE	3.16	3.17	2.66	4.32
DW	1.01	1.02	1.72	0.63

Note: Figures in [ ] are t-statistic.

coefficient estimates of the one year lagged saving rate variable are about 0.45 in equations (9.3), indicating that the adjustment of the saving rate is slow. As can be observed from the estimated equations, all the variables have the expected signs of their coefficient estimates. The coefficient estimates of the variables excluding the ratio of bank loans to GDP are highly significant. Other things being equal, the coefficient estimates for the lifetime horizon, T, indicate that as a longer lifetime horizon is expected, the saving rate of the household rises. The sign on the growth rate of per household real disposable income is consistently negative. This suggests that households calculate their life cycle income in a forward-looking manner. The result of a negative growth rate effect differs from the finding of Collins (1994) that the national saving-GDP ratio in Korea is positively correlated with unanticipated growth in real income. Collins (1994) inferred that Koreans regarded current income growth as transitory income.[22] In the period from 1989 to 2002, which is beyond the period of Collins' sample, the Korean economy has continued to maintain high growth rates. Hence, Koreans took an optimistic view about the future and lowered their saving rates.[23] This suggests that households calculate their life cycle income in a forward-looking manner.

A rise in the ratio of real net worth per GDP is found to reduce the saving rate, as expected. Household real disposable income has a positive effect on the saving rate, namely, as real income per household rises, households save more than what would be when their income were low. The coefficients of the two dummy variables are statistically significant. D24 has a negative coefficient, and D55 has a positive coefficient. The saving rate of the age group, 24 years and lower, is less than the average ratio of the savings to current income. The saving rate of the age group, 55 years and older, is higher than the average ratio. This might be a reflection of the individual decision to save more for precautionary purposes as they get closer to their retirement.

Life expectancy, T, is a demographic factor in the specification. We have not seen empirical studies on saving rates that used the lifetime horizon. Hence, we are interested in testing whether the results obtained with and without the variable differ statistically. We computed the F statistics, 162 from equations (9.3) and (9.4). These statistics exceed the critical value of F(1,201) ratio at the one percent level of significance, 6.85. Hence, we reject the null hypothesis that the coefficient of T is zero. Hence, the lifetime horizon variable is one of the most statistically significant determinants and greatly contributes to the explanation of saving rate variations.

[22] In Collins (1988, p.344), she stated that "current income is negatively related to income in the previous 2 years" Her interpretation of this result is that high current income is viewed as transitory.

[23] Campbell (1987) showed that anticipated increases in income lower saving rates.

<Table 10> Long-Run Elasticities of Household Saving Rates

Eq. No.	9.1	9.2	9.3
T	0.58	0.58	0.72
g	-0.03	-0.03	-0.01
W / GDP	-0.28	-0.30	-0.44
YD	0.33	0.33	0.41

Note: Long run elasticities are at the sample mean values.

Table 10 summarizes the computed elasticities of saving rates with respect to a change in the determinants at their sample mean values. The elasticities are computed from equations (10.1)-(10.3). Our discussions are made on the elasticities computed with equation (10.2). The elasticities with respect to a change in the lifetime horizon and the growth rate of real disposable income are 0.58 and –0.03, respectively. A one percent rise in the net-worth-to-GDP ratio reduces the saving rate by 0.3 percent. On the other hand, a one percent rise in per household real disposable income increases the saving rate by 0.33. Hence, the saving rates are inelastic to a change in the determinants.

Ⅶ. The Role of Dependency Ratios

Many past empirical studies on the economy-wide national saving rate found that the young-age dependency ratio and the elderly-dependency ratio were important, while a number of other studies disputed their importance.[24] On testing (not reported here) whether the two dependency ratios serve as additional determinants of household saving rates, the test results were not affirmative. To further examine whether the household saving rate is negatively correlated with the dependency ratios, we decided to run regressions of a variant of the specification used by Fry and Mason (1982) that covers the specification of Leff (1969), and Kang (1994). The equation specification is as follows:

$$s = \beta_1 + \beta_2 g + \beta_3 D24 + \beta_4 D55 + \beta_5 YDEP + \beta_6 ODEP + \beta_7 (g * YDEP) + \beta_8 (g * ODEP) \quad (20)$$

[24] Leff (1969) introduced a relationship between aggregate savings ratios and dependency ratios. Since then, many empirical studies reported a statistically significant negative relationships as well as an insignificant relationships. It seems that the empirical results are inconclusive. For empirical studies that obtained a negative relationship, see De Serres and Pelgrim (2002), Heller and Symansky (1997, p.11), Meredith (1995, p.37), and Ram (1982). For studies that disputed the relationship, see Koskela and Viren (1989).

where YDEP is the young-age dependency ratio defined as the ratio of the population of 14 years old and under to the population of 15 years old-64 years old, and ODEP is the old-age dependency ratio as the ratio of the population of 65 years old and above to the population of 15 years old-64 years old.

The two dependency ratios are constructed using data from the *Annual Report on the Economically Active Population Survey*, and *Major Statistics of the Korean Economy*, and www.nso.go.kr. The regression results are given in Table 11. The coefficient estimates of the growth rate in income variable in equations (11.1)-(11.3) are close to those given in Table 9 and are negative. The coefficient estimates are larger in the absolute value in equations (11.4)-(11.7) in which both g*YDEP and g*ODEP enter, whose coefficient estimates are positive and mostly insignificant.

<Table 11> Saving Rates Equations: Demographic Factors

Eq. No.	11.1	11.2	11.3	11.4	11.5	11.6	11.7	11.8
Constant	24.1	25.5	25.4	34.1	25.3	33.1	24.9	25.3
	[4.72]	[4.58]	[62.9]	[4.16]	[61.8]	[3.98]	[66.6]	[62.1]
g	-0.12	-0.11	-0.15	-1.22	-0.97	-1.15	-0.94	
	[3.77]	[3.75]	[4.74]	[1.63]	[1.97]	[1.52]	[1.89]	
D24	-2.08		-2.08	-2.13	-2.14			-2.09
	[2.29]		[2.19]	[2.35]	[2.28]			[2.21]
D55	-1.43		-1.42	-1.45	-1.36			-1.36
	[1.57]		[1.49]	[1.59]	[1.44]			[1.44]
YDEP	-0.07	-0.07		-0.18		-0.17		
	[1.21]	[1.19]		[1.97]		[1.87]		
ODEP	0.51	0.51		-0.21		-0.15		
	[1.34]	[1.29]		[0.33]		[0.24]		
g*YDEP				0.01	0.05	0.01	0.004	-0.003
				[1.55]	[1.12]	[1.43]	[1.05]	[2.65]
g*ODEP				0.08	0.08	0.08	0.08	0.005
				[1.38]	[2.04]	[1.26]	[1.96]	[0.51]
Adj R^2	0.18	0.16	0.11	0.19	0.12	0.17	0.11	0.12
SEE	4.28	4.34	4.48	4.28	4.44	4.33	4.49	4.46
DW	0.58	0.56	0.58	0.65	0.61	0.62	0.58	0.55

Note: Figures in [ ] are t-statistic.

The coefficient estimates of D24 are significantly negative, the same as in Table 9. The negative sign of the coefficient estimates of D55 differs from its positive sign reported in Table 9, and the coefficients are insignificant at the 5 percent level. The younger age dependency ratio, YDEP, has a negative coefficient. The estimates are marginally significant in two equations, (11.4) and (11.6). The elderly dependency ratio, ODEP, has insignificant coefficient estimates in the four equations. In the light of this evidence, the two dependency ratio variables do not seem to be of importance in explaining the household saving rate behavior in Korea during our sample period. [25]

Heller and Symansky (1998) reported their regression results which indicated that for the Asian "Tigers", the national saving rates were positively related to the growth rate and negatively to the dependency ratios. They also maintained that the private saving rates were not statistically related to the economic growth and the dependency ratios. This would raise an interesting issue: why would the national and private saving rates behave differently? Weil (1994) argues that bequests are the source of the discrepancy between the saving rate behaviors in micro and macro data.

Ⅷ. The Effects of Life Expectancy on Saving Rates

Table 12 contains selected demographic information from the National Statistical Office (2001), *Population Projections for Korea: 2000-2050*. The rate of increase in Korea's population is projected to fall in the future, and it will become negative in 2030. The index of aging will increase from 38 percent in 2002 to 186 percent in 2030. Furthermore, life expectancy is projected to rise from 77.3 years in 2002 to 81.5 years in 2030. It seems clear that Korea will have joined the class of aging countries.

In light of the expected changes in these demographics, it is interesting to explore the implications for Korea's saving rates. Our inquiry is limited, however, to estimating the extent the economy wide saving rate would rise or fall, when the duration of life expectancy rises in Korea as projected, ignoring the impact of any feedback relationship.

[25] Collins (1994) reported no statistically significant relationship between the national saving rate and the economy's dependency ratios (shares of the population under age 15 or over 65) in the Korean case. Heller and Symansky (1997, p. 35) reported their regression results which indicated that for the Asia " Tigers", the national saving rates were positively related to the growth rate and negatively to the dependency ratios, whereas the private saving rates were not statistically related to the economic growth and the dependency ratios. This would raise an interesting issue: why would the national and private saving rates behave so differently? .Weil (1994) argues that bequests are the source of the discrepancy between the saving rate behaviors in micro and macro data.

<Table 12> Projections of Population, Dependency, and Life Expectancy

Age Groups	2010		2020		2030	
	millions	%	Millions	%	millions	%
Total	49.59	100.00	50.65	100.00	50.30	100.00
0~14	8.55	17.24	7.03	13.89	6.22	12.36
15~64	35.74	72.07	35.95	70.97	32.48	64.57
15~19	3.46	6.97	2.72	5.37	2.32	4.61
20~24	3.08	6.21	3.16	6.24	2.50	4.97
25~29	3.80	7.66	3.42	6.75	2.69	5.35
30~34	3.82	7.70	3.06	6.04	3.14	6.24
35~39	4.32	8.71	3.77	7.45	3.40	6.76
40~44	4.18	8.43	3.77	7.44	3.02	6.01
45~49	4.17	8.41	4.23	8.36	3.71	7.37
50~54	3.90	7.87	4.08	8.06	3.69	7.34
55~59	2.81	5.66	4.03	7.96	4.11	8.18
60~64	2.21	4.46	3.70	7.31	3.89	7.74
65~95+	5.30	10.69	7.67	15.14	11.60	23.07
65~69	1.79	3.60	2.57	5.07	3.71	7.38
70~74	1.52	3.06	1.91	3.77	3.25	6.45
75~79	1.04	2.09	1.39	2.74	2.08	4.13
80~84	0.57	1.15	1.00	1.98	1.32	2.62
85~89	0.28	0.56	0.54	1.07	0.75	1.48
90~94	0.09	0.18	0.20	0.40	0.38	0.75
95+	0.02	0.04	0.05	0.10	0.13	0.26
Growth Rate,%	0.41		0.06		-0.21	
Youth Dependency,%	23.93		19.57		19.15	
Eldly Dependency,%	14.83		21.33		35.73	
Index of Aging,%	62.00		109.00		186.63	
Life Expectancy(yrs.)	78.80		80.70		81.50	

Source: National Statistical Office, *Population Projections for Korea*, and www.nso.go.kr, 05/02/03.

The aggregate saving rate is a weighted average of s_j, the saving rate of age group j, and its weight is its income share.[26] The real net saving rate is a weighted average of the private and government real net saving rates.[27] We consider first the private saving rate and three broad age groups: (a) 14 years and younger, (b) between 15 years old and 64 years old, and (c) 65 years and older. We have the data on the age group distributions of Korea's population. The per capita income shares of the age group, 14 years and younger, is assumed to be zero given the child labor regulations, leaving no need for its saving rate information. For the age group, 15 years through 64 years, the future age distributions of saving rates and real disposable income are assumed to remain the same as that of the group in 2002. We computed the lifetime duration of individual jth age group, T_j, that is the average life expectancy of Korea minus the mean years of individual jth age group in the years 2002, 2010, 2020, and 2030 from the NSO (2001) and www.nso.go.kr. We generated $s_{j,t}$ using $s_{j,t} = s_{j,t-1}(1 + E_{j,t}), E_{j,t} = 0.58 \times \Delta T_{j,t} / T_{j,t-1}$, and 0.58 is the elasticity estimate of the saving rate with respect to a change in T_j. We assumed that the per capita income share of jth age group, $Y_j / \overline{Y}$, remains at the level of the per capita income share in the year 2002, implying no changes in the relative per capita income shares. Using this assumption together with the population projections and calculated saving rates, we calculated the mean saving rate of the 15-64 age group. The calculation results are given in Table 13. The projected rise in life expectancy leads to higher saving rates for all age groups in the active working population. The effect of a rise in life expectancy is a 6.1 percent increase in the mean saving rate, an increase from 27.7 percentage points in 2002 to 29.7 percentage points in 2030. The rise in the saving rates support the life cycle hypothesis conclusion that households save more during their working years.

Next, we consider the age group, 65 years and above. Data are not available on the saving rates and incomes by different sub-groups in this age group for the year 2002. It was therefore necessary to make heroic assumptions in the absence of statistical information from Ko-

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[26] To show this, let Nj , Yj , and Sj be the number of persons, per capita income, and savings in jth age group. Aggregate income and savings are the sum of income and savings of individual aging groups. They are given by $S = \sum_{i=1} s_i N_{ii} Y_i$, $Y = \sum_{i=1} N_i Y_i$ and the aggregate saving rate may be expressed as,

$$s = \frac{S}{Y} = \sum_{i=1} \mu_i s_i, \; where \; \mu_i = (\frac{N_i}{N})(\frac{Y_i}{\overline{Y}}), \; \overline{Y} = (\sum_i N_i Y_i) / N, \; N = \sum_i N_i.$$

[27] Saving rates computed by the ratio of nominal savings to nominal income do not capture differential changes in price levels. The nominal and real net saving rates differ substantially; for 2002, the nominal and real net saving rates are 20.1 and 33.1 percent, respectively. Net saving rates are more appropriate than gross saving rates, since net savings is one of the sources available for capital investment.

rea: that the distributions of relative per capita income shares and saving rates of the sub-age groups of 55-64, 65-69, and 70-74 in the year 2002 are the same as those reported by Attanasio (1994, Tables 2.12) for the United States. Per capita income and the saving rate of the sub-age group of 75-79 years old were calculated using the ratios of per capita income and saving rate of the 75-70 age group to those of the 70-74 years old reported by Takayama and Kitamura (1994, Tables 3.2 and 3.9) for Japan. The distributions of the sub-group of 80 years and above are not reported in the two articles. The labor participation rate in Korea by the population 80 years old and above is virtually zero, and Koreans are very likely to retire before reaching 80. We assumed that per capita income for those 80 years and above is zero. Using the saving rate $s_{j,t}$ so calculated for the year 2002 and $s_{j,t} = s_{j,t-1}(1+E_{j,t})$,

<Table 13> Prediction of Household Real Net Saving Rates Associated with Life Expectancy Changes

age group	2002	2010	2020	2030
15~64	27.77	28.40	29.27	29.69
%		2.24	3.02	1.40
15~24	28.35	28.79	29.34	29.58
25~29	25.83	26.27	26.82	27.05
30~34	28.68	29.21	29.89	30.17
35~39	28.44	29.04	29.79	30.10
40~44	26.61	27.25	28.04	28.37
45~49	28.18	28.96	29.93	30.33
50~54	26.68	27.56	28.66	29.11
55~64	28.47	29.82	31.48	32.17
65+	9.07	6.81	7.04	6.87
%		-28.73	3.43	-2.46
65~69	16.04	17.35	18.92	19.56
70~74	2.49	2.87	3.31	3.49
75~79	2.29	-8.47	-12.89	-14.56
80+				
0~90+	26.49	26.57	26.77	25.71

Note: Predictions allow changes in the duration of life expectancy. They do not consider its feedback effects.
Source: The population projection by age and life expectancy figures are from National Statistical Office, *Population Projections for Korea* and www.nso.go.kr.

<Table 14> Prediction of National Real Net Saving Rate with the Assumed Life Expectancy

	2002	2010	2020	2030
Private				
Survey 0~95+	26.49	26.57	26.77	25.71
%		0.003	0.007	-0.04
NIA (A)	23.16	23.23	23.39	22.47
Government				
Real reveune	115083.7	151543.3	213766.8	301539.2
Growth %	6.4	3.5	3.5	3.5
Per GDP,%	21.93	21.93	21.93	21.93
Real consumption	42083.2	55415.54	78169.09	110265.2
Growth,%	2.91	3.5	3.5	3.5
per GDP,%	8.02	8.02	8.02	8.02
Aging Expendires	0.00	6909.16	38984.20	96234.35
per GDP,%		1.00	4.00	7.00
Government saving	73000.5	89218.6	96613.5	95039.6
per revenue, % (B)	63.43	58.87	45.20	31.52
per GDP,%	13.91	12.91	9.91	6.91
National Net Saving Rate				
0.75*(A)+0.25*(B)	33.08	32.14	28.84	24.73
% change		-2.83	-10.25	-14.24

Note: 1) Aggregate net saving rate in NIA account is a weighted average of private and government Saving rate, and the weight for the private saving rate in 2002 is 0.75.

2) We assume that real revenue net of capital consumption grows at 3.5 percent per year. And real government consumption expenditure grows at 3.5 per cent per year.

3) The medical and social safety net expenditures for the elderly per GDP are assumed to rise 1 percent for the 2003-2010, 4 percent for the 2011-2020 period, and 7 percent for the 2021-2030 period.

$E_{j,t} = 0.58 \times \Delta T_{j,t} / T_{j,t-1}$, we generated the saving rate for individual sub-age groups over time. Then, we computed the mean saving rate for the age group, 65 years old and above, as reported in Table 14. The calculated value of the group's saving rate declines from 9.08 percentage point in 2002 to 6.87 percentage point in 2030, a reduction of 24 percent, which is also consistent with the life cycle hypothesis.

We calculated the mean saving rate of the household sector, the income share weighted average of the saving rates of the two age groups,

5~64 and 65+, for the years 2010, 2020, and 2030. Assuming that the growth rate of private savings is identical to the growth rate of the household sector's saving rate, the private net saving rates are computed with the benchmark saving rate for the year 2002, 23.16 percentage point, and the calculated figures are presented in Table 14. The private real net saving rate is estimated to decline to 22.47 percentage point by the year 2030. The effect of the projected rise in life expectancy is a 3.3 percent decline in private saving rates from 2002 to 2030.

We turn to the impact on the government real net saving rate of lifetime changes. Under normal circumstances, one can project real government revenues and expenditures in Korea on the basis of assumed annual growth rates of 3.5 percent and 3.5 percent.[28] An increase in life expectancy would lead to additional real government expenditures for the elderly. We assumed that government expenditures per GDP increase by one percent per year in 2003-2010, by four percent in 2011-2020, and by seven percent in 2021-2030.[29] Adding the extra government expenditures for the elderly population to the projected government expenditures under normal circumstances would lower the government saving rate from 63.43 percentage points in 2002 to 31.52 percentage points in 2030, a decline of 51 percent from 2002 to 2030. Before 2010, the demographic effects are small. However, the effects increase as the elderly dependency ratio rises.

Finally, as a result of the rise in life expectancy, the real net saving rate of Korea would fall from 33 percentage points of GDP in 2002 to 24.7 percentage points in 2030, a 25 percent decline. The decline largely resulted from the government's supplying services that are sensitive to demographic changes. While the private saving rate is a little bit sticky, the needs of the rising elderly population would be met by fiscal expansion.

Ⅸ. Summary and Conclusion

Korea will face an increase in its aging population in the next 20 years and beyond. The increasing elderly population distribution will have an influence on the economic growth and social development of Korea.

[28] We assumed that the real GDP growth rate is 3.5 percent over the 2003 to 2030 period. The real GDP growth assumption is lower than, or is consistent with, the projected growth rate reported in Global Insight, *Quarterly Review and Outlook*, First Quarter 2003, pp. 97. Further, we assumed that the real GDP elasticty of real revenues and expenditures is one.

[29] The assumptions are based on the estimated narrow demographic effects on overall government expenditures as given in Heller and Symansky (1998, Table 4). See Heller (1999, Tables 1 and 2) for the estimated effects on public pension and health outlays.

Under the extended life cycle hypothesis on saving rates, the real saving rate of household is affected by the duration of lifetime, growth rates of income, credit availability, and per household real disposable income. We have tested the saving rate hypothesis empirically using Korean household survey data of cross-age pooled time series over the period of years, 1977-2002.

Our empirical results suggest that Korean household saving rates are consistent with the life-cycle/permanent income hypothesis. Real saving rates increase when the duration of lifetime and per household real income rise, and they decrease when the growth rate of real income and net worth–to-GDP ratio rise. Young- and old-age dependency ratios are found to have played an insignificant role in determining the saving rates.

A rise in life expectancy and a larger share of elderly are projected to occur for Korea from 2002 to 2030. All other things being equal, these demographic changes are estimated to bring about a modest reduction in the private real net saving rate. We show a substantial decline in the government real net saving rates. Consequently, the effect on the national real net saving rate of the rise in life expectancy is a 25 percent decline from 33 percentage points in 2002 to 24.7 percentage points in 2030.

The aging population and a rise in life expectancy are likely to lead to a fall in the domestic saving rate. The decline in the domestic savings ratio lowers growth in output per worker The resulting rise in capital productivity causes capital inflows and an appreciation of Korea's currency. Consequently a reduction in the current account surplus is likely to occur. Of course, appropriate policy changes will prevent this adverse effect from occurring.

The estimated effects on the saving rate and particularly the government saving rate are based on assumptions that are not necessarily reliable. Furthermore, our estimation does not take into account the possible feedback effects of improvements in life expectancy on the economy and the potential role of fiscal policy changes, for example, raising the retirement age, cutting benefits or raising taxes. Comprehensive study is desirable to provide comprehensive answers concerning to the extent the aging population will influence the economy in Korea. Comprehensive study remains as our future study.

REFERENCES

Abel, Andrew B., "Precautionary Saving and Accidental Baquests," *American Economic Review*, 74, 4, September 1985, pp.777～788.

Aghion, Phlippe and Peter Howitt, *Endogenous Growth Theory*, Cambridge: MIT Press, 1998.

Ando, A. and F. Modigliani, "The Life Cycle Hypothesis of Saving :Aggregate Implications and Tests," *American Economic Review*, 53, May 1963, pp. 55～84.

Attanasio, Orazio P, "Personal Saving in the United States," in James M. Poterba (ed.), *International Comparisons of Household Saving*, Chicago: the University of Chicago Press, 1994, pp. 57～124.

Attanasio, Orazio P., and G. Weber, "Is Consumption Consistent with Intertemporal Optimization? Evidence from the Consumer Expenditure Survey," *Journal of Political Economy*,103, 6, December 1975, pp. 1121～1157.

Bang, Ha Nam, "Retirement System of Korean Corporations" (in Korean), *Study Report of Korea Labor Institute*, No. 1998-004, 1998

Bang, Hong Gi, "Economic Effects and Issues in an Aging Society," (in Korean), *Monthly Bulletin of the Bank of Korea*, 2, 2003, pp. 56～84.

Bank of Korea, *National Income.*

Bank of Korea, *Flow of Fund Accounts in Korea.*

Barro, Robert J. and Xavier Sala-I-Martin, *Economic Growth*, McGraw-Hill, 1995.

Bernheim, B. Douglas, A. Shleifer, and Lawrence H. Summers, "The Strategic Bequest Motive," *Journal of Political Economy*, 93, 6, December 1985, pp. 1045～1076.

Bentzel, Ranger, and L. Beng, "The Role of Demographic Factors as a Determinant of Savings in Sweden," in F. Modigliani, and R. Hemming(ed.), *The Determinants of National Saving and Wealth*, New York: St. Martin's Press, 1983, pp. 152～188.

Caballero, Ricardo J., "Earnings Uncertainty and Aggregate Wealth Accumulation," *American Economic Review*, 81, 4, September 1991, pp. 859～871.

Campbell, John Y., "Does Saving Anticipate Declining Labor Income? An Alternative Test of the Permanent Income Hypothesis," *Econometrica*, 55, 6, November 1987, pp.1249～1273.

Carroll, Christopher D., "Buffer-Stock Saving and the Life Cycle/Permanent Income Hypotheses," *Quarterly Journal of Economics*, CXII, 1, February 1997, pp. 1～55.

Carroll, Christopher D., "How Does Future Income Affect Current Consumption," *Quarterly Journal of Economics*, CIX, 1, February 1994, pp. 111～147.

Carroll, C. D. and David N. Weil, "Saving and Growth: a Reinterpretation,"

Carnenegi-Rochester Conference Series on Public Policy, 40, 1994, pp. 133～192.

Collins, Susan M., ''Savings and Growth Experiences of Korea and Japan, '' *Journal of the Japanese and International Economies*, 2, 3, Sepember 1988, pp.328～350.

Collins, Susan M., ''Saving, Investment, and External Balances in South Korea, '' in S. Hoggard, R. Cooper, S. Collins, Choonsoo Kim, and Sung Tae Ro, (eds,), *Macroeconomic Policy and Adjustment in Korea, 1970-1990*, Seoul: Korea Development Institute, 1994, pp. 231～259.

Cutler, David M., J. Potterba, L. Sheiner, and L. Summers, ''An Aging Society: Opportunity or Challenge?,'' *Brookings Papers on Economic Activity*, 1990 :1, pp. 1～73.

Davies, James B., "Uncertain Lifetime, Consumption, and Dissaving in Retirement," *Journal of Political Economy*, 89, 3, June 1981, pp.561～577.

De Serres A. and F. Pelgrin, "The Decline in Private Saving Rates in the 1990s in OECD Countries: How Much Can Be Explained by Non-Wealth Determinants?" OECDEconomics Department Working Paper No. 344, December 2002.

Deaton, Angus, "Saving and Liquidity Constraints," *Econometrica*, 59, 5, September 1991, pp. 1221～1248.

Economic Planning Board, *Korean Economic Yearbook*, 1984. (in Korean)

Farrell, M. J., "The Magnitude of "Rate-of-Growth" Effects on Aggregate Saving," *Economic Journal*, 80, 320, December 1970, pp. 873～894.

Friedman, Milton, *A Theory of the Consumption Function*, Princeton: Princeton University Press, 1957

Fry, Maxwell J. and A. Mason, "The Variable rate of Growth Effect in the Life Cycle Saving Model," *Economic Inquiry*, XX, 3, July 1982, pp. 426～442.

Global Insight, *Quarterly Review and Outlook*, First-Quarter 2003.

Graham, John W., "International Differences in Saving Rates and the Life Cycle Hypothesis: Reply and Further Evidence," *European Economic Review*, 33, 7,September 1989, pp. 1499～1507.

Graham, John W., "International Differences in Saving Rates and the Life Cycle Hypothesis," *European Economic Review*, 31, 8, December 1987, pp. 1509～1529.

Guariglia, Alessndra, "Saving Behaviour and Earning Uncertainty: Evidence from the British Household Panel Survey," *Journal of Population Economics*, 14, 2001, pp. 619～634.

Guiso, L, T.J. Jappelli, and D. Terlizzese, "Saving and Capital Market Imperfections: The Italian Experiences," in Koskella and J. Paurio, (ed), *Saving Behavior-Theory, International Evidence and Policy Implications*, Cambridge: Blackwell Publisher, 1992, pp. 43～982

Hayashi, F. and A. Ando, "Life Cycles and Banquest Saving," *Journal of the Japanese and International Economies*, 2, 4, December 1988, pp. 490～491.

Heller, Peter S., "Aging in Asia: Challenges for Fiscal Policy," *Journal of Asian Economies*, 10, 1999, pp. 37～63.

Heller, Peter S. and Steve Symansky, "Implications for Savings of Aging in the Asian "Tigers"," *Asian Economic Journal*, 12, 3, September 1998, pp. 219～252.

Horioka, Charles Yuji, "Why is Japan's Household Saving Rate so High?, A Literature Survey," *Journal of the Japanese and International Economies*, 4,1, March 1990, pp.49～92.

Hyun, Am, and Sang Won Cho, (ed.), *A Code of Law*, Seoul: Hyun Am Co, 2000(in Korean)

Guiso, L, T. Jappelli, and D. Terlizzese,"Saving and Capital Market Imperfections: The Italian Experiences", in Koskella and J. Paurio, (ed.), *Saving Behavior-Theory, International Evidence and Policy Implications*, Cambridge: Blackwell Publisher, 1992, pp. 43～982

Jappelli, J. and M Pagano, "Consumption and Capital Market Imperfections: An International Comparison," *American Economic Review*, 79,3, December 1989, pp. 1088～1105.

Kang, Kenneth H., "Why Did Koreans Save So "Little" and Why Do They Now Save So "Much?"," *International Economic Journal*, 8, 4, Winter 1994, pp.99～111.

Kohl, Richard, and Paul O'Brien, "The Macroeconomics of Ageing, Pensions and Savings: A Survey," OECD Economics Department Working Paper No. 200, June 1998.

Korea Development Bank, "Effects of an Aging Society on the Korean Economy and Financial Market," *KDB Monthly Bulletin*, 568, March 2003, pp. 32～60. (in Korean)

Korea Statistical Office, *Major Statistics of Korean Economy*

Koskela, Erkki, and Matti Viren , "International Differences in Saving Rates and the Life Cycle Hypothesis: A Comment," *European Economic Review*, 33, 7, September 1989, pp. 1489～1498.

Kwack, Sung Yeung, "Household Saving Behavior and the Effect of Income Growth and Life Expectancy: Evidence form Korea Househole Survey Data," November 2003, unpublished article.

Kwack, Sung Yeung, "Saving Rate and Income Growth, Life Expectancy: Evidence from Korea Household Survey Data," November 2003, unpublished article

Kwack, Sung Yeung, "The Impact of Aging Population in Korea on Economic Growth: Household Saving Rate Behavior," presented at the 2003 KDI-KAEA Conference at KDI on July 2003, Seoul, Korea

Lee, En Mi,, "Economic Implications and Policies in an Aging Era," *Issue Paper of Sam Sung Economic Research Institute*, December 12, 2002. (in Korean)

Lee, Hae Hoon,, "Economic Impacts of Aging Population,"*Labor Policy Studies of Korea Labor Institute*, 2,2, 2002, pp. 23～41. (in Korean)

Leff, Nathaniel H., "Dependency Rates and Saving Rates," *American Economic Review*, 59, 5, December 1969, pp.886～890.

Leland, Hayne E., "Saving and Uncertainty: The Precautionary Demand for Saving," *Quarterly Journal of Economics*, LXXXII, 3, August 1968, pp.465～

473.
Masson, Paul R. and Ralph W. Tryon, "Macroeconomic Effects of Projected Population Aging in Industrial Countries," *IMF Staff Papers*, 37, 3, September 1990, pp. 453～597.
Meade, James E., "Life-Cycle Saving, Inheritance, and Economic Growth," 1966. *Review of Economic Studies*, XXXIII(1), 93, Janaury 1966, pp. 61～78.
Meredith, Guy, "Demographic Change and Household Saving in Japan," in Ulrich Baumgartner and Guy Meredith, (ed.), *Saving Behavior and the Asset Price "Bubble" in Japan: Analytical Studies*, IMF Occasional Paper No. 124, 1995, pp. 36～45.
Ministry of Labor (Korea), *Report on Wage Survey by Occupational Category*.
Ministry of Labor (Korea), *Yearbook of Labor Statistics*.
Modigliani, Franco., "Life Cycle, Individual Thrift, and the Wealth if Nations," *American Economic Review*, 76, 3, June 1986, pp. 296～314.
Modigliani, Franco, "The Life Cycle Hypothesis of Saving and Intercountry Differences in the Saving Ratio" in W. A. Eltis, M. F. Scott, and J. N. Wolfe, *Induction, Growth, and Trade: Essays in Honor of Sir Roy Harrod*, Oxford: Clarendon Press, 1970, pp. 197～225.
Modigliani, Franco, "The Life Cycle Hypothesis, the Demand for Wealth, and the Supply of Capital," *Social Research*, 33, 2, Summer 1966, pp. 160～217.
Modigliani, F. and R. Brumberg, "Utility Analysis and Aggregate Consumption Function: An Interpretation of Cross Section Data," in Kenneth K. Kurihara (ed.), *Post Keynesian Economy*, New Brunswick: Rutgers University Press, 1954, pp. 388～436.
Modigliani, Franco, and A. Stering, "Determinants of Private Saving with Special References to the Role of Social Security-Cross Section Tests" in F. Modigliani and R. Hemming (ed.), *The Determinants of National Saving and Wealth*, New York: St. Martin's Press, 1983, pp. 24～55.
National Statistical Office (Korea), *Annual Report on the Economically Active Population Survey*.
National Statistical Office, *Comprehensive Time Series Report on the Economically Active Population Survey: 1963-1993*, December 1994.
National Statistical Office, *Annual Report on the Family Income and Expenditure Survey*.
National Statistical Office, *Major Statistics of the Korean Economy*.
National Statistical Office (Korea), *Korea Statistical Yearbook*.
National Statistical Office (Korea), *Report on Population and Housing Census in Korea*.
National Statistical Office (Korea), *Population Projections for Korea: 2000-2050*, 2001. 12.
Obstfeld, Maurice and K. Rogoff, *Foundations of International Macroeconomics*, Cambridge: the MIT Press, 1997
Pagano, Marco, "Financial Markets and Growth: An Overview," *European Economic Review*, 37, 2/3, April 1993, pp. 612～622
Ram, Rati, "Dependency Rates and Aggregate Savings: A New International

Cross-Section Study," *American Economic Review*, 72, 3, June 1982, pp. 537～544.

Ramsey, Frank, P., "A Mathematical Theory of Saving," *Economic Journal*, XXXVIII, 152, December 1928, pp. 543～559, and in Joseph E. Stiglitz and Hirofumi Uzawa (ed.), *Readings in the Modern Theory of Economic Growth*, Cambridge: the MIT Press,1969, pp. 427～445.

Romer,David, *Advanced Macroeconomics*, MaCraw Hill Co, 1996.

Russell, Thomas, "Rate of Growth Effects on Aggregate Savings: Further Analysis,"*Review of Economic Studies*, XLIV(1), 136, February 1977, pp. 153～168.

Skinner, Jonathan, "Rsiky Income, Life Cycle Consumption, and Precautionary Savings," *Journal of Monetary Economics*, 22, 2, September 1988, pp. 237～255.

Soderstrom, Lars, "The Life Cycle Hypothesis and Aggregate Household Saving," *American Economic Review*, 172,9, June 1982, pp. 590～596.

Solow, Robert N. "A Contribution to the Theory of Economic Growth," *Quarterly Journal of Economics*, 70,1, February 1956, pp. 65～94.

Takayama, N. and Y. Kitamura, "Houshold Saving Behavior in Japan," in Poterba, James M. ed. *International Comparisons of Household Saving*, Chicago: the University of Chicago Press, 1994, pp. 125～167.

Tobin, James,"Life Cycle Saving and Balanced Growth," in William Fellner, et al., eds, *Ten Economic Studies in the Tradition of Irving Fisher*, New York: John Wiley, 1967, pp. 231～256.

Turner, D., C. Giorno, C., A. de Serres, A. Vourc'h, and P. Richardson, "The Macroeconomic Implications of Aging in a Global Context," OECD Economics Department Working Paper No. 193, March 1998

Weil, David N., "The Saving of the Elderly in Micro and Macro Data," *Quarterly Journal of Economics*, CIX, 1, February 1994, pp. 55～79.

Weil, Phillippe, "Overlapping Families of Infinitely-Lived Agents," *Journal of Public Economics*, 38, 1989, pp. 183～198.

Yarri, M. E., "Uncertain Lifetime, Life Insurance, and the Theory of the Consumer," *Review of Economic Studies*, 32(2), 90, March 1965, pp. 137～150.

Yarri, M. E., "On the Consumer Lifetime Allocation Process," *International Economic Review*, 5, 3, September 1964, pp. 304～317.

Zeldes, Stephen P., "Consumption and Liquidity Constraints: An Empirical Investigation," *Journal of Political Economy*, 97, 2, April 1989, April 1989, pp. 305～346.