CHAPTER 5

Insurance Markets for the Elderly

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Abstract

We describe the risks faced by the aging population and survey the corresponding insurance markets for these risks. We focus on income risk, health expenditure risk, long-term care expenditure risk, and mortality risk. We also discuss the interactions between social insurance and private insurance markets.

Keywords

Social insurance, Private insurance markets, Life insurance, Annuity insurance, Health insurance, Long-term care insurance, Risk

JEL Classification Codes

D14 (personal finance), G22 (insurance), I13 (health insurance, public, and private)

1. INTRODUCTION

Many nations, including almost all of the industrialized countries, are facing challenges from several demographic developments. First, the baby-boomer generation, the large cohort born within two decades after World War II, is approaching retirement and old age. Second, fertility rates have fallen in most countries. Third, mortality rates have also been falling, and life expectancies have been rising. These demographic trends will lead to a significant increase of both the number and percentage of the elderly population (those older than 65) and the very old population (those older than 85). Table 1 shows the number and percentage of the US population that are, respectively, aged 65 and over and 85 and over. It shows that the percentage of the population aged 65 and over in the United States has risen from about 8% in 1950 to 13% in 2010, and it is expected to further increase to close to 20% in the coming decades. Moreover, average life expectancies for both men and women at age 65 have been rising, which leads to an increasing proportion of the very oldest (age 85 and over). Table 1 shows that the percentage of population age 85 and over has risen substantially from 0.4% in 1950 to 1.8% in 2010 and is projected to increase to 4.3% in 2050.

The aging population trend is by no means unique to the United States. In fact, the United States is relatively young compared to Europe and Japan. Table 2 shows, according to United Nations Population Prospects (2010), the percentage of the population aged 65 and over in 2010 and projections for 2030 and 2050. It shows that while Europe and Japan populations are currently the oldest, several Asian countries and regions will join the ranks of the oldest by 2030.

Table 1 Number and percentage of people age 65 and over and age 85 and over, selected years 1900–2010 and projected 2020–50

	65 and over		85 and over	
Year	**Number (millions)**	**Percent (%)**	**Number (millions)**	**Percent (%)**
1900	3.1	4.1	0.1	0.2
1910	3.9	4.3	0.2	0.2
1920	4.9	4.7	0.2	0.2
1930	6.6	5.4	0.3	0.2
1940	9.0	6.8	0.4	0.3
1950	12.3	8.1	0.6	0.4
1960	16.2	9.0	0.9	0.5
1970	20.1	9.9	1.5	0.7
1980	25.5	11.3	2.2	1.0
1990	31.2	12.6	3.1	1.2
2000	35.0	12.4	4.2	1.5
2005	36.7	12.4	4.7	1.6
2010	40.3	13.0	5.5	1.8
2020*	54.8	16.1	6.6	1.9
2030*	72.1	19.3	8.7	2.3
2040*	81.2	20.0	14.2	3.5
2050*	88.5	20.2	19.0	4.3

Source: US Census Bureau, 1900–40, 1970, and 1980, US Census Bureau, 1983, Table 42; 1950, US Census Bureau, 1953, Table 38; 1960, US Census Bureau, 1964, Table 155; 1990, US Census Bureau, 1991, 1990 Summary Table File; 2000, US Census Bureau, 2001, Census 2000 Summary File 1; US Census Bureau, Table 1: Intercensal Estimates of the Resident Population by Sex and Age for the US: April 1, 2000 to July 1, 2010 (US-EST00INT-01); US Census Bureau, 2011. 2010 Census Summary File 1; US Census Bureau, Table 2: Projections of the population by selected age groups and sex for the United States: 2010–50. For the years with *, the numbers are projected.

The increasing percentage of the elderly in the population will raise the dependency ratio (see Table 3 for selected OECD countries) and impose significant strains on the financing of social insurance programs, eg, the US Social Security system and the Medicare program (which is the government-provided medical insurance program for the retirees in the United States), that most of the retirees rely on. Fig. 1 plots the sources of income for married couples and nonmarried persons aged 65 and over. It shows that since the early 1960s, Social Security has provided the largest share of the total income for older Americans, at around 40%. It also shows that the share of income from pension withdrawals increased rapidly in the 1960s and 1970s to a peak in 1992, but has fluctuated since then at about a fifth of aggregate income. The share of income from assets peaked in the mid-1980s and has generally declined since then. The share from earnings has shown the opposite pattern—declining until the mid-1980s and generally increasing since then. In 2010 the aggregate income for the population aged 65 and over came largely from four sources: Social Security accounted for 37%, earnings 30%, pensions 19%, and asset incomes 11%. Given the rising elderly dependency ratio, projected for the United States

Table 2 Sixteen oldest countries in 2030 according to the percentage of age 65 and over

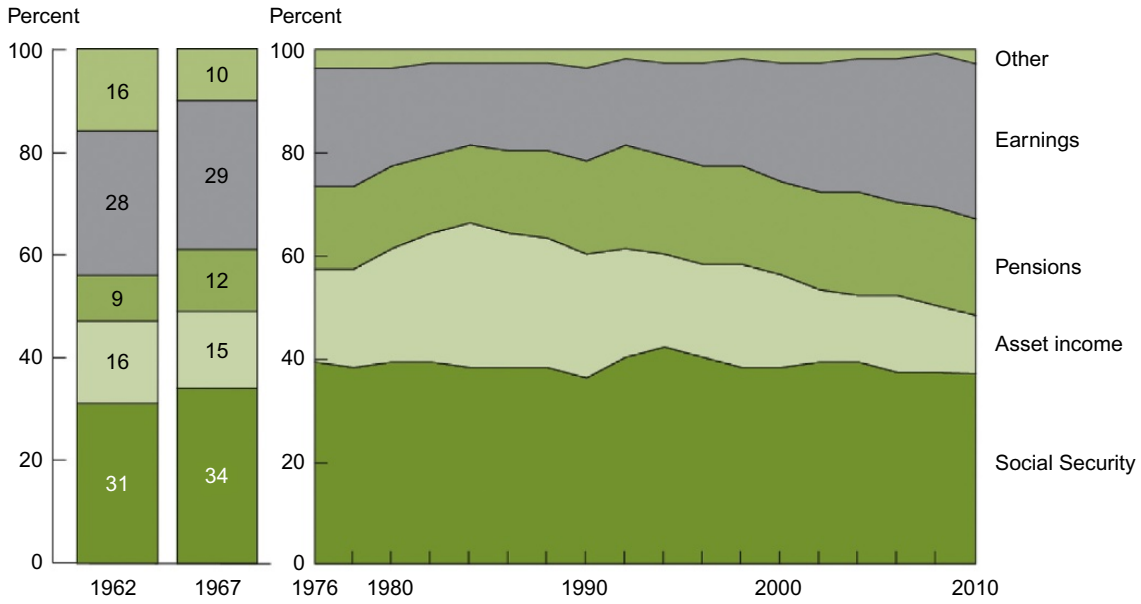
Country	65 and over (rank)		
	2010	2030	2050
Japan	22.6% (1)	30.8% (1)	37.8% (1)
Germany	20.5% (2)	28.2 (2)	32.5% (6)
Singapore	10.2% (51)	27.5% (3)	32.6% (4)
Italy	20.4% (3)	26.8% (4)	33.3% (3)
Hong Kong	12.9% (41)	26.3% (5)	32.6% (5)
Finland	17.2% (13)	25.1% (6)	25.9% (27)
Austria	17.6% (8)	24.8% (7)	29.4% (15)
Slovenia	16.4% (19)	24.6% (8)	30.2% (13)
Portugal	17.9% (6)	24.5% (9)	32.1% (7)
France	17.0% (16)	24.3% (10)	26.9% (20)
Belgium	17.4% (10)	24.1% (11)	26.6% (21)
Switzerland	17.3% (12)	24.1% (12)	26.0% (24)
Greece	18.3% (4)	24.0% (13)	31.3% (9)
Netherlands	15.4% (23)	23.8% (14)	25.6% (29)
Croatia	17.3% (11)	23.8% (15)	28.2% (18)
South Korea	11.0% (49)	23.2% (16)	34.2% (2)
United States	13.0%	19.8%	21.6%
EU 27	17.5%	23.8%	28.7%
World	7.6%	11.7%	16.3%

Source: United Nations, World Population Prospects: The 2012 Revision.

Table 3 Elderly dependency ratios in OECE countries

Country	1975	2000	2025
Austria	24	21	32
Belgium	22	25	36
Denmark	21	22	32
Finland	16	22	37
France	22	25	37
Germany	23	23	34
Greece	19	27	37
Ireland	19	17	28
Italy	19	26	41
Luxembourg	20	21	41
Netherlands	17	20	36
Portugal	16	23	32
Spain	16	24	35
Sweden	24	26	36
United Kingdom	22	24	33
Switzerland	19	22	37
Turkey	8	9	14
Japan	12	24	43
United States	16	19	29
OECD average	17	21	32

Note: Elderly dependency ratio is defined as the ratio of the population aged 65 and over relative to the population aged between 15 and 64.
Source: Based on United Nations, Demographic Yearbook, various issues.



NOTE: A married couple is age 65 and over if the husband is age 65 and over or the husband is younger than age 55 and the wife is age 65 and over. The definition of "other" includes, but is not limited to, unemployment compensation, workers compensation, alimony, child support, and personal contributors.

Reference population: These data refer to the civilian noninstitutionalized population.

SOURCE: Current Population Survey, Annual Social and Economic Supplement, 1977–2011.

Fig. 1 Percentage distribution of sources of income for married couples and nonmarried persons age 65 and over: 1962–2010. *Source: From Older Americans, 2012. Key indicators of well-being. Accessed at: http://agingstats.gov/agingstatsdotnet/mainsite/ (Indicator 8).*

to be 29% in 2025, surveys have shown that there are serious concerns among baby-boomers regarding the amount of sustainable benefits of Social Security when they retire (see Bernheim and Levin, 1989; Bottazzi et al., 2006; Dominitz and Manski, 2006; Delavande and Rohwedder, 2010 for survey evidence).[a,b]

What Fig. 1 does not show is that retired households face a substantial drop in their income upon retirement. While it is true that the assets for the average household tend to peak at retirement, most assets are subject to significant rates of return risks (see Section 2.1). In fact, the elderly also face a multitude of other risks related to their health care expenditures, long-term care expenditures, and longevity, among others (see Section 2).

[a] In the most recent annual report, the US Social Security and Medicare Boards of Trustees (2014) projected that, under the current Social Security and Medicare benefits and tax rules, the Treasury would start to redeem the Social Security trust fund asset reserves from 2019 and the trust fund reserves would be depleted in 2033, from which point the tax income would be sufficient to pay about three-quarters of scheduled benefits (see http://www.ssa.gov/oact/tr/2014/index.html).

[b] See also Auerbach et al. (1989) for a quantitative analysis of the sustainability of the Social Security system in a computable dynamic general equilibrium model with an aging population.

When there are risks, there is scope for insurance to protect individuals against the risks. Given the retirees' diminishing earnings capacity over time, and the increasing risks (again over time) they expect to face, insurance is of the utmost importance for the welfare of the elderly. Indeed, most of the developed economies have instituted a variety of government-administered social insurance programs, for example, Social Security programs as a form of public annuity and Medicare as retirees' health insurance, and so on. However, it is unlikely that public insurance will meet all of the insurance needs of the retirees; thus the retirees may still have to think about the costs and benefits of purchasing additional insurance from private insurance markets. Of course, retirees may also be insured through informal insurance, including self-insurance (ie, savings) and transfers from relatives and children.[c]

While the details differ in terms of how each of the insurance products we subsequently describe impacts individuals' welfare, the basic economics for the value of insurance to hedge against the risks is common to all and is very simple. Consider the simplest case where the relevant risk is related to out-of-pocket health expenditures, which will then impact the individuals' level of consumption. Consumers are risk averse in the sense that their preferences can be represented by a strictly concave utility function $u(c)$, where c is level of consumption, and is given by $c = y - \tilde{e}$, where y is the income and $\tilde{e}$ is the random out-of-pocket medical expenditures drawn from a distribution $f(\tilde{e})$ with mean $E\tilde{e} = \mu_e$. Suppose that if the consumer purchases a health insurance at premium p, her out-of-pocket medical expenditure is reduced to 0. Her expected utility from purchasing the insurance is simply $u(y-p)$, while her expected utility without insurance is $Eu(y-\tilde{e})$. If the insurance premium p is actuarially fair, ie, if $p = E\tilde{e}$, then we know from Jensen's inequality that $u(y-p) > Eu(y-\tilde{e})$; that is, the consumer is strictly better off by purchasing an actuarially fair insurance than not doing so.[d] In essence, the welfare gain from actuarially fair insurance is obtained by transferring resources from states with low marginal utility of consumption (ie, states without losses) to states with high marginal utility of consumption (ie, states with losses).

While the preceding simple example illustrates the potential source of welfare gains from owning insurance, the reality for the elderly is a lot more complicated. First, the risks the elderly face are multidimensional, including health expenditure risks, income risks, mortality risks, and long-term care expenditure risks, to name the most important

[c] We will focus on formal private and public insurance in this chapter, but clearly self-insurance via precautionary saving and informal insurance via family support are both important components of individuals' strategy to deal with risks in retirement. See Chapter 4 by Attanasio et al. (this volume) for a focused discussion on consumption and saving.

[d] This simple argument assumes that the marginal utility of consumption $u'(\cdot)$ does not depend on health status. Also, self-insurance tends to complicate the welfare gains from insurance, though it is well known that saving is an imperfect substitute for insurance (see, eg, Baily, 1978).

ones. Second, the distributions of the risks are often affected by their own behavior; for example, health expenditure risks may depend on prior health investment, and income risks are affected by their retirement portfolio choices and labor supply decisions. Third, insurance markets are often subject to adverse selection and other forms of market failure (Arrow, 1963; Akerlof, 1970; Rothschild and Stiglitz, 1976). Fourth, individuals' demand for and benefits from purchasing private insurance are often impacted by social insurance, leading to important and interesting interactions between public and private insurance markets, on both the demand and supply sides.

The remainder of this chapter is structured as follows. In Section 2 we describe the major risks that the elderly face, including income risks, health risks, longevity/mortality risks, and morbidity/long-term care expenditure risks. In Section 3, we describe a variety of insurance products, offered either via the private markets or via government-administered programs, and the main theoretical and empirical findings regarding the workings of these insurance markets. In Section 4 we discuss the literature on the interaction between social insurance programs and the corresponding private insurance markets. Finally in Section 5 we conclude and discuss directions for future research. We would like to point out upfront that most of the literature we review in this chapter is about the US experience, though when appropriate we also discuss certain evidence from other OECD countries.

2. RISKS FACED BY THE ELDERLY

In this section, we describe the multitude of risks the elderly face. We focus on income risks, health and health expenditure risks, longevity/mortality risks, and morbidity/long-term care expenditure risks.

2.1 Income Risks

The income risks the elderly face can originate from a variety of sources. To the extent that the elderly still work, they face job displacement risks and labor income risks. But they also face risks in investment income, housing equity, and other pension incomes.

An ever-growing fraction of elderly workers still participate in the labor force. According to the Bureau of Labor Statistics (2012a), the labor force participation rates for Americans aged 65 and over have been steadily increasing since the 1990s, a reversal of the long-standing prior trend toward ever-earlier retirement. The labor force participation rate for men aged 65 and over increased from 16.3% in 1990 to 22.1% in 2010 and is projected to increase further to 26.7% in 2020. Similarly, the labor force participation rate for women aged 65 and over increased from 8.6% in 1990 to 13.8% in 2010 and is projected to be 19.2% in 2020. The increase in labor force participation rates also applies to an even older population: the labor force participation rate for men (women, respectively) aged 75 and over increased from 7.1% (2.7%, respectively) in 1990 to 10.4%

(5.3%, respectively) in 2010 and will further increase to 12.8% (8.0%) in 2020.[e] Of course, the labor force participation decision is endogenous, and working often constitutes an informal channel for the elderly to cope with risks they face; moreover, rising life expectancy also contributes to the increase in the labor force participation rates among those aged 65 and over.[f]

2.1.1 Job Displacement and Labor Income Risks

Substantial literature documents the job displacement rates for near-retirement-age workers. Farber (2005) found that the 3-year job displacement rate for the 50–64 age group averages around 9–10% for the two decades from 1981 to 2003. There is evidence that older workers are less likely to become displaced from their jobs than the younger workers. For example, using Survey of Income and Program Participation data from the 1996, 2001 and 2004 panels, Johnson and Mommaerts (2011) found that, between 1996 and 2007, men aged 50–61 (respectively, men aged 62 and older) are 21% (respectively, 23%) less likely than those aged 25–34 to become displaced from their jobs each month. A similar pattern also applies to women. However, Johnson and Mommaerts pointed out that this is mainly driven by the tenure of their employment, not by their age. Once job tenure and other characteristics were held constant, they found that older workers are just as likely as younger workers to lose their jobs. Similarly, Munnell et al. (2009), using data from the Displaced Worker Survey over 1984–2006, found that the difference in the displacement rates between younger (25–54) and older (55+) workers disappeared.

There is also strong evidence that older workers have a harder time finding a job, if they are displaced, than younger workers. Heidkamp et al. (2010) reported that, according to data from the Heldrich Center's "No End in Sight" survey conducted in August 2009 of men and women who had been unemployed at some point in the previous 12 months, only 14% of the respondents who were aged 55 or above had found new jobs as of March 2010 compared to 37% of the younger job seekers. Two-thirds of the older job seekers are still actively looking for work as compared to only 52% of the prime age group. Statistics from the Bureau of Labor Statistics (2012b) showed that the median duration of unemployment for those aged 55–64 is 33.4 weeks, as compared to 21 weeks for those aged 34–44, and 27.6 weeks for those aged 45–54. Johnson and Mommaerts (2011) found that displaced men aged 50–61 are 39% less likely to become reemployed each month than otherwise identical men aged 25–34, and men aged 62 and older are 51%. Johnson and Kawachi (2007) examined older adults'

[e] See table 3 in Bureau of Labor Statistics (2012a).

[f] Fries (1980) and recently Cutler et al. (2013) documented evidence for significant compression of morbidity in the elderly US population, suggesting that increases in life expectancy are related to increases in healthy and productive lives.

employment opportunities by studying job changes at ages 45–75 using data from the Health and Retirement Study. They found that many older workers move to new occupations and industries when they switch jobs, often assuming positions that involve less stress and physical effort, and they generally experience sharp hourly wage reductions and often lose pension coverage and health benefits.

Evidence also shows that older workers suffer from wage cuts in new jobs. Chan and Stevens (2001) focused on workers above age 50 in the Health and Retirement Study 1992.[g] They found that among reemployed workers, half receive wages at least 19% below their predisplacement wages, and almost 25% see their wages halved. On the other hand, nondisplaced workers enjoy about 5% earnings growth between the survey waves. They found that 6 or more years after displacement, earnings losses still ranged from 23% to 29%. Couch et al. (2011), using administrative earnings data from Connecticut unemployment insurance records, compared the experience of workers who were impacted in a mass layoff with those who remained continuously employed during the period of 1993–98. They found that on average that 6 years after job displacement caused by mass layoffs, older workers' earnings remain 26% below those of the comparison group; workers aged 40 and above still have a 14% reduction in earnings, while the reduction in earnings is a more steep 37% for those aged 55 and above. Similarly, Johnson and Mommaerts (2011) found that older displaced workers who find a job usually experience a sharp wage decline: for those reemployed at ages 50–61, the new median wage falls 20% below the old median wage and the median wage fall is an even steeper 36% for people 62 or older.

2.1.2 Investment Income Risks

Because wealth accumulation typically takes place over individuals' entire working lives, elderly households have more assets on average than younger households. Household wealth includes housing, various forms of financial assets, Social Security, and pension wealth. Poterba and Samwick (2001), using data from the Survey of Consumer Finances, showed that both the median and the mean household typically enter a period of fairly rapid accumulation of financial assets when they are about 34 years old, and that median and mean holdings of financial assets peak at about ages 58 and 64, respectively. They also found interesting life-cycle patterns of asset accumulation: as a percentage of total assets, financial assets show a U-shaped pattern with age; specifically, they decline as households age and then begin to increase at advanced ages. However, investment real estate and equity in privately held business display a hump-shaped pattern, while owner-occupied housing does not decline at older ages. Also, Poterba and Samwick (2001) found that, within financial assets, the percentage in bonds, particularly tax-exempt bonds, significantly rise with age; but the portfolio share of all taxable equity exhibits a rather flat

[g] See also Chan and Stevens (1999).

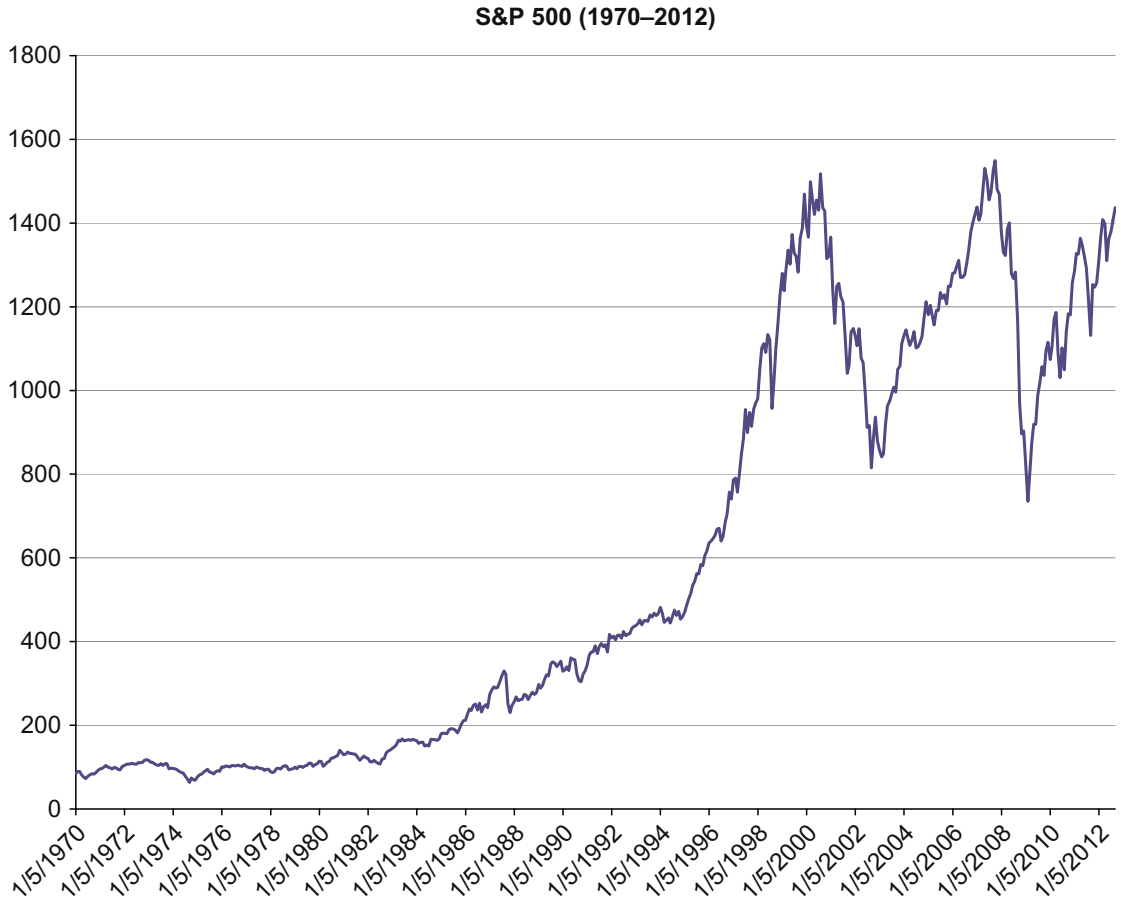


Fig. 2 S&P 500 index: 1970–2012.

age profile, suggesting that households do not necessarily follow the popular financial advice to switch from stocks to bonds as they approach retirement.[h]

To the extent that risky investments, including equity or bond holdings in either taxable or tax-deferred accounts, are in the households' financial portfolios, older individuals are thus more exposed, at least in absolute magnitude, to the volatilities in the asset market than younger workers (see Fig. 2 for the series of S&P 500 index at the beginning of each month between 1970 and 2012). For example, the Vanguard Report (2008) showed that about two-thirds of retirees' 401(k) portfolios are invested in equities, and as a result stock market volatilities often would result in significant risks for older workers' financial wealth, with little time for the market to recover. In fact, Glover et al. (2011), using 2007 Survey of Consumer Finances data, documented that the average net worth is 1.9 times the average labor income for 20–29 year olds, while it is 21.1 times the average for those 70 or older. The authors revalued these portfolios using relevant market indices

[h] See also, Coile and Milligan (2009) for similar findings.

and found that during the Great Recession people between ages 60 and 69 lost the most: $310,000 on average, which is nearly four times their average annual income.[i]

2.1.3 Housing Wealth

In 1998 households aged 50 and older held over $24.8 trillion in net worth, or 2.9 times the US GDP for that year (Kopczuk and Lupton, 2007). Most of that wealth was in the form of housing equity. At the household level, over 80% of households in their fifties are homeowners. Housing wealth accounts for over 50% of household wealth among homeowners, and it dominates other asset holdings for the majority of such households. Because of the significance of housing wealth in the portfolio of the elderly, housing market volatilities also contribute to the risks that the elderly face to the extent that they may be using housing equity to finance their retirement (see Fig. 3 for the S&P Case/Shiller home price indices from 1987 to 2013).[j] In a series of papers,

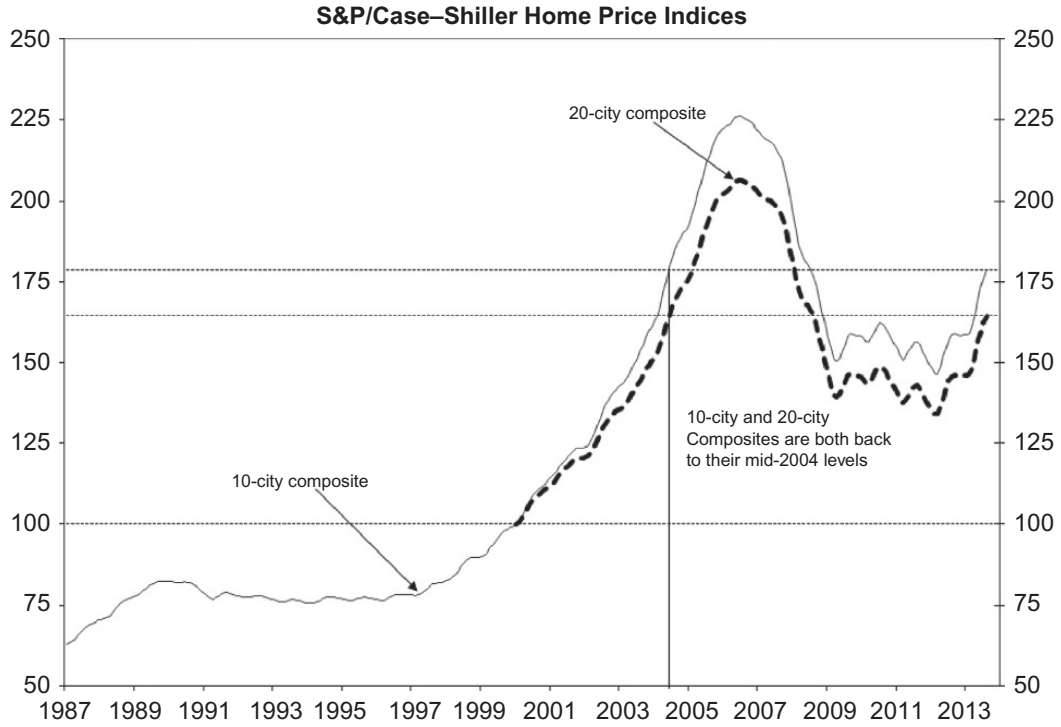


Fig. 3 S&P/Case–Shiller home price indices: 1987–2013. *Source: S&P Dow Jones Indices and CoreLogic.*

[i] However, Gustman et al. (2010) focused on the early boomer population (ages 53–58) and found a much smaller effect of the stock market decline on their wealth. Using Health and Retirement Study data, they reported that in 2006, those in their early to mid-fifties had only 15% of their total wealth in stocks, including 401(k) plans and IRAs.

[j] Poterba et al. (2011) also considered the role of housing equity in the portfolios of retirement-age households and explored the extent to which households draw down housing equity and financial assets as they age. They found that many households appear to treat housing equity and nonannuitized financial assets as "precautionary savings."

Venti and Wise (2001, 2004), using a variety of data sets, found that as they age households do not seem too willing to use housing equity to support their general nonhousing consumption. They found that large reductions in home equity are typically associated with the death of a spouse, retirement, or with other precipitating shocks. We will come back to housing wealth and its potential role in insuring risks associated with retirement in Section 3.2.3 when we discuss reverse mortgages.

2.1.4 Decline of Defined Benefit Pension Plans

As shown in Fig. 1, incomes from employer pension plans constitute an important source of retirement income. There are two main categories of employer pension plans, the defined benefit (DB) plans and the defined contribution (DC) plans.[k]

In a DB pension plan, workers accrue a promise of a regular monthly payment from the date of their retirement until their death or, in some cases, until the death of their spouse. The promised deferred life annuity is commonly based on a formula linked to an employee's wage or salary and years of tenure at the sponsoring firm. In contrast, in a DC pension plan, workers accrue funds in individual accounts administered by the plan sponsor. The contributions of employees are typically deducted directly from their pay and frequently some portion of these contributions is matched by the employer. In contrast to a DB plan, it is the contributions rather than the benefit that is fixed in a DC pension plan; the retirement income that will be provided is unknown in advance. The pension benefit accumulated during the employee's working career will depend on the contributions made while working and the investment returns earned on the plan balances.

DB and DC plans also differ in how several important risks are distributed between the employers and the employees. Under a DB plan, the employer bears the investment return risk associated with the pension funds and, by promising a stream of annuity payments to the worker, bears the worker's longevity risk. In contrast, under a DC plan, the employee is fully responsible for the investment return risk, as well as his/her own longevity risk.

Traditional DB pension plans are gradually losing their dominance in the occupational pension systems of many countries. Over the past few decades, there has been a gradual shift toward DC pensions, and in some countries, DC plans now account for the majority of invested assets in private sector occupational pension plans. In 1983 more than 60% of US workers had some kind of DB plan; today, it is less than 20%.[l] Using the Form 5500 Annual Report data set, Fig. 4 shows that in the United States, the total

[k] See Chapter 14 by Mitchell and Piggott (this volume) for a detailed analysis of the economic aspects of occupational pensions.

[l] See Broadbent et al. (2006) for a detailed overview of the shift from DB to DC plans and the associated implications for asset allocation and risk management.

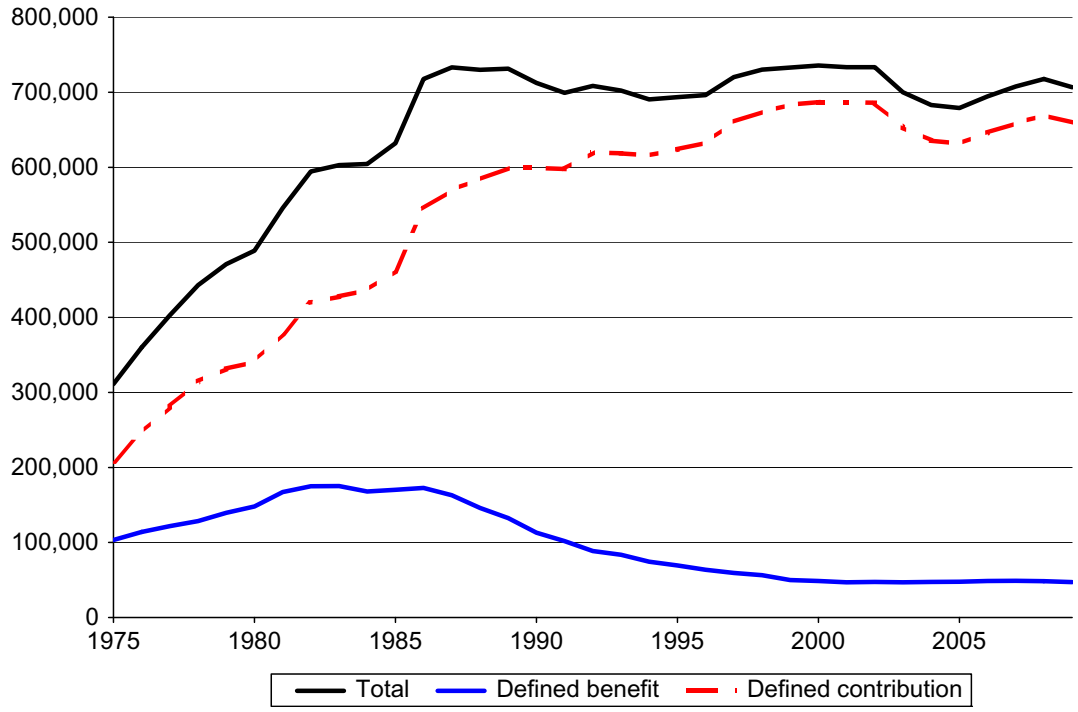


Fig. 4 Number of pension plans, by type of plan, 1975–2009. *Source: Author's calculation from Form 5500 database.*

number of DB plans peaked around 1983 and has been steadily declining; in contrast, the number of DC plans has been steadily increasing from 1975.[m] Fig. 5 shows that as a percentage of total number of employer pension plans, DB plans have been steadily losing ground to DC plans: in 1975, about 32% of all employer pension plans are DB plans, but in 2009 only 8% are DB plans. Notice that Figs. 4 and 5 are in terms of the *number* of employer pension plans unweighted by the asset levels in each plan. Fig. 6 shows the evolution of percentage share of pension assets in DB and DC plans, respectively, from 1975 until 2009, using data in the US Flow of Funds Accounts. It shows that the share of assets in DB plans has steadily declined over the past 30 years.

A number of explanations have been offered for the shift from DB to DC pension plans (see Broadbent et al., 2006). Increased workforce mobility associated with demographic and industrial changes appears to be an important driver of the shift away from DB pension plans; all else being equal, mobile workers have less of a preference for DB pensions because traditional benefit formulas are "back-loaded," favoring long-tenured employees, and because DB benefits are not portable from one employer to another. Other factors that may have contributed to the trend toward DC plans include pension

[m] The Form 5500 Annual Report is the primary source of information about the operations, funding, and investments of approximately 800,000 employer-sponsored retirement and benefit plans.

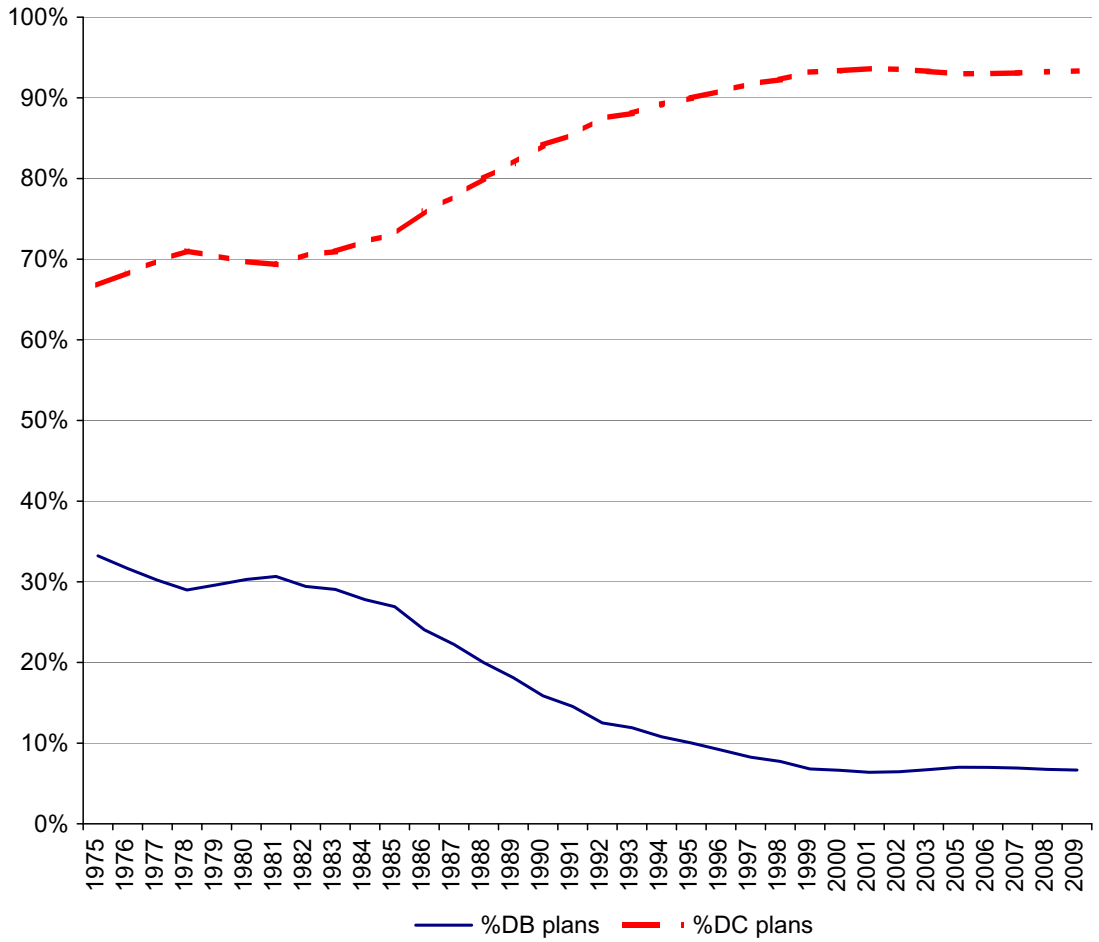


Fig. 5 Percentage of DB/DC plans among total pension plans, 1975–2009. *Source: Author's calculation from Form 5500 database.*

underfunding and its persistence because of a decline in long-term interest rates; the move to more market-based accounting; increasing regulatory burden; and the uncertainty and recognition of the effects of increased longevity on plan costs. It is also linked to the regulatory and accounting reforms that are making these risks more transparent. Since DC contributions can be fixed as a predictable share of payroll, migrating to a DC plan offers employers a means of reducing balance sheet and earnings volatility at least over the long term.

As employers shift their pension plans from DB to DC, the risks and responsibilities associated with providing retirement income are increasingly shifted from the employer to the employee (Munnell and Sunden, 2004; Friedberg and Webb, 2005). In terms of responsibilities, the employee in a DC plan decides whether or not to participate, how much to contribute, how to invest the assets, and how to withdraw the money at retirement. However, Munnell and Sunden (2004) found that 26% of workers who are eligible

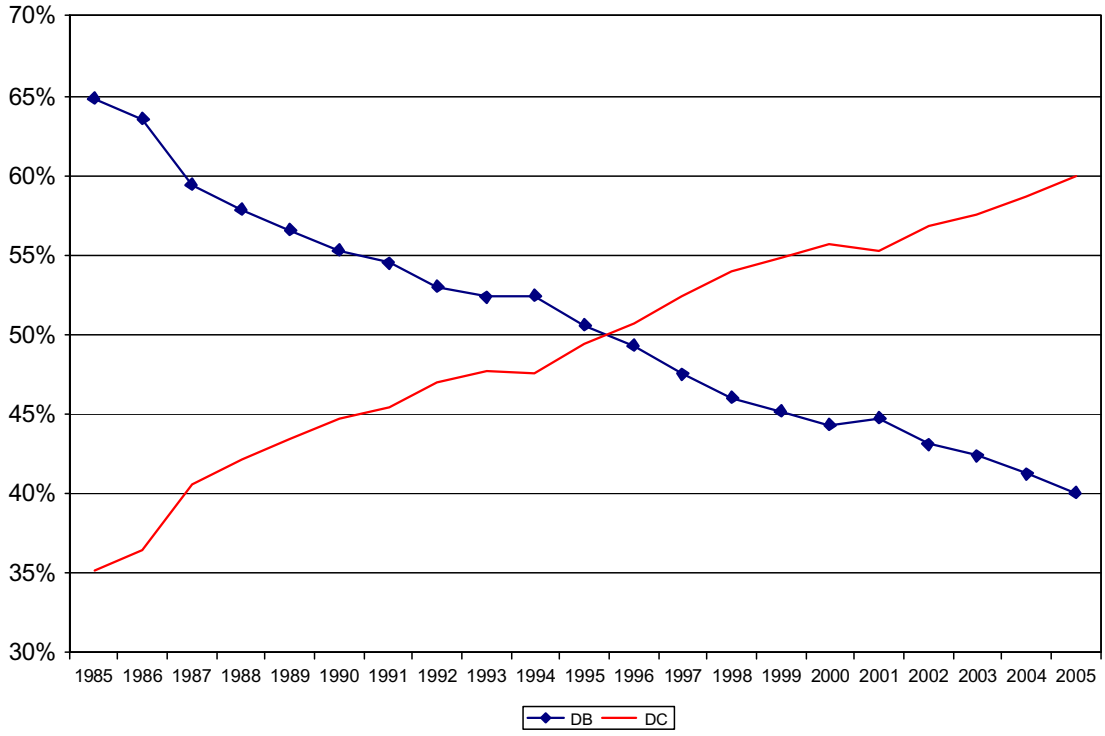


Fig. 6 Percentage share of assets in US DB and DC pension plans: 1975–2009. *Source: US Flow of Funds Account data.*

do not participate; less than 10% of those who do participate contribute the maximum; over half do not diversify their investments, and almost none rebalance their portfolios in response to age or market returns; many cash out when they change jobs; and most do not annuitize at retirement.

2.2 Health and Health Expenditure Risks

Older age is often accompanied by increased risk of certain diseases and disorders. Large proportions of older Americans report a variety of chronic health conditions such as hypertension and arthritis. According to Older Americans (2012), in 2009–10, 38% of people aged 65 and over were obese, compared with 22% in 1988–94; and total health care costs (including both out-of-pocket costs and costs covered by insurance) increased significantly among older Americans from $9850 in 1992 to $15,709 in 2008 (in 2008 constant dollars). From 1977 to 2009, the percentage of household income that people aged 65 and over allocated to out-of-pocket spending for health care services increased from 12% to 22% among those in the poor/near poor income category. French et al. (2006) found that death is often preceded by a costly illness; that out-of-pocket medical expenditures related to increased drug costs, doctor visits, and hospital and nursing home stays go up by about 200% in the few years before death; and that the increase in medical

spending before death, combined with burial expenses, can explain about 24% of the decline in assets of the soon-to-be deceased and about 37% of the decline in assets in the last year of life.[n]

In the United States, the retirees are almost all covered by Medicare (see Section 3.1.1 for details). However, Medicare pays just over half of total health care costs; thus retirees are still exposed to high out-of-pocket spending because Medicare has substantial deductibles and cost sharing.[o] For example, in 2012 Medicare Part A includes a deductible of $1156 per hospitalization; for hospital stays longer than 60 days, beneficiaries have cost sharing of $289 per day for days 61–90, $578 per day for days 91–150, and receive no coverage after 150 days. For Part B, beneficiaries pay a $140 deductible and 20% coinsurance per visit. There is also significant cost sharing and limited coverage for skilled nursing. Even with supplemental insurance for medical and prescription drug expenses, retirees face out-of-pocket expenses for cost-sharing obligations and for items or services not covered by Medicare or supplemental coverage. And, of course, they are subject to pay for the premiums for Medicare supplemental coverages. Hoffman and Jackson (2012) found that in 2006, the major components of out-of-pocket spending were premiums (39%); long-term care (19%); medical providers and supplies (15%); prescription drugs (14%); dental (6%); and inpatient and outpatient hospital costs (5%).

Ample literature investigates the *mean* total medical expenditures or the *mean* out-of-pocket medical expenditure by age. Meara et al. (2004) used a combination of household surveys and total spending data to analyze the trends in medical spending from 1963 to 2000. They found that during this nearly 40-year period, *total* medical spending grew fastest among the elderly. Per person spending among the elderly grew rapidly from 1963 to 1987, but this trend was then reversed during the next decade. In contrast, Norton et al. (2006) focused on *out-of-pocket* health care expenditures paid by elderly Americans. Using data from the Medicare Current Beneficiary Survey (MCBS) (1992–98), Norton et al. (2006) show in Fig. 7, which is reproduced from their paper, that mean monthly out-of-pocket health care expenditures rise steadily as a function of age, from $85 per month at age 66 to $485 per month at age 95. It also shows that the increase in total out-of-pocket health care expenditures by age is driven almost entirely by long-term care; other out-of-pocket expenditures, such as primarily inpatient care, physician services, and pharmaceuticals, are essentially independent of age. Fig. 8 shows the ratio of out-of-pocket medical expenditures over income at different percentiles (25th, 50th, 75th, and 90th) for different ages. It shows an increasing range of out-of-pocket health care expenditures relative to income as retirees get older. Marshall et al. (2011) focused on the risk of out-of-pocket health care expenditures at the end of life

[n] See also Kelley et al. (2013) for similar findings.

[o] See Department of Health and Human Services, *What are the Medicare Premiums and Coinsurance Rates for 2012*, at http://answers.hhs.gov/questions/3006.

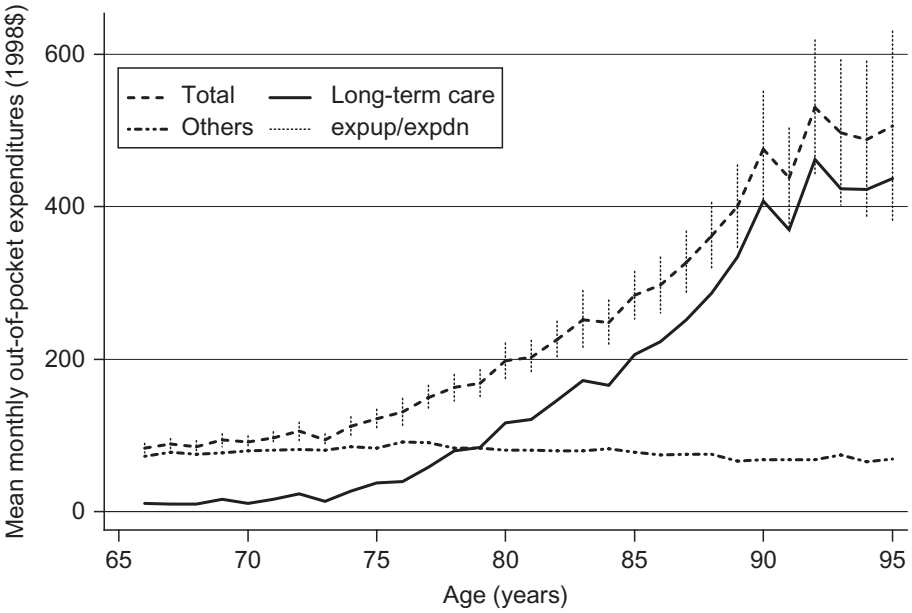


Fig. 7 Out-of-pocket health care expenditure (means) by age and type of expenditures. *Source: From Norton, E.C., Wang, H., Stearns, S.C., 2006. Behavioral implications of out-of-pocket health care expenditures. Swiss J. Econ. Stat. 142 (Special Issue), 3–11 (figure 1).*

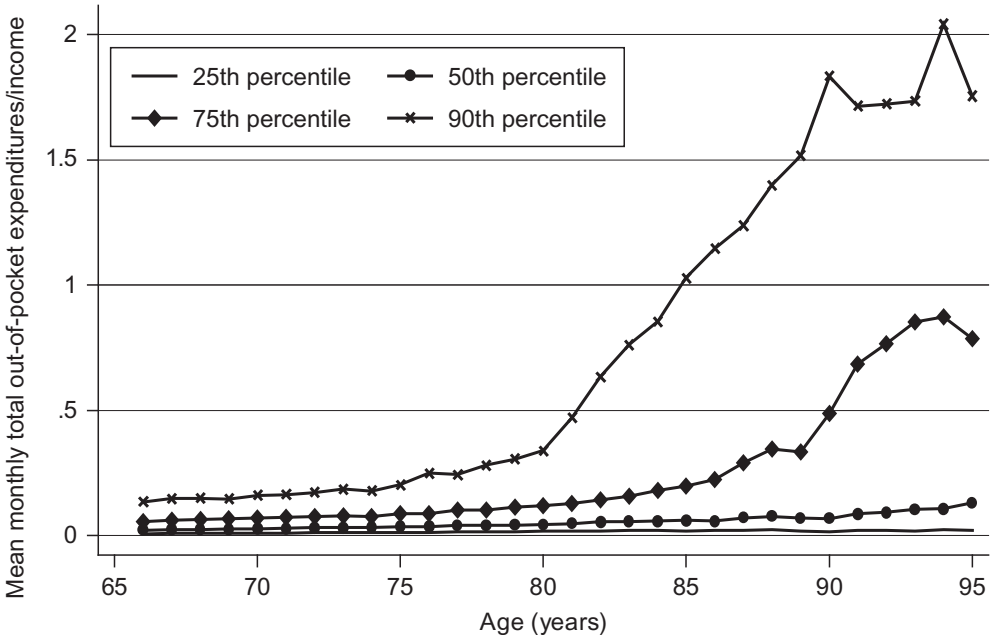


Fig. 8 Total out-of-pocket health care expenditures/income at different percentiles, by age. *Source: From Norton, E.C., Wang, H., Stearns, S.C., 2006. Behavioral implications of out-of-pocket health care expenditures. Swiss J. Econ. Stat. 142 (Special Issue), 3–11 (figure 2).*

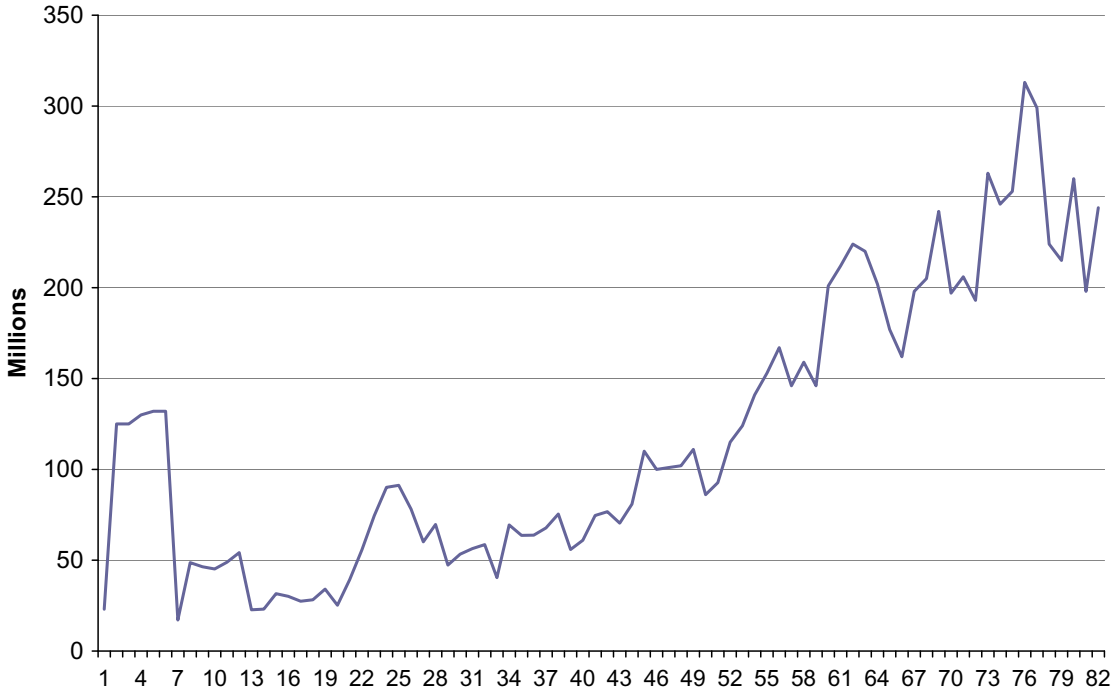


Fig. 9 Variance of total health care expenditures, by age. *Source: Author's calculation based on Medical Expenditure Panel Survey data (2009).*

using the Health and Retirement Study (HRS) 1998–2006. They found substantial variations in out-of-pocket expenditures near death, with the largest single category of the spending near death being nursing home care.

For individuals who are thinking about insurance choices, the more relevant risk is total health care expenditures, not just the out-of-pocket expenditures given their current health insurance coverages; this is particularly true because of the uncertainty about the funding and coverage of government-provided health insurance programs. Fig. 9 shows the variances of unpredictable medical expenditures using data from the Medical Expenditure Panel Survey (MEPS) 2009. In constructing the graph, total medical expenditure information in MEPS data is regressed on self-reported health status, sex, and gender, and the variance of the residual expenditures for each age is calculated and plotted.[p] Fig. 9 shows that the variances of medical expenditures that cannot be easily predicted increase significantly after age 50.[q]

[p] In order to smooth the graph because of small samples especially for children and the elderly, the sample used in the construction of variance at each age bin includes individuals within a 2-year bandwidth.

[q] See Capatina (2012) for an interesting study on the life-cycle effects of health risks.

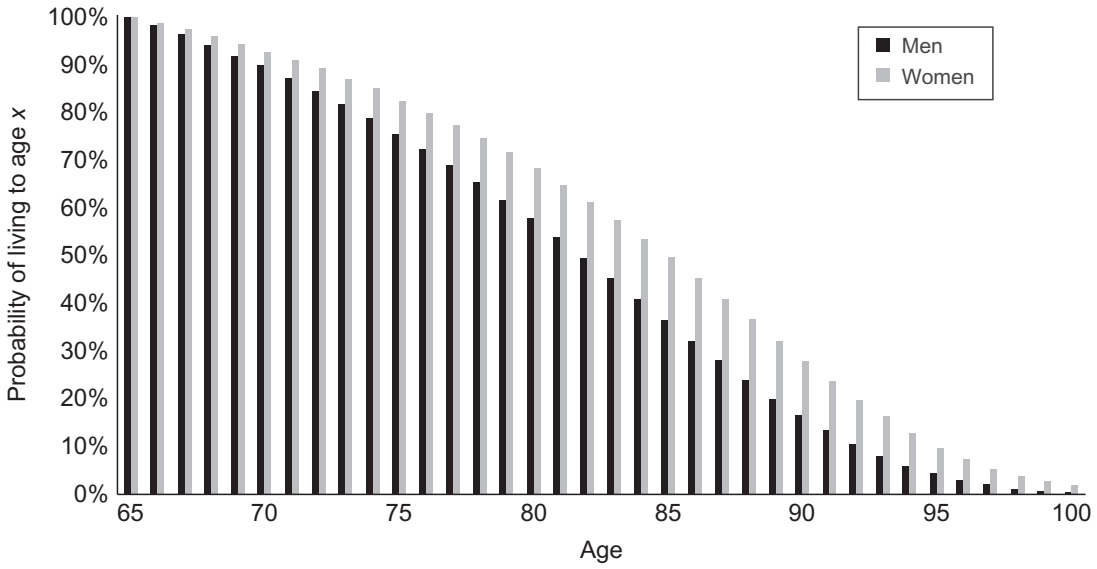


Fig. 10 The distribution of life expectancy for a 65-year-old. Note: The chart displays the probability of 65-year-old men and women living to age *x*. *Source: Reproduced from Benartzi, S., Previtero, A., Thaler, R.H., 2011. Annuitization puzzle. J. Econ. Perspect. 25 (4), 143–164, which is based on the life expectancy data from Bell and Miller (2005): http://www.ssa.gov/oact/NOTES/pdf_studies/study120.pdf, table 6, pp. 60–61.*

2.3 Longevity/Mortality Uncertainty

Another important risk that the elderly face is their longevity/mortality risk. Mortality risk is simply the risk that an individual will die at any age. Longevity risk is the risk that a retired person will live significantly beyond her expected life span and thus run out of money for retirement. These two risks are important in determining how much individuals, including and particularly the retirees, should consume, how much they need to save, and how much bequest to leave to their children and loved ones.

Brown (2000) documented the remaining life expectancy and probabilities of survival to selected ages for 65-year-olds in the year 2000: while men and women at age 65 can expect to live, respectively, an additional 16.4 and 19.6 years, 12% of men and 7.7% of women will die prior to their 70th birthday, and 17.5% of men and 31.4% of women will live to age 90 or beyond. More generally, Fig. 10, which we reproduce from Benartzi et al. (2011), shows a large variation in life expectancy at age 65. There is a 22-year difference between the 10th and 90th percentile of the distribution for men (dying at 70 vs 92). Similarly, there is a 23-year difference between the 10th and 90th percentile of the distribution for women (dying at 72 vs 95).[r]

Not only is there significant uncertainty in the life expectancy, but there is also substantial heterogeneity in this uncertainty. Table 4 is reproduced from De Nardi et al. (2009). They used the AHEAD data set and found that rich people, women, and healthy

[r] Also see Brown (2000) for similar findings.

Table 4 Life expectancy in years, conditional on being alive at age 70

Income percentile	Healthy male	Unhealthy male	Healthy female	Unhealthy female	All
20	8.1	6.3	13.4	11.7	11.7
40	8.9	7.0	14.3	12.7	12.6
60	9.9	7.9	15.4	13.8	13.6
80	10.9	9.0	16.4	15.0	14.8

Source: From De Nardi, M.D., French, E., Jones, J.B., 2009. Life expectancy and old age savings. Am. Econ. Rev. 99 (2), 110–115. Papers and Proceedings.

Table 5 Percent living to ages 85 and 95, conditional on being alive at age 70

Income percentile	Healthy male	Unhealthy male	Healthy female	Unhealthy female	All
Percent living to age 85					
20	12.3	8.2	39.2	32.5	31.4
40	15.8	10.8	44.0	37.6	36.3
60	20.3	14.5	49.9	43.5	41.6
80	26.0	19.4	55.8	49.7	47.5
Percent living to age 95					
20	0.8	0.5	7.2	6.0	5.4
40	1.1	0.8	8.7	7.5	6.9
60	1.7	1.2	10.9	9.4	8.7
80	2.5	1.9	13.8	12.3	10.9

Source: From De Nardi, M.D., French, E., Jones, J.B., 2009. Life expectancy and old age savings. Am. Econ. Rev. 99 (2), 110–115. Papers and Proceedings.

people live much longer than their poor, male, and sick counterparts, conditional on being alive at age 70. Table 5, also from De Nardi et al. (2009), showed that there is a substantial variation in the probability of living to ages 85 and 95, conditional on being alive at age 70, and these variations are importantly related to income, gender, and health status at age 70.

2.4 Morbidity/Long-Term Care Risks

An important risk that is specially pertinent to the elderly is the morbidity risk, which is related to the need for long-term care. Long-term care is a range of services and supports necessary for health or personal care needs over a long period of time (see Norton, 2000). It is important to note that most long-term care is *not* medical care, but rather assistance with the basic personal tasks of everyday life (sometimes called Activities of Daily Living,

Table 6 Percent distributions of limitation in activities of daily living (ADLs) and instrumental activities of daily living (IADLs) by age: United States, 2003–07

	Limitations in ADLs				Limitations in IADLs	
Age	**None**	**1**	**2**	**3+**	**No**	**Yes**
55–64 years	98.4	0.4	0.3	0.9	95.8	4.2
	(0.07)	(0.03)	(0.03)	(0.05)	(0.12)	(0.12)
65+ years	94.3	1.4	1.2	3.2	87.8	12.2
	(0.13)	(0.06)	(0.05)	(0.09)	(0.21)	(0.21)
65–74 years	97.1	0.7	0.6	1.6	93.8	6.2
	(0.11)	(0.05)	(0.05)	(0.08)	(0.18)	(0.18)
75–84 years	93.9	1.4	1.2	3.5	86.2	13.8
	(0.21)	(0.10)	(0.09)	(0.16)	(0.31)	(0.31)
85+ years	82.2	4.7	3.4	9.7	64.7	35.3
	(0.62)	(0.33)	(0.28)	(0.49)	(0.81)	(0.81)

(1) Data source: National Health Interview Survey, 2003–07. Estimates are based on household interviews of a sample of the civilian noninstitutionalized population. (2) From National Center for Health Statistics: http://www.cdc.gov/nchs/health_policy/ADL_tables.htm.

ADLs), and assistance with everyday tasks (sometimes called Instrumental Activities of Daily Living, IADLs).[s]

The morbidity risk, and consequently the risk for long-term care needs, that the elderly face depends importantly on the number of limitations in ADLs and IADLs. Table 6, from the National Center for Health Statistics, shows that as retirees age, the limitations in ADLs and IADLs both increase substantially; and also importantly, there are substantial variations in the number of limitations in both ADLs and IADLs even conditional on age.

As a result of experiencing the limitations in ADLs and IADLs, about 70% of people will need some form of long-term care at some point in their lives (Brown and Finkelstein, 2008). The duration and level of long-term care needs vary from person to person and often change over time. On average, an individual who is 65 today will need some type of long-term care services and supports for 3 years, and women need care longer (3.7 years) than men (2.2 years). However, about one-third of today's 65-year-olds may never need long-term care support, but 20% will need it for longer than 5 years.[t]

[s] ADLs include needing the help of other persons with bathing or showering, dressing, eating, getting in or out of bed or chairs, using the toilet (including getting to the toilet), and getting around inside the home; IADLs include everyday household chores, doing necessary business, shopping, or getting around for other purposes. See http://longtermcare.gov.

[t] Manton et al. (2006), however, showed that age-specific incidence of ADL limitations have been declining over time in the United States.

The "very old" elderly receive long-term care either at home, or in community service organizations, or in long-term care facilities. Examples of home care services include an unpaid caregiver who may be a family member or a friend, or a nurse, home health or home care aide, and/or a therapist who comes to the home. Community support services include adult day care service centers, transportation services, or home care agencies that provide services on a daily basis or as needed. Outside the home, a variety of facility-based programs exist. Nursing homes provide the most comprehensive range of services, including nursing care and 24-h supervision. Other facility-based choices include assisted living, board and care homes, and continuing care retirement communities. Brown and Finkelstein (2008) use Robinson's model to predict the probability distribution of long-term care utilization. Table 7, reproduced from Brown and Finkelstein (2008), shows that there is a considerable right tail risk to this distribution. For example, although 73% of 65-year-old men (and 56% of 65-year-old women) will never enter a nursing home, of those who do, 12% of men (and 22% of women) will spend more than 3 years there.[u]

3. INSURANCE MARKETS

The elderly deal with the preceding risks in a variety of ways, particularly, they may use insurance products to help cope with these risks. In this section, we describe several important insurance markets. We will mostly focus on private insurance markets, but will discuss public insurances as well.

3.1 Health Insurance Market

3.1.1 US Health Insurance System for the Elderly

The United States does not have a national health insurance system. However, the health insurance coverage for those aged 65 and older is almost universal. The sources of health insurance coverage for this population mainly consist of the following: Medicare, Medicaid, employer-provided coverage, and supplemental insurance (known as Medigap). According to Kaiser Family Foundation reports, on average basic Medicare benefits cover about 50% of the personal health care expenditures (excluding long-term care costs) of aged beneficiaries in the United States. Retirees must finance these costs not covered by Medicare by purchasing insurance coverage supplemental to Medicare or by paying directly for such costs out of pocket. Ninety percent of all retirees obtain supplemental insurance coverage from one of four main sources to help fill in these gaps: Supplemental Employer-Sponsored Insurance for Retirees (about one-third); Medicare Advantage (about one-fourth); Medigap policies (about 18%); and Medicaid for which

[u] However, see Friedberg et al. (2014), which updated and modified the Robinson model using the most recent National Long-Term Care Survey for 1999–2004.

Table 7 Care utilization for 65-year-old from the Robinson model

Type of care		Prob. of ever using	Among users						
			Mean age of first use	Mean years in care	Prob. of using care for			Prob. of leaving care alive	Mean number of spells
					>1 year	>3 years	>5 years		
Nursing home	Men	0.27	83	1.3	0.33	0.12	0.05	0.65	1.28
	Women	0.44	84	2.0	0.42	0.22	0.12	0.66	1.39
Assisted living	Men	0.12	82	0.58	0.16	0.04	0.01	0.90	1.18
	Women	0.20	85	0.48	0.13	0.04	0.01	0.93	1.26
Home health care	Men	0.29	79	1.9	0.52	0.22	0.09	0.67	1.45
	Women	0.35	81	2.3	0.52	0.28	0.15	0.77	1.68
Any care	Men	0.40	82	2.9	0.77	0.53	0.17	0.33	1.20
	Women	0.54	80	4.2	0.85	0.37	0.31	0.35	1.27

Source: Reproduced from Brown, J.R., Finkelstein, A., 2008. The interaction of public and private insurance: Medicaid and the long-term insurance market. Am. Econ. Rev. 98 (3), 1083–1102 (table 1).

about 15–16% of Medicare beneficiaries are "dually eligible" if they are disabled or meet the income and assets thresholds.[v]

3.1.1.1 Medicare

The main source of health insurance coverage for the elderly is Medicare. Medicare is a national social insurance program established in 1965 under Title XVIII of the Social Security Act that provides health insurance for Americans aged 65 and older.[w] Anyone who has, or whose spouse has, worked for at least forty quarters in Medicare-covered employment (ie, paid FICA taxes) is eligible for Medicare coverage. It is important to note that, as a social insurance program, the eligibility for Medicare does *not* depend on the retirees' income and asset levels. Note that Medicare does not use any mechanism (either pricing mechanism or eligibility criterion) to select risk, which differs substantially from private health insurance programs that manage their risk portfolio by both pricing and underwriting mechanisms.

Medicare has four parts. Part A provides coverage for hospital care, while Part B provides outpatient medical services (ie, doctor visits). Medicare enrollees also have the choice between what is called the "traditional Medicare" and Medicare Part C (also known as "Medicare Advantage"). Part D is for prescription drugs.

Part A, known as "Hospital Insurance," covers inpatient hospital stays (at least overnight stays). The maximum length of stay that Medicare Part A covers in a hospital inpatient stay is typically 90 days, where the first 60 days are paid for in full by Medicare but days 61 and 90 require a co-payment (as of 2012, $289 per day). The beneficiary is also allocated at most 60 days of "lifetime reserve days" that can be used after 90 days, which also requires a co-payment (as of 2012, $578 per day). Part A also covers brief stays for convalescence in a skilled nursing facility, and hospice benefits for terminally ill persons with less than 6 months to live as determined by the patient's physician. Medicare-eligible retirees are automatically covered for Part A.

Part B, known as "Medical Insurance," pays for some services and products not covered by Part A on an outpatient basis. Part B coverage includes physician and nursing services, and a list of diagnostic tests and other outpatient hospital procedures and medical treatments administered in a doctor's office. Part B also covers the purchase of necessary durable medical equipment (DME). Part B coverage begins once a patient meets his or her deductible ($140 in 2012), and then typically covers 80% of approved services, while the remaining 20% is paid by the patient.

Enrollment in Part B may be deferred if the beneficiary or his/her spouse is still working and has group health coverage through that employer. The retirees have to pay a small

[v] While varying across states, these thresholds are low across the board, which means that Medicaid coverage only protects a subset of the poorest retirees against significant out-of-pocket exposure. See French et al. (2012) for a discussion of the relationship between Medicaid and the elderly.

[w] Medicare also provides health insurance coverage to younger people with disabilities as well as people with end stage renal disease and persons with Lou Gehrig's disease (see Medicare.gov website).

premium, which does not depend on assets or on existing health conditions, for enrollment in Part B. Almost all Medicare enrollees who do not work enroll in Part B.

Part C, also known as "Medicare Advantage," was introduced in 1997, where Medicare beneficiaries were given the option to receive their Medicare benefits through private health insurance plans, instead of through the original Medicare (Parts A and B), which is sometimes also referred to as the "fee-for-service" (FFS) Medicare. Retirees face a *trade-off* in the choice between the traditional Medicare and the Medicare Advantage. The traditional Medicare allows enrollees access to any doctors and hospitals that accept Medicare patients, but its coverage is limited to the standard Medicare benefit package; enrollees of a Medicare Advantage plan, however, are restricted to access only the doctors and hospitals in the network of the private insurer who sells the Medicare Advantage plan, but the enrollees face lower co-payments and deductibles and may receive more benefits than offered by the traditional Medicare (for example, prescription drugs). For people who choose to enroll in a Medicare Advantage health plan, Medicare pays the private health plan a fixed amount every month; and the members may also have to pay a small premium in addition to the Medicare Part B premium for benefits not included in the traditional Medicare. In Section 4.2 we discuss the interactions between Medicare and Medicare Advantage plans.

Part D covers prescription drugs. It was introduced in the Medicare Modernization Act enacted in 2003 and took effect in 2006. Anyone with Part A or B is eligible for Part D. To receive this benefit, a person with Medicare must enroll in a stand-alone prescription drug plan or Medicare Advantage plan with prescription drug coverage. These plans are approved and regulated by the Center for Medicare and Medicaid Services (CMS), but are actually designed and administered by private health insurance companies and private drug companies. Part D coverage is not standardized, and approved plans are allowed to choose which drugs (or even classes of drugs) they wish to cover, at what level (or tier) they wish to cover them, and are free to choose not to cover some drugs at all, though Medicare specifically excludes some drugs from coverage (see Duggan et al., 2008 for an extensive description of the Medicare Part D program). A large set of literature studies the Medicare Part D program, including causes of its increasing costs (eg, Duggan and Scott Morton, 2010), consumers' choice of plans (Heiss et al., 2007; Abaluck and Gruber, 2009; Kling et al., 2009; Ketcham et al., 2010; Ericson, 2010; Heiss et al., 2012), and insurer behavior (Decarolis, 2013).

3.1.1.2 Medicaid

Medicaid is the health program for families and individuals with low income and resources in the United States. It is a government insurance program for persons of *all ages* whose income and resources are insufficient to pay for health care. In contrast to Medicare, Medicaid is a *means-tested* program that is jointly funded by the state and federal governments and managed by the states, with each state enjoying substantial discretion in determining eligibility and coverage. Because Medicaid is for individuals of all ages, as

long as they are low income and meet the asset eligibility rules, many retirees also are on Medicaid. Importantly, if a retiree becomes eligible for Medicaid, the coverage provided under Medicaid is much broader than that under Medicare, particularly for long-term care (see Section 3.4). It should be noted that for beneficiaries who are dual eligible for both Medicare and Medicaid, Medicaid may pay for drugs not covered by part D of Medicare.

As we will describe in Section 3.1.2, the recent Patient Protection and Affordable Care Act (ACA) health care reform significantly expanded both eligibility for and federal funding of Medicaid beginning January 1, 2014. Under the law as written, all US citizens and legal residents with incomes up to 133% of the poverty line, including adults without dependent children, qualify for Medicaid coverage. However, the US Supreme Court ruled in *National Federation of Independent Business v. Sebelius* that states do not have to agree to this expansion in order to continue to receive existing levels of federal Medicaid funding, and many states have chosen to continue with current funding levels and eligibility standards.

3.1.1.3 Employer Coverage for Retirees

Retiree health benefits are an important consideration for older workers making decisions about their retirement. Health benefits for retirees provide an important supplement to Medicare for retirees aged 65 or older. This constitutes another important source of health insurance coverage for retirees. However, the fraction of firms that offer retiree health coverage is fast declining. According to a recent report by the Kaiser Family Foundation and the Health Research and Educational Trust (2012), just 25% of employers with more than 200 workers even offered retiree health benefits to their workers in 2012. There has been a downward trend in the percentage of firms offering retirees coverage, from 66% in 1988 to 32% in 2005 (see Fig. 11). Moreover, the Kaiser Family Foundattion surveys found that the offering of retiree health benefits varies considerably by firm characteristics. For example, in 2012 it found that large firms are much more likely to offer retiree health benefits than small firms—25% vs 4%. Moreover, the rate of offering retiree health benefits among large firms also varies by industry, and by the fraction of lower-wage workers in the firm: large firms in the retail industry are less likely (9%) to offer retiree health benefits than large firms in other industries; and large firms with fewer lower-wage workers (those earning $24,000 or less annually) are more likely to offer retiree health benefits. Importantly, among firms offering retiree health benefits, most large firms offer them to early retirees under the age of 65 (88%). A lower percentage (74%) of large firms offering retiree health benefits offer them to Medicare-age retirees.[x]

[x] See Monk and Munnell (2009) for a study on the potential consequences of the declining retiree health insurance offering for both pre-Medicare and Medicare-eligible retirees.

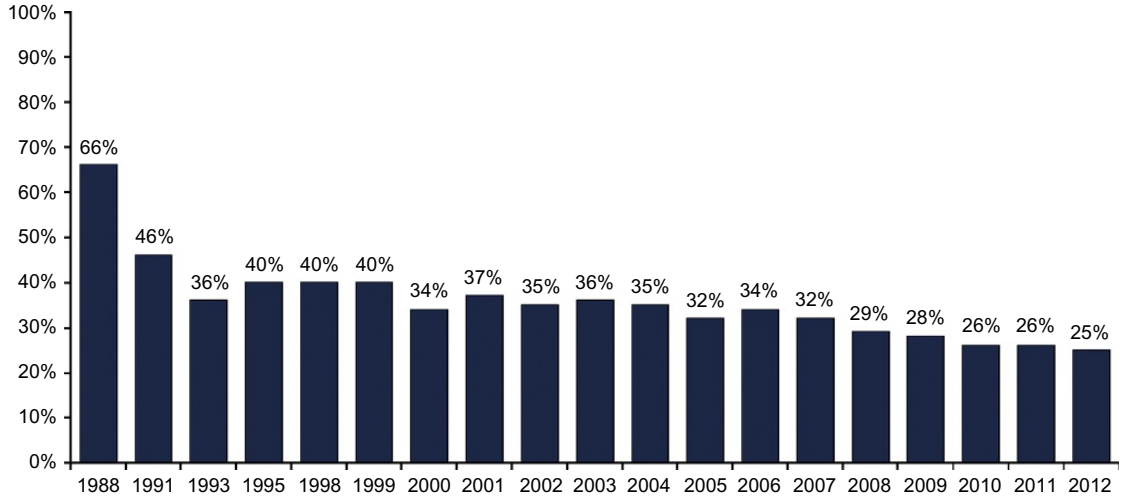


Fig. 11 Among all large firms (200 or more workers) offering health benefits to active workers, percentage of firms offering retiree health benefits, 1988–2012.

3.1.1.4 Medicare Supplemental Insurance

Medicare supplemental insurance, also known as "Medigap," refers to various private supplemental health insurance plans sold to Medicare beneficiaries in the United States that provide coverage for medical expenses that are not or are only partially covered by Medicare, the "gaps" in the Medicare coverage. As of 2006, 18% of Medicare beneficiaries were covered by a Medigap policy. In order to enroll in Medigap, a person must be enrolled in parts A and B of Medicare. The Medigap insurance market is heavily regulated. Since 1992, the coverage and pricing of Medigap policies have been highly regulated by the US government. Specifically, in all but three states (Massachusetts, Minnesota, and Wisconsin) insurance companies can sell only ten standardized Medigap policy types; moreover, within the 6-month Medigap open enrollment period—which starts when an individual is both older than 65 and enrolled in Medicare Part B—an insurer cannot deny Medigap coverage, or place conditions on a policy, or charge more for preexisting health conditions. Outside of open enrollment, the issuing insurance company may require medical screening and may obtain an attending physician's statement if necessary.

Medigap plans are standardized by plan type, organized alphabetically from A to N. Although these plans often have high premium costs, most offer first-dollar coverage of many or all of the costs not covered by Medicare, leading to criticism that they invite moral hazard. The most popular plans (Plans C and F) cover nearly all costs that Medicare does not; some Plan F beneficiaries opt for a "high deductible" option where they pay the first $2000 in expenditures, after which the Medigap plan covers all costs. Premiums for these plans vary by plan type and by state, and by the gender and age of the enrollees, and can range from under $100 to over $400 per month. Some Medigap policies sold before

January 1, 2006, may include prescription drug coverage, but after that date no new Medigap policies could be sold with drug coverage because of the introduction of the Medicare Part D benefit.

3.1.2 Health Insurance Reform in the United States

In March 2010 the United States enacted the Patient Protection and Affordable Care Act, typically known as the Affordable Care Act, or the ACA, which represents the most significant reforms to the US health insurance and health care market since the establishment of Medicare in 1965. This legislation has many components, the four most important of which are as follows:

- *Individual mandate*: All individuals must have health insurance that meets the law's minimum standards or face a penalty when filing taxes for the year, which will be 2.5% of income or $695, whichever is higher.[y,z]
- *Employer mandate*: Employers with more than 50 full-time employees will be required to provide health insurance or pay a fine of $2000 per worker each year if they do not offer health insurance, where the fines would apply to the total number of employees minus some allowances.
- *Insurance exchanges*: State-based health insurance exchanges will be established where the unemployed, the self-employed, and workers who are not covered by employer-sponsored health insurance (ESHI) can purchase insurance. Importantly, the premiums for individuals who purchase their insurance from the insurance exchanges will be based on the average health expenditure risks of those in the exchange pool.[aa] Insurance companies that want to participate in an exchange need to meet a series of statutory requirements in order for their plans to be designated as "qualified health plans."
- *Premium subsidies*: All adults in households with income under 133% of federal poverty line (FPL) will be eligible for receiving Medicaid coverage with no cost sharing. For individuals and families whose income is between the 133% and 400% of the FPL, subsidies will be provided toward the purchase of health insurance from the exchanges.

Most of the changes introduced in the ACA are for the purpose of reducing the uninsured rate, and thus increase the access to affordable health care, in the US population.

[y] These penalties were implemented fully in 2016. In 2014 the penalty was 1% of income or $95 and in 2015, it was 2% or $325, whichever was higher. Cost-of-living adjustments will be made annually after 2016. Hardship exemptions are permitted if the least inexpensive policy available costs more than 8% of one's income.

[z] This component of the ACA was one of the core issues in the United States Supreme Course case 567 US 2012 where the constitutionality of the individual mandate and the Medicaid expansion were challenged. The United States Supreme Court ruled to uphold the constitutionality of the individual mandate on a 5-to-4 decision.

[aa] States that opt not to establish their own exchanges will be pooled in a federal health insurance exchange.

However as we mentioned earlier, because of the almost universal coverage of the elderly via Medicare, the ACA reform will have a rather small impact on the insurance coverage of those who are 65 and over. Nonetheless, two important changes introduced in the ACA are relevant to the elderly population, and we focus on them here. First, the "premium subsidies" component of the ACA represents a significant expansion of the current Medicaid system because many states currently cover adults with children only if their income is considerably lower, and do not cover childless adults at all. Apart from ACA, states differ in their income thresholds for Medicaid eligibility, and on average it is about 65% of the FPL. Thus raising the Medicaid income threshold to 133% of the FPL line represents a significant expansion of Medicaid coverage. Because Medicare enrollees can be dually eligible for Medicaid, this could impact the retiree population as well.[ab]

The second important change relevant to the Medicare population is the introduction of a Medicare surtax on investment income for high-income households. Specifically, a new 3.8% Medicare surtax will be levied on the lesser of net investment income or the excess of modified adjusted gross income above $200,000 for individuals, $250,000 for couples filing jointly, and $125,000 for spouses filing separately. In additional, wages above $200,000 (individuals) and $250,000 (joint filers) will now have to pay an additional 0.9% on earned income above the thresholds previously mentioned.

Emerging literature focuses on the impact of the ACA on both health insurance coverage and the labor market. Aizawa and Fang (2013) studied the equilibrium impact of the health insurance reform described in Section 3.1.2 on the labor market, with an emphasis of firms' internal responses in their compensation package offerings in response to the ACA. Aizawa (2013) studied the optimal design of the health insurance exchange using an estimated life-cycle equilibrium labor market model. Handel et al. (2013) studied the equilibrium of the health insurance exchange under community-rating regulation; they argue that, on the one hand, community-rating regulation worsens the problem of adverse selection and leads to potential welfare loss, but on the other hand, it can generate welfare gains because it provides reclassification risk insurance to individuals. They find that welfare gains from reclassification risk insurance outweigh the welfare loss from adverse selection. Cole et al. (2013) argued that guaranteed issuance and community-rating regulations of the ACA will lead to reduced incentives for individuals to invest in their health. Pashchenko and Porapakkarm (2013) constructed and calibrated a general equilibrium life-cycle model that incorporates both medical expenses and labor income risks to evaluate the welfare effects of the community-rating regulation of the

[ab] The United States Supreme Court also ruled on June 28, 2012, that the law's provision stating that if a state does not comply with the ACA's new coverage requirements, it may lose not only the federal funding for those requirements but also all of its federal Medicaid funds, is unconstitutional. This ruling allows states to opt out of ACA's Medicaid expansion, leaving each state's decision to participate in the hands of governors and state leaders. As of the writing of this chapter, 25 states are moving forward with the Medicaid expansion, 22 states will not, and 4 are still weighing their options.

individual health insurance market and an increase in income redistribution in the economy, both features of the ACA . Neither Cole et al. (2013) nor Pashchenko and Porapakkarm (2013) modeled the firm-side responses to the ACA.

3.1.3 Health Insurance System in Other OECD Countries

According to OECD (2011a,b), among the 31 OECD countries, as of early 2010 all except four (Chile, Mexico, Turkey, and the United States) have universal health insurance. Among those, 13 (Australia, Canada, Denmark, Finland, Iceland, Ireland, Italy, New Zealand, Norway, Portugal, Spain, Sweden, and the United Kingdom) offer automatic national health insurance coverage to their citizens financed by *general tax revenue*. Twelve (Austria, Belgium, Czech Republic, France, Germany, Greece, Hungary, Japan, Korea, Luxembourg, Poland, and Slovakia) achieve universal coverage by mandating that all citizens *purchase a single-pool national health insurance*. But the financing of the coverage is not through general tax revenues; instead, except for Czech Republic and Slovakia, the premium is paid privately though the government provides an income-based premium subsidy. In the Czech Republic and Slovakia, the health insurance premium for working individuals is shared by the worker and the employer, while the premium for those who do not work is paid for by the government. Germany differs slightly from the other countries in this group: it allows high-income individuals to opt out of the national health insurance risk pool and purchase private health insurance. The Netherlands and Switzerland also achieve universal health insurance through a mandate; however, in these two countries, health insurance is not provided through the state, instead it is purchased from regulated private health insurers. Private insurance companies that operate in the health insurance market compete for enrollees, while subject to community-rating regulations. The government provides premium support to low-income individuals. Because of the lack of national health insurance or a mandatory health insurance requirement in Chile, Mexico, Turkey, and the United States (see the preceding US health insurance reform), a substantial percentage of people are uninsured in these countries.

Even with national health insurance, primary health insurance does not cover all costs. Table 8, from OECD (2011a,b), summarizes the share of the costs for selected functions of care covered in 2008–09 by the basic primary health insurance in various countries.

3.2 Annuity Insurance Market

Annuities are generally defined as contracts that provide periodic payments for an agreed-upon span of time. They include annuities certain, which provide periodic payouts for a fixed number of years, and life annuities, which provide such payouts for the duration of one or more persons' lives. As we described in Section 2.3, retirees face significant risks in longevity, which poses problems in ensuring sufficient savings for retirement. The principal role of life annuities is to protect individuals against outliving their resources. All developed countries have instituted some form of *public* annuity, eg, Social Security in

Table 8 Basic primary health insurance coverage of selected functions of care and share of typical costs covered, 2008–09

	Acute inpatient care	Outpatient primary care and specialist contacts	Pharmaceuticals	Dental care
Australia	Covered, 100%	Covered, 76–99%	Covered, 76–99%	Not covered
Austria	Covered, 76–99%	Covered, 100%	Covered, 76–99%	Covered, 100%
Belgium	Covered, 76–99%	Covered, 76–99%	Covered, 76–99%	Covered, 76–99%
Canada	Covered, 100%	Covered, 100%	Covered, 51–75%	Not covered
Czech Republic	Covered, 76–99%	Covered, 76–99%	Covered, 51–75%	Covered, 1–50%
Denmark	Covered, 100%	Covered, 100%	Covered, 51–75%	Covered, 1–50%
Finland	Covered, 76–99%	Covered, 76–99%	Covered, 51–75%	Covered, 76–99%
France	Covered, 76–99%	Covered, 51–75%	Covered, 51–75%	Covered, 1–50%
Germany	Covered, 100%	Covered, 76–99%	Covered, 76–99%	Covered, 76–99%
Greece	Covered, 76–99%	Covered, 76–99%	Covered, 76–99%	Covered, 1–50%
Hungary	Covered, 100%	Covered, 100%	Covered, 1–50%	Covered, 76–99%
Iceland	Covered, 76–99%	Covered, 76–99%	Covered, 76–99%	Covered, 76–99%
Ireland	Covered, 100%	Covered, 100%	…	Not covered
Italy	Covered, 100%	Covered, 76–99%	Covered, 100%	Covered, 1–50%
Japan	Covered, 76–99%	Covered, 76–99%	Covered, 76–99%	Covered, 76–99%
Korea	Covered, 76–99%	Covered, 51–75%	Covered, 51–75%	Covered, 51–75%
Luxembourg	Covered, 76–99%	Covered, 76–99%	Covered, 76–99%	Covered, 51–75%
Mexico	Covered, 100%	Covered, 100%	Covered, 100%	Covered, 100%
Netherlands	Covered, 100%	Covered, 100%	Covered, 100%	Covered, 1–50%
New Zealand	Covered, 100%	Covered, 51–75%	Covered, 76–99%	Not covered
Norway	Covered, 100%	Covered, 76–99%	Covered, 76–99%	Not covered
Poland	Covered, 100%	Covered, 100%	Covered, 51–75%	Covered, 100%
Portugal	Covered, 100%	Covered, 100%	Covered, 1–50%	Covered, 1–50%
Slovak Republic	Covered, 100%	Covered, 100%	Covered, 76–99%	Covered, 51–75%
Spain	Covered, 100%	Covered, 100%	Covered, 76–99%	Covered, 100%
Sweden	Covered, 76–99%	Covered, 76–99%	Covered, 51–75%	Covered, 1–50%
Switzerland	Covered, 100%	Covered, 76–99%	Covered, 76–99%	Not covered
Turkey	Covered, 100%	Covered, 76–99%	Covered, 76–99%	Covered, 100%
United Kingdom	Covered, 100%	Covered, 100%	Covered, 100%	Covered, 76–99%

Source: From OECD: http://dx.doi.org/10.1787/888932526806.

the United States, pension schemes in the United Kingdom and Ireland, and superannuation plans in Australia and New Zealand. Retirement pensions are typically in the form of a guaranteed life annuity, thus insuring against the risk of longevity. Social Security and public insurance are the focus of Chapter 13 by Börsch-Supan et al. (this volume) as a result, here we focus on the private annuity insurance market.

3.2.1 Theory of the Demand of Annuities

The theoretical literature on annuities started with the classic paper of Yaari (1965) where he considered the optimal consumption/saving/insurance problem for a consumer facing

an uncertain lifetime in a continuous time model, and showed the classic result that in the absence of bequest motives, an individual should annuitize all of his income, in order to insure against the lifetime uncertainty.[ac] Yaari's (1965) results were revisited in a simpler discrete time setting and under a somewhat more general asset structure by Davidoff et al. (2005). In what follows, we illustrate the economic benefit of annuitization in a simple two-period model as in Davidoff et al. (2005).

Consider a consumer who is definitely alive in period 1 but may be alive in period 2 with probability $1-q \in (0,1)$ so $q \in (0,1)$ is the death probability. Suppose that he has a utility function $U(c_1, c_2)$ over his consumption profile (c_1, c_2), where c_2 should be interpreted as his consumption level in period 2 if he is alive.

Suppose that the consumer has access to two securities: the first is a *bond* that returns R_B units of consumption in period 2 regardless of whether or not he is alive, in exchange for each unit of consumption good in period 1[ad]; the second is an *annuity*, which returns R_A in period 2 if he is alive and nothing otherwise, again in exchange for each unit of consumption good in period 1. In this simple environment without asymmetric information (ie, the death probability q is known to the insurance company), an actuarially fair annuity was

$$R_A = \frac{R_B}{1-q}.$$

However, suppose that we impose a weaker restriction:

$$R_A > R_B.$$

Let us denote by A the consumer's choice of savings in the form of annuities and B his saving in terms of bonds. Suppose that he has no income in period 2 and his asset or income in period 1 is Y, his choice problem in period 1 is simply

$$\begin{aligned} &\max_{\{c_1, A, B\}} U(c_1, R_A A + R_B B) \\ s.t. \quad &c_1 + A + B \leq Y \\ &A \geq 0, B \geq 0. \end{aligned}$$

It immediately follows from the first-order conditions with respect to c_1, A, and B that in the optimum, $B^* = 0$ as long as $R_A > R_B$, ie, all the consumption in the uncertain second period of the life should be funded by annuity, not bond. This is the well-known *full annuitization* result. The intuition is very simple: if $B^* > 0$, then one can increase second-period consumption while holding c_1^* constant by reducing the bond holding

[ac] See Sheshinski (2008) for a comprehensive review of the theory of annuities.

[ad] Thus the bond can be interpreted as a riskless saving instrument with interest rate $R_B - 1$.

to zero, and use the proceeds B^* to purchase B^* units of annuity instead. This change of portfolio will increase c_2 by $B^*(R_A - R_B) > 0$.

The preceding full annuitization results can be generalized to environments with many periods and many states when the market is complete. To see this, let us generalize the utility function of the consumer to $U(c_1, \mathbf{c}_2)$, where now $\mathbf{c}_2$ is a vector of date-state contingent consumption levels (eg, if there are T possible future periods and N states in each period, $\mathbf{c}_2$ will be a vector of length NT); let $c_{2(t,\,\omega)}$ denote the element in vector $\mathbf{c}_2$ that corresponds to the consumption in a future period $t \in \{2, \ldots, T+1\}$ and state $\omega \in \Omega$. The state ω can represent both uncertainty about aggregate issues such as the macro economy, the performance of the stock market, or individual issues including mortality or health. Suppose that we are in a complete market setting where we have "Arrow bonds" and "Arrow annuities" that pay out in (t, ω) for all $t \in \{2, \ldots, T+1\}$ and $\omega \in \Omega$ with payout rates $R_{B(t,\omega)}$ and $R_{A(t,\omega)}$, respectively. Suppose the individual chooses, respectively, $B_{(t,\omega)}$ and $A_{(t,\omega)}$ units of (t, ω)-contingent bonds and annuities, then his consumption in (t, ω), if he is alive then, is $c_{2(t,\omega)} = R_{B(t,\omega)} B_{(t,\omega)} + R_{A(t,\omega)} A_{(t,\omega)}$. Thus the consumer's problem is

$$\max_{\left\{c_1, \left(A_{(t,\omega)}, B_{(t,\omega)}\right)\right\}} U(c_1, \mathbf{c}_2)$$

$$s.t. \quad c_1 + \sum_{(t,\omega) \in \{2, \ldots, T\} \times \Omega} \left(A_{(t,\omega)} + B_{(t,\omega)}\right) \leq Y$$

$$c_{2(t,\omega)} = R_{B(t,\omega)} B_{(t,\omega)} + R_{A(t,\omega)} A_{(t,\omega)} \quad \text{for all } (t,\omega) \in \{2, \ldots, T+1\} \times \Omega$$

$$A_{(t,\omega)} \geq 0, B_{(t,\omega)} \geq 0 \quad \text{for all } (t,\omega) \in \{2, \ldots, T+1\} \times \Omega.$$

Again, the first-order conditions for the preceding optimization problem immediately lead to the conclusion that optimally, it must be the case that for all (t, ω), $B^*_{(t,\omega)} = 0$ as long as $R_{A(t,\omega)} > R_{B(t,\omega)}$; that is, all the consumption for the uncertain future periods and states should be funded through purchase of date and state contingent annuities. One may say that date and state continent annuities differ from the conventional life annuities that pay out in every date until death. But with complete markets, we can always create such conventional annuities by combining these date and state contingent Arrow annuities.

Thus we have a very general result about the optimality of full annuitization: in a complete-market Arrow–Debreu equilibrium, it is optimal for a consumer *without* a bequest motive to annuitize all savings. The full annuitization result does *not* hold when markets are incomplete, or there are liquidity needs, or when individuals have bequest motives. However, the forces in favor of annuitization underlying the full annuitization result would imply that *some annuitization* would be optimal even under these circumstances. Let us consider the case of incomplete markets as an example. Markets are incomplete when there is not a sufficiently rich set of Arrow bonds and Arrow annuities to allow consumers to achieve a consumption profile by choosing appropriate combinations of

these securities. For instance, most real world annuity markets require that a consumer purchase a particular time path of payouts, or the payouts are linked to the performance of the underlying portfolio of assets or to the actual mortality experience for the class of investors. We can model the restrictions on the available annuity products by assuming that the agent can purchase only annuity products that pay out in a set of states $\omega \in \Omega_A$, which is a strict subset of Ω. Denote by ℓ a row vector with one in states that belong to Ω_A. Let $\mathbf{R}_B$ denote the matrix of returns for the available set of bonds, and let $\mathbf{B}$ denote the collection of bond assets. If $\mathbf{R}_A A = \mathbf{R}_B \mathbf{B}$ implies that $A < \ell \mathbf{B}$ (ie, any consumption vector that may be purchased strictly through annuities is less expensive when financed through annuities than when purchased by a set of bonds with matching payoffs), then an arbitrage-like dominance of the annuity over the matching combination of bonds, as long as such trade is feasible, which is the underlying force for the preceding full annuitization result, still holds. Therefore we can conclude that *some* annuitization is optimal and the optimal portfolio has zero bonds in at least one dated event. Similar arguments for the optimality of partial annuitization also apply in cases where consumers face liquidity needs, or when individuals have bequest motives.

3.2.2 Under-Annuitization Puzzle and Its Solutions?

The theoretical predictions that individuals should annuitize their wealth are derived under a set of conditions, and calibrated life-cycle models taking into consideration bequest motives and other market frictions suggest that typical 65-year-olds would be willing to pay one-fourth of their wealth at retirement for access to actuarially fair annuities, which exceeds the usual 10–15% of annuity loads (see Mitchell et al., 1999, among others). However, in most countries voluntary annuitization is almost *nonexistent*. For example, Johnson et al. (2004) documented, using data from the Health and Retirement Study, that among people at least 65 years old in the US private annuities make up just 1% of total wealth. James and Song (2001) described the private annuity markets in Australia, Canada, Chile, Israel, Singapore, Switzerland, the United Kingdom, and the United States and concluded that in all of these countries, the annuities markets remain underdeveloped, especially relative to the life insurance market (which we describe in Section 3.3). The puzzle is not easily explained by the loadings of annuity products. For example, Mitchell et al. (1999) showed that annuity products in the United States offer very high "money's worth"—the ratio of expected discounted lifetime benefits to initial capital cost of the annuity. Similar findings are obtained for other countries by James and Song (2001), who found that, when discounting at the risk-free rate, money's worth for annuitants are greater than 95% in most countries and sometimes greater than 100%.

The evidence has been termed the "underannuitization puzzle,"[ae] and a large set of literature has emerged to explain it (see, eg, Brown, 2007; Benartzi et al., 2011). The

[ae] Modigliani (1986), in his Nobel acceptance speech given in 1985, noted: "It is a well known fact that annuity contracts, other than in the form of group insurance through pension systems, are extremely rare. Why this should be so is a subject of considerable current interest. It is still ill-understood."

existing explanations can be categorized into two groups, demand-side-based explanations and supply-side-based explanations. Supply-side explanations emphasize market failure because of barriers created by asymmetric information (Finkelstein and Poterba, 2004; Hendren, 2013) or because of the large loading factor that limits the annuity returns (Friedman and Warshawsky, 1990). Demand-side explanations, on the other hand, emphasize that the consumers may have substantial bequest motives that make them unwilling to annuitize (Lockwood, 2011), or they may suffer from behavioral biases in their decision making (Brown et al., 2008).[af,ag]

3.2.2.1 Information Problems in Annuity Insurance Market

The possibility of market failure because of private information has been well known since Akerlof (1970)'s classic paper on lemons. Thus underannuitization could be a result of private information in the annuity insurance market. It is indeed conceivable that informational barrier may be the reason for the low market penetration rate in the annuity insurance market. For example, Finkelstein and Poterba (2004) tested for evidence of private information using unique administrative data from an annuity insurance company in the United Kingdom.

Hendren (2013) developed a theory of low penetration in certain insurance markets based on private information. He argued that if the adverse selection problem is sufficiently severe, then it is rational for insurance companies to *reject* insurance applications. His model is as follows. Suppose that there exists a unit mass of agents endowed with nonstochastic wealth $w > 0$. All agents face a potential loss of size $l > 0$ that occurs with random probability P (with realization denoted by p), which is private information to the agent. The random loss probability P is distributed in the population with cumulative distribution function $F(\cdot)$ on the support $\Psi \subseteq [0,1]$. Suppose that agent with loss probability p has standard von Neumann–Morgenstern preferences with expected utility given by

$$pu(c_L) + (1-p)u(c_{NL}),$$

where c_L and c_{NL} are, respectively, the consumption in the event of loss and no loss. Denote an allocation by $A = \{c_L(p), c_{NL}(p)\}_{p\in\Psi}$, which specifies the consumption level in the event of loss and no loss for each type $p \in \Psi$. An allocation A is implementable if

[af] Pashchenko (2013) used a quantitative model to assess the importance of many potential impediments to annuitization, including a large percentage of preannuitized wealth in retirees' portfolios, adverse selection, bequest motives, medical expense uncertainty, government safety net in terms of means-tested transfers, illiquidity of housing wealth and restrictions on minimum amount of investment in annuities, and she found that quantitatively four explanations play a big role in reducing annuity demand: preannuitized wealth, minimum annuity purchase requirement, illiquidity of housing wealth, and bequest motives.

[ag] Brown and Poterba (2000) recognized that longevity risk sharing by couples may reduce their willingness to pay for annuity products. They evaluated a married couple's utility gain from joint-life annuitization using joint-and-survivor life tables and found that previous estimates of the utility gain from annuitization, which applied to individuals, overstate the benefits of annuitization for married couples.

- A is resource feasible, ie,

$$\int [w - pl - pc_L(p) - (1-p)c_{NL}(p)]dF(p) \geq 0;$$

- A is incentive compatible, ie,

$$pu(c_L(p)) + (1-p)u(c_{NL}(p)) \geq pu\left(c_L\left(\widetilde{p}\right)\right) + (1-p)u\left(c_{NL}\left(\widetilde{p}\right)\right) \quad \text{for all } p,\ \widetilde{p} \in \boldsymbol{\Psi};$$

- A is individually rational, ie,

$$pu(c_L(p)) + (1-p)u(c_{NL}(p)) \geq pu(w-l) + (1-p)u(w) \quad \text{for all } p \in \boldsymbol{\Psi}.$$

The key theoretical result is the following no-trade theorem:

Theorem *The endowment,* $\{(w-l, w), \text{for all } p \in \boldsymbol{\Psi}\}$, *is the only implementable allocation* if and only if

$$\frac{p}{1-p}\frac{u'(w-l)}{u'(w)} \leq \frac{E[P|P \geq p]}{1 - E[P|P \geq p]} \text{for all } p \in \boldsymbol{\Psi}\backslash\{1\}. \tag{1}$$

Conversely, if the preceding condition does not hold, then there exists an implementable allocation which strictly satisfies resource feasibility and individual rationality for a positive measure of types.

The intuition for the preceding no-trade theorem can be described as follows. The left-hand side of (1) denotes the marginal rate of substitution between the consumption in the loss state and no loss state, evaluated at the endowment $(w-l, w)$ for a type-p agent. This is also type-p agent's willingness to pay for a small amount of additional consumption in the event of the loss, in terms of consumption in the event of no loss. The actuarially fair cost of this transfer for type-p agent is $p/(1-p)$, but such an actuarially fair price is not incentive feasible in an environment with private information. Instead, the relevant price is the average cost if all types with risks higher than p also obtain the transfer, ie, at the price $E[P|P \geq p]/\{1 - E[P|P \geq p]\}$, which is the right-hand side of (1). If no agent is willing to pay this cost, then endowment is the only implementable allocation.

Based on condition (1), Hendren (2013) defines the *pooled price ratio at* p, $T(p)$, as

$$T(p) \equiv \frac{E[P|P \geq p]}{1 - E[P|P \geq p]}\frac{1-p}{p},$$

after which condition (1) can be succinctly stated as

$$\frac{u'(w-l)}{u'(w)} \leq \inf_{\boldsymbol{\Psi}\backslash\{1\}} T(p).$$

The statistic $\inf_{\boldsymbol{\Psi}\backslash\{1\}} T(p)$, which is called *the minimum pooled price ratio*, can then be interpreted as a measure of informational barrier to trade in an insurance market. The higher the minimum pooled price ratio, the harder it is to implement trade.

Hendren (2013)'s idea to explain the low-penetration rate of some of the insurance markets—such as those for annuities, long-term care, and disability—is to estimate the distributions of $F(p|X)$, where X is a vector of observable characteristics for those who are rejected by the insurance company and those who are served by the insurance company, respectively, and to show that the estimated risk distributions imply that the minimum pooled price ratio for the rejectees is higher than that for those who are served by the market. Indeed he found larger barriers to trade imposed by private information for the rejectees, for whom private information imposes a barrier to trade equivalent to an implicit tax on insurance premiums of 82% in long-term care, 42% in life insurance, and 66% in disability insurance; in contrast, he found that smaller implicit taxes for the non-rejectees that are not statistically different from zero in any of the three market settings.

While Hendren (2013) provided conditions under which adverse selection in consumer's risk type may lead to no trade, one of the major findings in the recent literature on the test of asymmetric information in insurance markets is that consumers may have *multi*dimensional private information.[ah] For example, Finkelstein and Poterba (2004) examined a unique data set from a large annuity insurance company in the United Kingdom where retirees are required to annuitize at least a certain percentage of their tax-preferred retirement savings account balance, but have a choice over the annuity products that differ in guaranteed payout periods (0, 5, or 10 years) and in whether they are capital protected. They found evidence of systematic relationships between the *ex-post* mortality and some annuity characteristics such as the timing of payments and the possibility of payments to the annuitants' estates, which suggests the presence of selection based on private information. Using the same data set, Einav et al. (2010b) estimated a structural model where individuals are hypothesized to have private information regarding their mortality risk as well as their bequest motive, and these two dimensions of private information are allowed to be correlated. They identify and estimate the two dimensions of private information based on the retirees' choice of annuity guarantee length and their *ex-post* mortality experience. They found strong evidence of positive correlation between the two dimensions of private information. In related papers on the long-term care insurance market by Finkelstein and McGarry (2006), which we will discuss in Section 3.4, and on Medigap insurance market by Fang et al. (2008), which we discuss in Section 4.2, all found evidence that consumers' insurance purchases are likely driven by their risk type, their preference type (eg, risk aversion), and even their cognitive ability.

While selection based on risk type has been emphasized in the classic papers such as Akerlof (1970) and Rothschild and Stiglitz (1976), the recent empirical finding of the presence and importance of selection based on preference types—in particular, selection based on risk aversion—may offer a unified explanation for why different insurance

[ah] For a survey, see Einav et al. (2010a).

markets vary so much in size: for example, markets for health, home, and life insurance are all large, while markets for annuities and long-term care insurance are quite small.

To illustrate how selection based on multidimensional private information provides a potential unified explanation for size differences across insurance markets, it is useful to contrast the life and annuity insurance markets. These markets cover opposite risks: life insurance covers the risk of mortality, while annuities cover the risk of longevity. In life insurance markets, the "bad risks" from an insurer's viewpoint are people with higher mortality probabilities. In a unidimensional model, less healthy people should have a greater demand for life insurance. But it is plausible that more cognitively able people or those with more income also demand more life insurance and tend to be healthier because they invest more in their health (similar to what we find in the health insurance market). If these two forces roughly balance, it is possible that overall there is no positive correlation between life insurance coverage and *ex-post* mortality risk, as empirically found by Cawley and Philipson (1999). Given the lack of adverse selection in the aggregate, this market can be expected to be large.

In contrast, in an annuity insurance market, the "bad risks" from an insurer's viewpoint are healthy people who expect to live long lives. People with private information that they are relatively healthy should be more likely to purchase annuities, creating an adverse selection problem. Now let us assume, as before, that (i) more cognitively able people and those with more income are both more likely to purchase annuities, just as they are more likely to purchase health or life insurance, and (ii) more cognitively able people and those with more income are healthier and live longer, because they invest more in their health. This creates an additional source of adverse selection.

Thus, while selection based on cognitive ability and income alleviates the problem of adverse selection based on health risk in the life insurance market, it exacerbates the adverse selection problem in the annuity market. Similar patterns hold when we look at the other markets we mention previously (auto, health, long-term care). That is, in markets where we would expect selection based on cognitive ability or income to exacerbate selection based on risk type, the market is small and vice versa. Thus the theory of advantageous selection provides a plausible explanation of the size difference between life, annuity, and other insurance markets without relying on institutional assumptions.[ai]

3.2.2.2 High Loadings of Annuities

Friedman and Warshawsky (1990) argued that people may decide not to purchase individual annuities because such products are not priced fairly in the actuarial sense because of high loading factors. Such loading factors could reflect ordinary transaction costs, including taxes and competitive returns to the annuity insurer's capital. However, Brown (2007)

[ai] Nevertheless, at this point these arguments are only speculative. Rigorous theoretical analysis of the relationship between equilibrium market size and the presence of advantageous selection is an interesting area for future research.

argued that this explanation for the underannuitization does not seem to square with the behavior of Social Security participants. He noted that in the United states, individuals are allowed to start claiming Social Security benefits as early as age 62 but do not have to begin claiming before turning age 70. As one delays longer before claiming benefits, the benefits are adjusted upward in an actuarially fair manner. Specifically, for each year after the normal retirement age that benefits are delayed up until age 70, the amount of benefits increases by roughly 8% a year.[aj] Effectively, the Social Security Administration is offering the participants, by delaying the start date of the Social Security benefits, to buy at an actuarially fair premium, a large annuity.[ak] However, Muldoon and Kopcke (2008) showed that most people begin claiming Social Security benefits within a year of becoming eligible, and less than 5% delay claiming benefits past age 66.[al]

3.2.2.3 Bequest Motives

As is known in Yaari (1965), bequest motives could be a reason not to annuitize all of the individual's wealth. Several studies try to *quantify* how much bequest motive can explain the low-penetration rate of voluntary annuitization. For example, Friedman and Warshawsky (1990) and Vidal-Melia and Lejarraga-Garcia (2006) both showed that sufficiently strong bequest motives can eliminate purchases of annuities with high enough loads. Lockwood (2012) also quantified the strength of bequest motives needed to eliminate the demand for actuarially unfair annuity products. He found that moderate bequest motives, much weaker than those required to eliminate purchases of actuarially fair annuities, can eliminate purchases of *available* annuities. Even in a model in which the only reason to prefer nonannuity wealth to annuity income is that nonannuity wealth is bequeathable, altruists who wish to leave bequests gain little from actuarially unfair annuities and are in many cases better off not annuitizing any wealth at available rates. Moreover, in simulations of annuity decisions by single retirees in the United States, five of the six estimates of bequest motives from the saving literature significantly reduce the predicted demand for annuities.[am]

[aj] The Social Security Administration describes the benefit adjustment for delayed retirement at http://www.ssa.gov/oact/quickcalc/early_late.html.

[ak] The premium is in the form of the forgone normal benefits the participants are entitled to receive had they retired at the normal benefit age. Since Social Security benefit is indexed for inflation and offers survivor benefits, one may even argue that the premium for delayed benefits is actuarially favorable.

[al] Sun and Webb (2011) showed that, for plausible preference parameters, the optimal age for claiming Social Security benefits for nonliquidity constrained single individuals and married men is between 67 and 70.

[am] Ameriks et al. (2011) also considered the possible role of what they referred to as "public care aversion" in underannuitization. The idea is that if people annuitize too much of their wealth, the probability of having insufficient wealth for private long-term care and therefore needing public care, which the individual is averse to, will increase. They administered a novel strategic survey instrument that includes hypothetical questions to disentangle the relative importance of public care aversion and bequest motive. They found that public care aversion is very significant, and that bequest motives are strong also for the middle class.

3.2.2.4 Behavioral Explanations

Brown et al. (2008) provided experimental evidence that individuals' aversion to annuities may be related to whether the annuity product is viewed by the consumer through the "consumption frame" or through an "investment frame." When annuity is viewed through the consumption frame, the consumer focuses on the end result of what can be spent over time; but when it is viewed through the investment frame, the consumer instead focuses on the intermediate results of return and risk features when choosing assets and does not consider the consequences for consumption. For the sake of illustrating the potential differences of the two frames, consider a two-period case where the individual has probability q of dying. If an individual invests wealth W in a simple bond with a return R, he will be able to consumer $W(1+R)$ in the second period if he stays alive. If, in contrast, he buys an actuarially fair annuity, he is able to consume $W(1+R)/(1-q)$ if he lives. Viewed from a consumption frame, the consumer will notice that what he is able to consume in the second period with an annuity, $W(1+R)/(1-q)$, is higher than what he can consume with a simple bond, $W(1+R)$. However, viewed from an investment frame, the consumer may focus on the rate of return and the variance of payments of the two investment alternatives. In the preceding example, a bond has return of R and poses no risk, since it pays the same irrespective of the state; on the other hand, the annuity has a return of $(1+R)/(1-q)$ with probability q and a return of 0 with probability q. Even though the bond and the annuity have the same expected return, the annuity appears *riskier* than the bond. Brown et al. (2008) conducted choice experiments in which subjects are asked to choose to allocate a certain amount of money between a life annuity and a bond, but the choices are described randomly by using an "investment frame" or a "consumption frame." They found that 72% of respondents prefer a life annuity over a savings account when the choice is framed in terms of consumption, but only 21% of respondents prefer a life annuity when the choice is framed in terms of investment features.[an]

3.2.3 Reverse Mortgage

A reverse mortgage insurance, or sometimes called a reverse mortgage loan, can be a valuable retirement planning tool that can greatly increase retirees' income streams by using their largest assets—their homes. As we described in Section 2.1, home equity is the dominant form of wealth for older Americans, particularly widows. Based on the 2001 Survey of Consumer Finances, Aizcorbe et al. (2003, quoted in Davidoff and Welke, 2004) showed that 76% of household heads 75 or over own a home, with a median value of $92,500, and only 11% of these households owe any mortgage debt. Among the majority

[an] Agnew et al. (2008) also used experiments to examine the role of gender, framing, and default on annuity choices.

of older single women in the 2000 AHEAD survey who own homes, the median ratio of home value to total assets was 79%.[ao]

A reverse mortgage allows homeowners to borrow against their home equity, while still maintaining ownership of the home until they die. The modern reverse mortgage industry dates to 1961 in the United States and the early part of the 20th century in Europe.[ap] Reverse mortgage borrowers must be 62 or older, must be homeowners with very little outstanding mortgage debt, and must live in the house. The amount that homeowners can borrow via a reverse mortgage, called the initial principal limit, is larger if the house value is larger, if there is a lower (or zero) outstanding balance on other mortgage loans, if the borrower is older, and if the interest rate is lower. Once the lender calculates the initial principal limit, borrowers can generally take out up to 60% of their initial principal limit in the first year. Reverse mortgage borrowers can receive payments in several forms: a borrower may receive a single lump sum payment, or a line of credit with an increasing maximum outstanding balance, or monthly payments that last for a fixed period (term payments), or monthly payments that last as long as the borrower lives in the home (tenure payments). Borrowers may receive payments in a combination of any of these forms. The line of credit is by far the most popular option (and it includes lump sum payments as a subset). If a borrower decides to take a reverse mortgage with tenure payments, it may be considered as an annuity insurance with one's home equity as the capital, which can potentially insure borrowers against the risks of housing market and their longevity risk.

In the United States the most popular reverse mortgage is administered by the Federal Housing Administration (FHA), called a home equity conversion mortgage (HECM), while the private market for reverse mortgages has been shrinking.[aq] Shan (2011) reported that HECM loans represent over 90% of all reverse mortgages originated in the US market. It should be pointed out that with a reverse mortgage, borrowers are insured against substantial drops in house prices because the reverse mortgage loan includes an insurance in all HECMs administered by the FHA. Borrowers (or their heirs) can repay the loan either by letting the reverse mortgage lender sell the house or by paying in cash. Most use the first option. In the first case, a mortgage lender sells the house attached to the reverse mortgage loan and uses the proceeds of the sale to repay the loan and to pay for various costs. If the sale value of the house turns out to be greater than the sum of the total loan amount and the various costs of the loan, the borrowers receive the remaining value. In the opposite case, where the house value cannot cover the total costs

[ao] See Davidoff and Welke (2004) for more discussions about the reverse mortgage market. Nakajima (2012) provided a very useful basic introduction.

[ap] In French, reverse mortgage is known as a "viager."

[aq] In 2011 the two biggest lenders of reverse mortgage loans, Bank of America and Wells Fargo, exited the reverse mortgage market (see New York Times, "2 Big Banks Exit Reverse Mortgage Business," June 17, 2011).

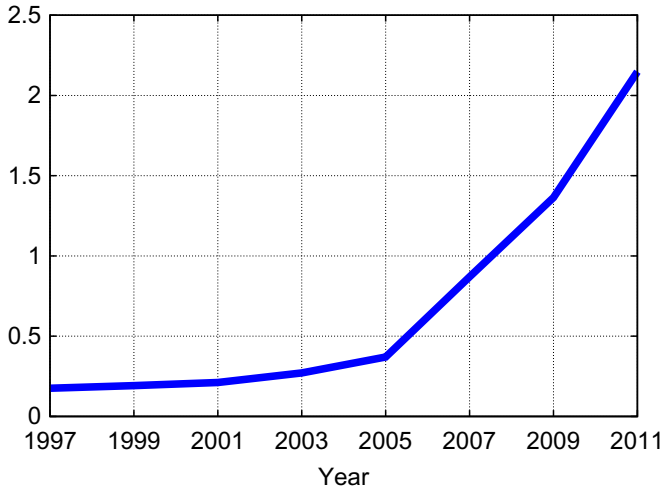


Fig. 12 Percentage of older (age 65) homeowners with reverse mortgages. *Source: American Housing Survey, Various Waves. Reproduced from Nakajima, M., Telyukova, I.A., 2013. Reverse mortgage loans: a quantitative analysis. Working Paper, Federal Reserve Bank of Philadelphia.*

of the loan, the insurance covers the difference and the borrowers do not need to pay anything extra (see Nakajima, 2012). The number of households with reverse mortgages has been growing. Fig. 12, reproduced from Nakajima and Telyukova (2013), shows the proportion of homeowner households of age 65 and above that have reverse mortgages, including both the HECM loans and private mortgage loans, between 1997 and 2011. Fig. 12 shows that the reverse mortgage market was very small before 2000. In 2001 the share of eligible homeowners with reverse mortgages was about 0.2%. This share increased rapidly since then, reaching 2.1% in 2011.

There is growing economics literature that investigates various aspects of the reverse mortgage market. Davidoff and Welke (2004) empirically showed that the reverse mortgage market is characterized by advantageous selection; ie, reverse mortgage borrowers appear to exit their homes at a faster pace than the general population. The authors suggested that a higher discount rate among the borrowers combined with housing price appreciation may explain observed advantageous selection. Nakajima and Telyukova (2013) analyze reverse mortgages in a life-cycle model of retirement, calibrated to age-asset profiles. They found that the *ex ante* welfare gain from reverse mortgages is sizeable at $1000 per household. They also argued that bequest motives, nursing home moving risk, house price risk, and interest and insurance costs all contributed to the low take-up rate of reverse mortgages.

3.3 Life Insurance Market

Individuals face mortality risks as described in Section 2.3. If they care for their dependents (eg, the spouse, the children, or sometimes the parents, or any other person), they

have a desire to ensure that their dependents' quality of life is not affected by their death.[ar] Life insurance provides such protection. The basic economic theory of the demand for life insurance starts with Fischer (1973) and Karni and Zilcha (1986) and was summarized in a survey by Villeneuve (2000).

There are two main types of individual life insurance products, *term* life insurance and *whole* life insurance.[as] A *term* life insurance policy covers a person for a specific duration at a fixed or variable premium for each year. If the person dies during the coverage period, the life insurance company pays the face value of the policy to the person's beneficiaries, provided that the premium payment has never lapsed. The most popular type of term life insurance has a fixed premium during the coverage period and is called level term life insurance. A *whole* life insurance policy, on the other hand, covers a person's entire life, usually at a fixed premium. In any period, life insurance is a contract between the insured and the insurance company that specifies a *premium* and a benefit amount payable to the beneficiary of the life insurance policy (known as the *face amount*) conditional on the death of the insured. Both term life and whole life are contracts that specify a sequence of such annual premium/death benefit combinations, and the difference is that under term life, the sequence has a fixed period (so, eg, a 20-year term life insurance policy has a sequence of 20 years), while under whole life, the sequence has a random length equal to the random longevity of the policyholder.

In contrast to the rather small private annuity insurance market, as discussed in Section 3.2, the life insurance market is large and important.[at] According to Life Insurance Marketing and Research Association International (LIMRA International), 78% of American families owned some type of life insurance in 2004. By the end of 2008, the total number of individual life insurance policies in force in the United States stood at about 156 million; and the total individual policy face amount in force reached over 10 trillion dollars (see American Council of Life Insurers, 2009). In the United States at year-end 2008, 54% of all life insurance policies in force were term life insurance. Of the new individual life insurance policies purchased in 2008, 43%, or 4 million

[ar] As shown in Fang and Kung (2012a), the life insurance ownership rates are high among the Health Retirement Study respondents whose ages range from 54 to 84. In 1996, when the respondents are between 54 and 74 years old, life insurance ownership rate is at 88.1%; in 2006, when the surviving respondents are between 64 and 84 years old, the ownership rate remains high at 78.6%. It is somewhat a puzzle why elderly individuals continue to own life insurance. Brown (2001) provided evidence against the hypothesis that elderly individuals with strong bequest motives purchase term life insurance to offset mandatory annuitization by the existing Social Security system.

[as] The whole life insurance has several variations such as universal life (UL), variable life (VL), and variable-universal life (VUL). UL allows flexible premiums subject to certain minimums and maximums. For VL, the death benefit varies with the performance of a portfolio of investments chosen by the policyholder. VUL combines the flexible premium options of UL with the varied investment option of VL (see Gilbert and Schultz, 1994).

[at] The discussion here borrows from Fang and Kung (2012a).

policies, were term insurance, totaling $1.3 trillion, or 73%, of the individual life face value issued (see American Council of Life Insurers, 2009). Besides the difference in the period of coverage, term and whole life insurance policies also differ in the amount of receivable cash surrender value (CSV) if the policyholder surrenders the policy to the insurance company before the end of the coverage period. For term life insurance, the CSV is zero; for whole life insurance, the CSV is typically positive and prespecified to depend on the length of time that the policyholder has owned the policy. One important feature of the CSV on whole life policies relevant to our following discussions is that by government regulation, CSVs do *not* depend on the health status of the policyholder when surrendering the policy.[au]

3.3.1 Front-Loaded Premiums and Reclassification Risk Insurance

An important feature of life insurance contracts is that life insurers often offer long-term insurance contracts with fixed premiums that are front-loaded; that is, the premium is higher than the actuarially fair premium in the early parts of the life insurance contract. Hendel and Lizzeri (2003) provided an elegant model that explains the front-loading of life insurance premiums. They showed that insurers require front-loaded premiums in order to provide *reclassification risk* insurance—insuring against the risk from stochastic second-period premium as a result of stochastic second-period health realization—which is valued by policyholders.

Hendel and Lizzeri (2003) consider a perfectly competitive primary market for life insurance that includes individuals (policyholders) and life insurance companies.[av] There are two periods. In the first period, the policyholder has a probability of death $p_1 \in (0,1)$ known to both himself and the insurance companies. In the second period, the policyholder has a new probability of death $p_2 \in [0,1]$, which is randomly drawn from a continuous and differentiable cumulative distribution function $\Phi(\cdot)$ with a corresponding density $\phi(\cdot)$. A consumer's period 2 health state p_2 is not known in period 1, but p_2 is symmetrically learned by the insurance company and the consumer, and thus common knowledge, at the start of period 2.

The policyholder's income stream is $\gamma - g$ in period 1 and $\gamma + g$ in period 2, where γ is interpreted as the mean life-cycle income and $g \in (0, \bar{g}]$ with $\bar{g} < \gamma$ captures the income growth over the periods. Both γ and g are assumed to be common knowledge.

The policyholder has two sources of utility: his own consumption should he live, and his dependents' consumption should he die. If the policyholder lives, he derives utility $u(c)$ if he consumes $c \geq 0$; if he dies, then he has a utility $v(c)$ if his dependents consume $c \geq 0$. $u(\cdot)$ and $v(\cdot)$ are both strictly concave and twice differentiable.

[au] The life insurance industry typically thinks of the CSV from the whole life insurance as a form of a tax-advantaged investment instrument (see Gilbert and Schultz, 1994).

[av] This rendition of the Hendel and Lizzeri (2003) model follows Fang and Kung (2010).

However, in period 2, there is a chance that the policyholder no longer has a bequest motive. Denote by $q \in (0,1)$ the probability that the policyholder loses his bequest motive.[aw] The bequest motive uncertainty is resolved at the same time as the period 2 health state; however, we assume that it is private information to the policyholder and cannot be contracted upon. If the policyholder retains his bequest motive, his utility in period 2 is again $u(\cdot)$ if he is alive and $v(\cdot)$ if he dies; if the policyholder loses the bequest motive, then his utility is $u(\cdot)$ if he stays alive, and some constant that is normalized to zero if he dies. Hendel and Lizzeri (2003) assume that there are no capital markets, thus the consumer cannot transfer income from period 1 to period 2. The only way for the consumer to ensure a stream of income for his dependents is to purchase life insurance.

We now provide more details about the timing of events. At the beginning of period 1, after learning the period-1 health state p_1, the consumer may purchase a long-term contract from an insurance company. A *long-term contract* specifies a premium and face value for period 1, $\langle Q_1, F_1 \rangle$, and a menu of health-contingent premiums and face values $\langle Q_2(p_2), F_2(p_2) \rangle$ for each period-2 health state $p_2 \in [0,1]$. In contrast, a spot contract is simply a premium and a face value $\langle Q, F \rangle$ that earns zero expected profit for a given coverage period.

The key assumption is that insurance companies can commit to these terms in period 2, but that the policyholders cannot. The *one-sided commitment* assumption has two important implications. First, it implies that the period-2 terms of the long-term insurance contract must be at least as desirable to the policyholder as what he could obtain in the period-2 spot market; otherwise, the policyholder will lapse the long-term contract into a new spot contract. This imposes a constraint on the set of feasible long-term contracts that consumers will demand in period 1. Second, if a policyholder suddenly finds himself without a bequest motive, he could lapse his policy by refusing to pay the second-period premium.

In period 2, after learning the period 2 health state p_2, the policyholder has three options. He can either continue with his long-term contract purchased in period 1, or he can let the long-term policy lapse and buy a period-2 spot contract, or he can let the long-term policy lapse and simply remain uninsured.

To characterize the equilibrium set of contracts, we first consider the actions of a policyholder in the second period who no longer has a bequest motive. Given the absence of a secondary market, and we have not yet allowed the insurance companies to buy back contracts through CSVs, the best course of action for those who no longer have a bequest motive is to simply let the long-term policy lapse and become uninsured.

Competition among primary insurance companies ensures that the equilibrium contract is a long-term contract $\langle (Q_1, F_1), (Q_2(p_2), F_2(p_2)) : p_2 \in [0,1] \rangle$ that solves

[aw] A loss of bequest motive could result from divorce or from changes in the circumstances of the intended beneficiaries of the life insurance policy.

$$\max\left[u(y-g-Q_1)+p_1v(F_1)\right] + (1-p_1)\int\left\{(1-q)\begin{bmatrix}u(y+g-Q_2(p_2))\\ +p_2v(F_2(p_2))\end{bmatrix}+qu(y+g)\right\}d\Phi(p_2) \tag{2}$$

$$\text{s.t.}\quad Q_1-p_1F_1+(1-p_1)(1-q)\int\left[Q_2(p_2)-p_2F_2(p_2)\right]d\Phi(p_2)=0, \tag{3}$$

$$Q_2(p_2)-p_2F_2(p_2)\le 0,\ \text{for all}\ p_2\in 0,1], \tag{4}$$

where (2) is the expected utility the policyholders receive from the contract, (3) is the *zero-profit* constraint that reflects perfect competition in the primary market, and constraints in (4) guarantee that there will not be lapsation among policyholders with a bequest motive in the second period.

Hendel and Lizzeri's (2003) main results are summarized in the following proposition:

Proposition *(Hendel and Lizzeri, 2003) The equilibrium set of contracts satisfies the following:*

1. *There is a period-2 threshold health state p_2^* (which is higher than the period 1 death probability p_1) such that for all $p_2 \le p_2^*$ the period-2 premiums are actuarially fair, and for all $p_2 > p_2^*$ the period-2 premiums are constant, actuarially favorable and given by $Q_2(p_2) = Q_2(p_2^*) = Q_1 + 2g$;*
2. *When the income growth parameter g is sufficiently small, p_2^* is strictly less than 1, ie, reclassification risk insurance is provided for policyholders with low-income growth.*

Part (1) of the preceding proposition provides a theoretical justification for level-term and whole life insurance, which typically have fixed premiums for the duration of the contract. Fig. 13 depicts equilibrium premiums in the second period as a function of the period-2 health state p_2.[ax]

3.3.2 Life Settlement Market and Its Welfare Effects

A *life settlement* is a financial transaction in which policyholders sell their life insurance policy to a third party—the life settlement firm—for more than the cash value offered by the policy itself. The life settlement firm subsequently assumes responsibility for all future premium payments to the life insurance company and becomes the new beneficiary of the life insurance policy if the original policyholder dies within the coverage period.[ay] The life settlement industry is quite recent, growing from just a few billion dollars in the late 1990s to about $12–15 billion in 2007, and, according to some projections, it is expected to grow to more than $150 billion in the next decade (see Chandik, 2008).

[ax] Hendel and Lizzeri (2003) made the ingenious observation that exactly the same outcome for the consumers would occur if the insurance company offers a contract that guarantees the second-period premium to be $Q_1 + 2g$ for *all* health states.

[ay] The legal basis for the life settlement market seems to be the Supreme Court ruling in *Grigsby v. Russell* [222 US 149, 1911], which upheld that for life insurance, an "insurable interest" only needs to be established at the time the policy becomes effective, but does not have to exist at the time the loss occurs. The life insurance industry has typically included a 2-year contestability period during which transfer of the life insurance policy will void the insurance.

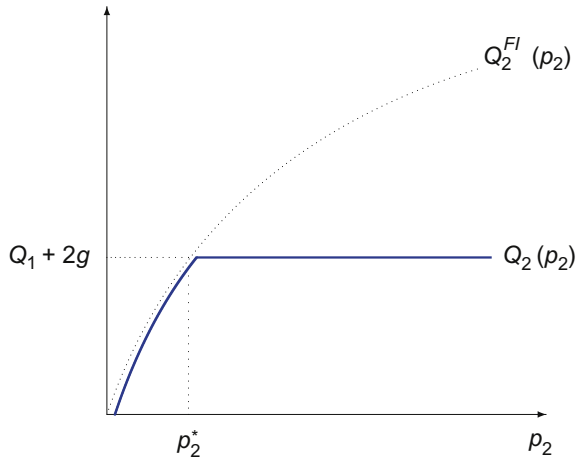


Fig. 13 Equilibrium life insurance premium profile in the second period as a function of mortality rates. *Source: Adapted from Hendel, I., Lizzeri, A., 2003. The role of commitment in dynamic contracts: evidence from life insurance. Q. J. Econ. 118 (1), 299–327.*

The opportunity for the life settlement market results from two main features of life insurance contracts. First, most life insurance policies purchased by consumers, either term or whole life, have the feature that the insurance premium stays fixed over the course of the policy. Because policyholders' health typically deteriorates over time, the fixed premium implies that policyholders initially pay a premium that is higher than actuarially fair, but in later years the same premium is typically actuarially favorable. This is the *front-loading* phenomenon we described earlier. Front-loading implies that policyholders of long-term life insurance policies, especially those with impaired health, often have locked in premiums that are much more favorable than what they could obtain in the spot market. This generates what has been known as the *actuarial value* of the life insurance policy (see Deloitte Report, 2005). Second, as we mentioned earlier, the CSV for life insurance policies is either zero for term life insurance or at a level that does not depend on the health status of the policyholder. Because the actuarial value of a life insurance policy is much higher for individuals with impaired health, the fact that the CSV does not respond to health status provides an opening for gains of trade between policyholders with impaired health and life settlement companies.[az] Life settlement firms

[az] Deloitte Report (2005, p. 3) states that the CSVs of whole life insurance policies are, by regulation, not allowed to be conditioned on health impairments of the policyholder who surrenders the policy. Doherty and Singer (2002) also argue that regulatory constraints faced by life insurance carriers deter life insurance companies from offering health-dependent CSVs: "Such an offering of explicit health-dependent surrender values by a life insurance carrier, however, would be fraught with regulatory, actuarial, and administrative difficulties. Life insurance carriers do not offer health-adjusted surrender values, which suggests that these difficulties outweigh the benefits that carriers would obtain by offering health-dependent surrender values to consumers." Life settlement firms so far are not yet regulated in their pricing of life insurance policies.

operate by offering policyholders, who are intending to either lapse or surrender their life insurance policies, more cash than the CSV offered by the insurers.

The emerging life settlement market has triggered controversies between some life insurance companies who oppose it and the life settlement industry who supports it. The views from the two opposing camps are represented by Doherty and Singer (2002) and Singer and Stallard (2005) on the proponent side, and the Deloitte Report (2005) on the opponent side. Doherty and Singer (2002) argued that a secondary market for life insurance enhances life insurance policyholders' liquidity by eroding the monopsony power of the carrier. This will increase the surplus of policyholders and in the long run will lead to a larger primary insurance market. On the other side, life insurance companies, as represented by the Deloitte Report (2005), claim that the life settlement market, by denying them the return on lapsing or surrendered policies, increases the costs of providing policies in the primary market. They allege that these costs will have to be passed on to consumers, which would ultimately make consumers worse off.

A key issue in the contention between the opposing sides is the role of lapsing or surrendering in the pricing of life insurance in the primary market (see Daily, 2004). Policyholders may choose to lapse or surrender in a variety of situations. First, the beneficiary for whom the policy was originally purchased could be deceased or no longer need the policy; second, the policyholder may experience a negative income shock (or a large expense shock) that leads him to favor more cash now over a bequest.[ba] In the absence of the life settlement market, when a health-impaired policyholder chooses to lapse or surrender its policy, the life insurance company pockets the intrinsic economic value of the policy, which potentially allows the life insurance company to offer insurance at a lower premium. In the presence of the life settlement market, these policies will be purchased by the life settlement firms as assets; thus the primary insurance company will always have to pay their face value if the original policyholder dies within the coverage period.

Daily et al. (2008) and Fang and Kung (2010) studied the effect of life settlement on the primary life insurance market, using a dynamic equilibrium model of life insurance similar to Hendel and Lizzeri (2003), under the assumption that the lapsation of policyholders is driven by loss of bequest motives. Fang and Kung (2010) showed that the life settlement market affects the equilibrium life insurance contracts in a qualitatively important manner: with the settlement market, risk reclassification insurance will be offered in the form of *premium discounts*, rather than in the form of flat premiums as is the case without a settlement market, which we discussed in the previous section. This may lead to a *smaller* degree of front-loading in the first period. They also show a general welfare result

[ba] For example, the *Wall Street Journal* reports that older adults are turning to the "life settlement" industry to help them through tough times in an article titled "Source of Cash for Seniors Are Drying Up" (November 13, 2008).

that the presence of the settlement market always leads to a decrease of consumer welfare relative to what could be achieved in the absence of the settlement market. They also provide conditions under which the life settlement market could lead to a complete collapse of reclassification risk insurance as a result of unraveling. If one relaxes the assumption that prohibits endogenously chosen CSVs, Fang and Kung (2010) found that whether or not CSVs can be made health-contingent has crucial implications. If CSVs are restricted to be nonhealth contingent, Fang and Kung (2010) show that an endogenous CSV is an ineffective tool for primary insurance companies to counter the threat of the life settlement industry. Fang and Kung (2012b), however, shows that if policyholders' lapsation is driven by income or liquidity shocks, then a life settlement market may potentially improve consumer welfare.

The intuition for the difference in the welfare result is as follows. Life insurance is typically a long-term contract with one-sided commitment in which the life insurance companies commit to a specified death benefit provided that the premium payments are made, whereas the policyholder can lapse anytime. Because the premium of life insurance policies is typically front-loaded, the life insurance company pockets the *lapsation profits* whenever policyholders lapse their policy after holding it for several periods, which is factored into the pricing of the life insurance policy to start with because of competition (see Gilbert and Schultz, 1994). The key effect of the settlement firms on the life insurers is that the settlement firms will effectively take away the lapsation profits, forcing the life insurers to adjust the policy premiums and possibly the whole structure of the life insurance policy, since lapsation profits can no longer exist. In the theoretical analysis, we showed that life insurers may respond to the threat of life settlement by limiting the degree of reclassification risk insurance, which certainly reduces consumer welfare. However, the settlement firms are providing cash payments to policyholders when the policies are sold to the life settlement firms. The welfare loss from the reduction in the extent of reclassification risk insurance has to be balanced against the welfare gain to the consumers when they receive payments from the settlement firms. If policyholders sell their policies because of income shocks, then the cash payments are received at a time when the marginal utility of income is particularly high, and the balance of the two effects may result in a net welfare gain for the policyholders. If policyholders sell their policies as a result of losing bequest motives, the balance of the two effects on net results in a welfare loss. Thus, to inform policy-makers on how the emerging life settlement market should be regulated, an empirical understanding of why policyholders lapse is of crucial importance.

3.3.3 Why Do Life Insurance Policyholders Lapse?

The theoretical prediction discussed above that the equilibrium effect of the life settlement market on consumer welfare depends on why policyholders lapse—loss of bequest motives or income shocks—motivate an empirical analysis on why do policyholders their life insurance policies in Fang and Kung (2012a).

Lapsation is an important phenomenon in life insurance markets. Both LIMRA and the Society of Actuaries consider that a policy lapses if its premium is not paid by the end of a specified time (often called the grace period).[bb] According to LIMRA (2009, p. 11), the life insurance industry calculates the annualized lapsation rate as the ratio of the number of policies lapsed during the year over the number of policies exposed to lapse during the year. The number of policies exposed to lapse is based on the length of time the policy is exposed to the risk of lapsation during the year. Termination of policies because of death, maturity, or conversion is not included in the number of policies lapsing and contributes to the exposure for only the percentage of the policy year they were in force. Table 9 provides the lapsation rates of individual life insurance policies, calculated according to the preceding formula, both according to face value and the number of policies for 1998–2008. Of course, the lapsation rates also differ significantly by the age of the policies. For example, LIMRA (2009, p. 18) showed that the lapsation rates are about 2–4% per year for policies that were in force for more than 11 years in 2004–05.[bc]

Fang and Kung (2012a) presented and empirically implemented a structural dynamic discrete choice model of life insurance decisions to study why life insurance policyholders lapse their policies using the limited life insurance holding information from the HRS data. They found that a large fraction of life insurance lapsation is driven by idiosyncratic choice-specific shocks, particularly when policyholders are relatively young. But as the remaining policyholders get older, the role of such idiosyncratic shocks gets less important, and more of their lapsation is driven by either income, health, or bequest motive shocks. Income and health shocks are relatively more important than bequest motive shocks in explaining lapsation when policyholders are young, but as they age, the bequest motive shocks play a more important role. These empirical findings have important

Table 9 Lapsation rates of individual life insurance policies, calculated by face amount and by number of policies: 1998–2008

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
By face amount	8.3	8.2	9.4	7.7	8.6	7.6	7.0	6.6	6.3	6.4	7.6
By number of policies	6.7	7.1	7.1	7.6	9.6	6.9	7.0	6.9	6.9	6.6	7.9

Source: American Council of Life Insurers, 2009. 2009 Life Insurers Fact Book. Reproduced from Fang, H., Kung, E., 2012a. Why do life insurance policyholders lapse? Loss of bequest motives vs. liquidity shocks. NBER Working Paper No. 17899.

[bb] This implies that if a policyholder surrenders his/her policy for CSV, it is also considered as a lapsation.

[bc] Krebs et al. (2011) also studied the life insurance choices in a life-cycle macroeconomic model with physical and human capital, human capital risk, and limited contract enforcement and found both theoretically and empirically using Survey of Consumer Finance data that young households are the most exposed to human capital risk and are also the least insured.

implications regarding the effect of the life settlement industry on consumer welfare. As shown in theoretical analyses in Daily et al. (2008) and Fang and Kung (2010), the theoretical predictions about the effect of life settlement on consumer welfare crucially depend on why life insurance policyholders lapse their policies. If bequest motive shocks are the reason for lapsation, then the life settlement industry is shown to reduce consumer welfare in equilibrium; but if income shocks are the reason for lapsation, then life settlements may increase consumer welfare. To the extent that we found that both income shocks and bequest motive shocks play important roles in explaining life insurance lapsations, particularly among the elderly population targeted by the life settlement industry, our research suggests that the effect of life settlement on consumer welfare is ambiguous.

3.4 Long-Term Care Insurance Market

As we mentioned in Section 2.4, retirees face significant risks in their morbidity and needs for long-term care. Long-term care in the United States is expensive. According to MetLife Mature Market Institute (2012), the cost for a semiprivate room in a nursing home is about $222 per day or $6753 per month, and $248 per day or $7543 per month for a private room in a nursing home. It is somewhat cheaper in an assisted-living facility at a cost of $3550 per month. A home health aide costs on average about $21 per hour, and it costs $70 per day for services in an adult day health care center.[bd] Not only is long-term care expensive, but also lifetime long-term care expenditures are spread unevenly across the population: as described in Table 7, between 35% and 50% of 65-year-olds will use a nursing home at some point in their remaining lives. Of those who use a nursing home, 10–20% will live there more than 5 years (Brown and Finkelstein, 2009).[be]

As emphasized in Norton (2000), long-term care differs from acute medical care in four important ways: long-term care is care for chronic illness; the nursing home industry is dominated by for-profit facilities sometimes facing excess demand; long-term care is often provided by unpaid caregivers; and little private long-term care insurance is purchased.[bf] In this section, we will focus on the private long-term care insurance (or lack of it).

3.4.1 Basic Facts of Long-Term Care Arrangements

Long-term care includes both home health care for people residing in the community and institutional care provided in nursing homes or assisted-living facilities. Expenditures on home health care account for about one-third of the total long-term care spending (Centers for Medicare and Medicaid Services, 2010).

[bd] Cost of long-term care information is available at http://longtermcare.gov/costs-how-to-pay/costs-of-care/.

[be] See Friedberg et al. (2014) for some new evidence on the probability of using nursing homes and the average duration of nursing home stays conditional on use.

[bf] See also Chapter 16 by Norton (this volume), which summarizes the key connections between long-term care and population aging.

Table 10, reproduced from Byrne et al. (2009), shows how the care arrangements for elderly parents vary across families.[bg] In their sample, which is from the 1993 wave of the AHEAD data set, 22% of elderly individuals receive formal or informal care in their homes. Among those receiving some type of care, 18% receive formal care, 90% receive informal care, and 8% receive both formal and informal care. Overall, 6% of unmarried,

Table 10 Characteristics of care provision for families of various sizes

	Number of children		Number of children[a]					
Type of family	**Single**	**Married**	**1**	**2**	**3**	**4**	**5**	**Total**
Percentage of all families	17.8	3.7	20.8	27.8	16.9	9.0	3.9	100
Percent of families								
Receiving care	5.6	38.1	26.3	24.7	25.7	26.1	22.9	22.3
Receiving formal care[b]	100	9.8	21.8	12.9	12.2	8.2	3.1	17.8
Receiving informal care[b]		98.0	88.3	93.5	96.8	100	100	89.9
Receiving formal and informal care[b]		7.8	10.2	6.5	9.0	8.2	3.1	7.7
Percent of families where								
Children help pay for care[c]			11.6	12.5	5.3	0	0	8.7
Spouse provides informal care[d]		100	48.9	62.9	63.6	63.5	68.8	62.6
Children provide informal care[d]			54.0	40.1	43.7	42.4	40.6	41.7
Multiple children provide informal care[e]				9.7	16.7	19.4	23.1	14.4
Children and spouse provide informal care[d]			2.9	3.0	7.3	5.9	9.4	4.6
Average hours per week								
Informal care provided by spouse[f]		26.8	25.8	25.8	24.3	27.1	34.4	26.2
Informal care provided by children[g]			21.3	23.7	27.5	21.9	16.8	23.5

[a]Includes families with single and married respondents.
[b]As share of families with respondents receiving any care.
[c]As share of families with respondents receiving formal care.
[d]As share of families with respondents receiving informal care.
[e]As share of families with children providing informal care.
[f]Average over families with spouse providing informal care.
[g]Average over families with children providing informal care.
Source: From table 5 in Byrne, D., Goeree, M., Hiedemann, B., Stern, S., 2009. Formal home health care, informal care, and family decision-making. Int. Econ. Rev. 50 (4), 1205–1242.

[bg] Note that the target population for the AHEAD survey consists of US household residents who were born in 1923 or earlier. Persons in institutions (including nursing home, long-term medical care, or dependent care facilities, prisons, and jails) at the time of the Wave 1 survey are ineligible for AHEAD (see Heeringa, 1995). This initial sample selection could prejudice some of the statistics of the care utilization patterns.

childless respondents and 38% of married, childless respondents receive care in their homes. Regardless of the number of children, roughly one-fourth of elderly parents receive some type of care. Among families providing some type of care, the provision of informal care depends positively and the provision of formal care depends negatively on the number of adult children. Among elderly individuals receiving informal care, 63% receive care from their spouse, 42% receive care from their children, and 5% receive care from both their spouse and at least one of their children. Conditional on the receipt of informal care from at least one family member, the likelihood that the spouse and at least one adult child share informal caregiving responsibilities ranges from 3% of those with one child to 9% of those with five children. A more common type of shared caregiving involves two or more adult children. Among families with at least one informal care provider and at least two adult children, 14% include multiple caregivers among the younger generation. Not surprisingly, the likelihood that siblings share caregiving responsibilities depends positively on family size. Conditional on the receipt of informal care from at least one family member, 10% of elderly individuals with two children receive care from both children, whereas 17%, 19%, and 23% of elderly individuals with three, four, and five children, respectively, receive care from more than one child. Among families where elderly individuals receive formal home health care, 9% of elderly parents receive financial contributions for this care from their children.[bh]

3.4.2 Why Is the Private LTC Insurance Market so Small?

Given the uncertain and expensive nature of the long-term care needs and expenses, we might have expected that there would be a large demand for long-term care (LTC) insurance. However, in the United States and in many developed countries, most of the long-term care expenditure risk is not insured. The private LTC insurance is rather small, at least relative to health insurance that covers acute health expenditure risks. The Congressional Budget Office (2004) estimates that in the United States, only 4% of long-term care expenditures are paid for by private insurance, while 33% are paid out of pocket; public insurance, including Medicare and particularly Medicaid, covers about 60% of long-term care expenditures.[bi]

It is useful to describe briefly the means of payment for long-term care expenditures previously mentioned. Medicare is designed mostly to cover care costs associated with recovery from acute illness episodes following a hospital stay of more than three consecutive days, rather than chronic impairments. It only pays for care provided in skilled

[bh] Byrne et al. (2009) note that these statistics understate the prevalence of informal and formal care, because only those AHEAD respondents reporting an ADL or IADL problem were asked about the provision of care. Furthermore, in the presence of an ADL or IADL problem, respondents were asked who provides care only if they reported receiving help with the problem "most of the time," and the amount of care is recorded only if the caregiver provided help at least once a week during the month prior to the survey.

[bi] For the related figures corresponding to other OECD countries, see OECD (2011b) .

nursing facility for up to 100 days, but does not pay for nonskilled assistance with ADL, which makes up the majority of long-term care services.[bj]

Medicaid serves as a second-payer insurance and pays for long-term care for individuals who meet Medicaid's income and asset eligibility thresholds. Medicaid is a rather imperfect form of insurance for long-term care risks because its asset eligibility requirement is essentially a deductible of nearly all of one's wealth.[bk] However, as we will discuss in Section 4.1, Brown and Finkelstein (2008) argued convincingly that the long-term care coverages provided by Medicaid contribute in an important way to the limited size of the private long-term care insurance market.

Long-term care insurance is designed to cover long-term services and supports, including personal and custodial care in a variety of settings such as home, community organization, and other facility. Long-term care insurance policies typically reimburse policyholders a daily amount (up to a preselected limit) for services to assist them with ADL such as bathing, dressing, and eating. Many long-term care insurance policies have limits on how long or how much they will pay; most policies will pay the costs of the long-term care for 2–5 years. The premium of a long-term care policy is based on the age at the purchase of the policy, the maximum amount that a policy will pay per day, the maximum number of days (years) that a policy will pay. Importantly, individuals who are in poor health or already receiving long-term care services may not qualify for long-term care insurance as most individual policies require medical underwriting.

It should be noted that private long-term care insurance policies typically set a relatively low maximum on the amount of covered expenses that the policy will reimburse per day in care. The average maximum daily benefit for nursing home care for policies sold in 2005 was only $142, which was substantially below the average daily nursing home costs of almost $200 per day in 2008 (MetLife Mature Market Institute, 2009). Moreover, since about one-quarter of policies have a maximum daily benefit that is fixed in nominal terms, the daily benefit caps are even more binding in practice.

An important literature examines the question of why the private LTC insurance market is so small, which is analogous to the literature on the underannuitization puzzle discussed in Section 3.2. Similar to the proposed solutions to the underannuitization puzzle, the explanations for the small private LTC market can also be grouped into explanations based on supply- and demand-side imperfections. While the most compelling explanation for why private LTC insurance is so small is that of Brown and Finkelstein (2008), which we discuss in Section 4.1, we will now describe two

[bj] Most employer-sponsored or private health insurance plans cover only the same kinds of skilled, short-term, medically necessary care as Medicare, if they cover long-term care at all.

[bk] In 1988 the US Congress passed the Medicaid spousal impoverishment provisions under which a certain amount of a couple's combined resources is protected for the spouse living in the community.

complementary explanations, one based on information barriers (and thus market failure) and the other based on a strategic lack of demand for long-term care insurance.

3.4.2.1 Informational Barriers in the LTC Insurance Market

Finkelstein and McGarry's (2006) study of the long-term care (LTC) insurance market used panel data from a sample of Americans born before 1923 (the AHEAD study) and found that there was no statistically significant correlation between LTC coverage in 1995 and use of nursing home care in the period between 1995 and 2000, even after controlling for insurers' assessment of a person's risk type. This evidence, alone, is consistent with both *no asymmetric information* and *multidimensional private information*. To distinguish between these competing explanations, they first eliminated the no asymmetric information interpretation. Specifically, they found that a subjective probability assessment contained in the 1995 AHEAD questionnaire, "What do you think are the chances that you will move to a nursing home in the next five years?" is *positively correlated* with both LTC coverage and nursing home use from 1995 to 2000, even after controlling for insurers' risk assessment. Since this variable is presumably unobserved by the insurer, these positive correlations suggest private information and adverse selection by the insured. Then Finkelstein and McGarry developed a proxy for risk aversion, using information on whether respondents undertake various types of preventive health care. They found that people who are more risk averse by this measure are both more likely to own LTC insurance and less likely to enter a nursing home—consistent with multidimensional private information and advantageous selection based on risk aversion. In fact, their findings suggest that, on average, adverse selection based on risk and advantageous selection based on risk aversion roughly cancel each other out in the LTC insurance market. This in fact presents an apparently larger puzzle: if adverse selection based on risk and advantageous selection based on risk aversion roughly cancel out, why is the LTC insurance market still so small? The no-trade theorem of Hendren (2013) discussed in Section 3.2 also applies to the LTC insurance setting.

3.4.2.2 Strategic Rational Nonpurchase

Pauly (1990) provided another explanation for rational nonpurchase of long-term care insurance, even for middle- or high-wealth individuals. He considered a model in which the parent prefers long-term care provided by her children over institutionalized care in nursing homes. The parent decides whether or not to purchase long-term care insurance before she becomes enfeebled, but her children determine the form of their parent's long-term care once their parent incurs a chronic illness. The parent anticipates that the purchase of long-term care insurance reduces the price of the institutionalized care, thus encouraging her children to initiate more formal (nonfamily-provided) care than would be the case without insurance. More specifically, without insurance, the children know that the nursing home care expenditure will reduce their inheritance, but if full insurance

is available, there is no such impact on the amount of their inheritance if nursing home care is chosen. Since the parent prefers family-provided care over institutionalized care, she will rationally choose not to purchase long-term care insurance. This explanation even predicts that the parent may not even permit the children to purchase long-term care insurance on her behalf. However, this explanation of strategic nonpurchase of LTC insurance does not apply to people without children.

4. INTERACTIONS BETWEEN SOCIAL INSURANCE AND PRIVATE INSURANCE PROGRAMS

So far we have described how retirees rely on combinations of social insurance programs, such as Social Security, Medicare and Medicaid, and private insurance purchases to insure against the multitude of risks they face. Important literature describes the interactions between the social insurance programs and private insurance markets. We summarize some of the key studies in this area.

4.1 Medicaid and Long-Term Care Insurance

Brown and Finkelstein (2008) argued that a potential explanation for the small size of the private long-term care insurance market is that the public insurance provided by Medicaid may crowd out the demand for private insurance. Recall that Medicaid is a public insurance program that provides health insurance, as well as long-term care insurance for the poor elderly. Brown and Finkelstein (2008) developed an optimization model of a 65-year-old risk-averse individual who chooses an intertemporal consumption path in an environment with long-term care expenditure risks. The individuals in their model face the typical state Medicaid rules, and they can buy long-term care insurance from the private market whose prices and coverages are also calibrated to the actual available policies.

The model is as follows. Suppose that a consumer at care state s at month t derives utility from consumption $C_{s,t}$ and some portion of the long-term care expenditures (eg, provision of food or shelter in a nursing home), denoted by $F_{s,t}$, according to $U_s(C_{s,t}+F_{s,t})$. The care state s can take five possible values: at home receiving no care, at home receiving home health care, residence in an assisted-living facility, residence in a nursing home, or deceased. At month t, the individual has an expectation that his care state will be s with probability $Q_{s,t}$; and the monthly discount rate is ρ. The consumer thus chooses consumption paths to maximize

$$\Sigma_{t=1}^{T}\Sigma_{s=1}^{5}\frac{Q_{s,t}}{(1+\rho)^t}U_s(C_{s,t}+F_{s,t})$$

subject to three constraints: first, an initial level of nonannuitized wealth W_0 and a given trajectory of annuitized income A_t from Social Security; second, a no-borrowing constraint imposed to eliminate the possibility that the individual dies in debt; and third, a

wealth accumulation equation that depends on whether the individual is eligible for Medicaid and whether he has purchased private long-term care insurance.

Under assumed preference parameters and calibrated Medicaid rules and long-term care insurance premiums and coverages, Brown and Finkelstein (2008) estimated how much a risk-averse life-cycle consumer would be willing to pay, over and above the required premiums, to purchase a long-term care insurance contract.

Their results suggest that Medicaid has a quantitatively large crowd-out effect on private long-term care insurance demand; specifically, they found that given the current structure of Medicaid, two-thirds of the wealth distribution would be unwilling to buy long-term care insurance even if it were offered at an actuarially fair price. Therefore the crowd-out effect of Medicaid seems to be a major contributor to the small size of the long-term care insurance.[bl] Moreover, their results show that Medicaid's large crowd-out effect mainly results from the combination of its means-tested eligibility and its secondary payer status for individuals with private insurance. Medicaid's secondary payer status for long-term care expenses for those with private insurance imposes an "implicit tax" on long-term care insurance purchase because a large part of the premium for a private policy pays for benefits that would have been provided by Medicaid. The presence of public Medicaid insurance thus limits the market for private long-term care insurance, but because of the means-testing for Medicaid eligibility, Medicaid actually provides a rather inadequate consumption smoothing mechanism for all but the poorest of individuals.[bm]

4.2 Medicare and Private Health Insurance

There is also substantial literature on the interaction between the social insurance program of Medicare and the private supplemental insurance known as Medigap, the Medicare Advantage plans (also known as Medicare Part C, see Section 3.1.1), and the employer-provided health insurance for workers.

4.2.1 Medicare and Medigap

Using MCBS data, Fang et al. (2008) studied who among the Medicare eligibles are more likely to enroll in the supplemental Medigap insurance. Table 11, reproduced from Fang et al. (2008), reports two panels of results from regressing "Total Medical Expenditure" on Medigap status, along with controls for the determinants of price (gender, a third-order polynomial of age, and controls for state and year), with or without controlling

[bl] Brown and Finkelstein (2008) predict that the LTC insurance purchase rate should be about one-third, still substantially higher than the 10% insurance rate in the data.

[bm] Brown and Finkelstein (2008) used a care status transition matrix developed by Robinson (1996). However, Friedberg et al. (2014) showed that this understates the risk but overstates the conditional mean duration. They show that using a corrected transition matrix reduces the percentage with a positive willingness to pay to levels closer to those observed in the data.

Table 11 OLS regression results of total medical expenditure on "Medigap" coverage in the MCBS

	(1)	(2)	(3)	(4)	(5)	(6)
	Panel A: Without health controls			Panel B: With direct health controls		
Variables	**All**	**Female**	**Male**	**All**	**Female**	**Male**
Medigap	−4392.7***	−6037.4***	−1863.4***	1937.0***	1677.3***	2420.9***
	(346.5)	(455.5)	(538.8)	(257.2)	(348.0)	(395.8)
Female	270.0	…	…	−751.6***	…	…
	(356.2)			(283.3)		
Age 65	387.5***	460.6***	292.9	394.5***	417.5***	355.4*
	(138.0)	(175.5)	(228.5)	(117.2)	(144.6)	(196.8)
$(\text{Age } 65)^2$	1.9	−1.8	5.6	−27.5***	−32.0***	−22.8
	(10.6)	(13.2)	(18.8)	(9.2)	(11.4)	(16.2)
$(\text{Age } 65)^3$	0.12	0.17	0.07	0.47**	0.55**	0.47
	(0.22)	(0.27)	(0.43)	(0.21)	(0.25)	(0.38)
State dummy	Yes	Yes	Yes	Yes	Yes	Yes
Year dummy	Yes	Yes	Yes	Yes	Yes	Yes
No. of obs.	15,945	9725	6220	14,129	8371	5758
Adjusted R^2	0.073	0.092	0.060	0.211	0.196	0.252

Note: The dependent variable is "Total Medical Expenditure." All regressions are weighted by the cross-section sample weights. Health controls included in Panel B are described in detail in the Data Appendix in Fang et al. (2008) under the category "Health." A total of 71 health indicators are included. Robust standard errors clustered at the individual level are in *parentheses*. *, **, and *** denote significance at 10%, 5%, and 1%, respectively.
Source: Reproduced from Fang, H., Keane, M.P., Silverman, D., 2008. Sources of advantageous selection: evidence from the Medigap insurance market. J. Polit. Econ. 116 (2), 303–350.

for the health status of the individuals. Each panel reports results separately for the full sample, and for male and female subsamples.

In Panel A where no health controls are included, we found a large and statistically significant relationship between total medical expenditure and Medigap status. Specifically, in the whole sample, those with Medigap have expenditures that are, on average, about $4000 *less* than those without Medigap; the negative relationship between Medigap coverage and total medical expenditure is stronger for women (about $6000) than for men (about $2000).

The regressions in Panel B are analogous to those in Panel A, but with the addition of extensive controls for health (see the Data Appendix in Fang et al., 2008 for details). Conditional on observable (but not priced) health indicators, in the full sample those with Medigap have total health care spending of about $1900 *more*, on average, than those without Medigap. The positive association between Medigap and total medical expenditure seems to be stronger for males (about $2400) than for females (about $1700).[bn]

[bn] Monk and Munnell (2009) obtained similar findings.

The results in Panel A alone indicate the presence of multidimensional private information. The results of Panel A and B together imply, *indirectly*, that there is advantageous selection in the Medigap market—ie, those with better health are more likely to purchase Medigap. That is the only way to rationalize simultaneously the large negative correlation between Medigap and *ex-post* health expenditure in Panel A without health controls, and the large positive correlation with health controls in Panel B. The results in Panel B indicate that once we condition on health status, those with Medigap have higher total health expenditures. This is what we would expect, and it may be related to the effects of moral hazard; for individuals with the same health, those with Medigap insurance face a lower price for health care.

To summarize, the results from Table 11 clearly illustrate two kinds of possible interactions between Medicare and Medigap. The first interaction is risk selection; namely, healthier Medicare eligibles are more likely to purchase Medigap plans. This type of risk selection has been called "advantageous selection" because it is favorable to the private insurers who sell the Medigap policies. Whether the advantageous selection is due to retirees' themselves or it is induced by the private insurance company via, eg, advertising targeting the relatively healthier individuals, is somewhat understudied for the Medigap insurance market.[bo] The second kind of interaction between Medigap and Medicare is moral hazard. Medigap effectively reduces Medicare enrollees' out-of-pocket costs to very low levels, thus increasing Medigap enrollees' health expenditure beyond what they would have spent if they did not have Medigap. This interaction results in a rather significant *fiscal externality by* the supplemental Medigap on Medicare. Indeed, the US government has noticed the fiscal impact of Medigap on Medicare expenditures, and in 2013 the Obama administration proposed to impose a surcharge by adding an amount equal to about 15% of the average Medigap policy premium to a Medigap policy owner's Medicare Part B premium to become effective in 2017.

4.2.2 Medicare and Medicare Advantage

As we described in Section 3.1.1, the traditional FFS Medicare (Parts A and B) reimburses costs of each medical care utilized by a beneficiary. Medicare still leaves seniors at significant risk of health expenditure. On average, basic Medicare benefits cover about 50% of the personal health care expenditures of aged beneficiaries in the United States (Kaiser Family Foundation, 2005). Medicare Advantage, which is privately managed care plan (either health maintenance organizations, HMO, or preferred provider organizations), is a private alternative to traditional Medicare run by a qualified private insurer. Insurers wishing to enroll Medicare beneficiaries sign contracts with the CMS describing what coverage they would provide, and at what costs. A Medicare Advantage (MA) plan

[bo] See Aizawa and Kim (2013) discussed later for evidence of the role of insurer advertising in risk selection in the Medicare Advantage market.

Table 12 Capitation payment and health expenditure by health status in Los Angeles County

Self-reported health status	Excellent	Very good	Good	Fair	Poor
Monthly capitation payment ($)	601.0	619.5	646.6	708.0	796.3
Monthly health expenditure ($)	266.0	347.8	575.4	923.7	2029.4
Monthly overpayment ($)	335.0	271.3	71.2	−215.7	−1233.1

Source: From Aizawa, N., Kim, Y.S., 2013. Advertising competition and risk selection in health insurance markets: evidence from Medicare advantage. Working Paper, University of Pennsylvania.

typically offers an enrollee more comprehensive coverage (eg, lower deductibles and co-pays) and provides benefits that are not available in traditional Medicare.[bp] However, enrollees in the Medicare Advantage plans can access only the provider network of the private insurer, which is more restricted than the network available under traditional Medicare—namely, any providers that accept Medicare payments. In 2011 about 25% of Medicare beneficiaries enrolled in MA.

Private insurers that offer MA plans receive a capitation payment from the government for each enrollee and then bear their health care costs. The capitation payments account for most of the plans' revenues because typically the MA plans charge zero to small premiums. However, it has been widely documented that the capitation payment received by private insurers does not fully reflect the cost of caring for an enrollee. Table 12 from Aizawa and Kim (2013) reports the average capitation payment and expected health expenditures by self-reported health status in Los Angeles County between 2000 and 2003, calculated from MCBS data.[bq] It shows that, from the perspective of the private insurers that offer MA plans, enrolling retirees with excellent or very good health is hugely profitable but enrolling those with fair or poor health leads to losses. This leads to strong incentives by the insurers to engage in risk selection.

Indeed, Langwell and Hadley (1989), Mello et al. (2003), and Batata (2004) found that healthier individuals are systematically more likely to enroll in an MA plan. This pattern of selection could be a result of consumer-driven selection or be induced by insurers through, eg, targeted advertising or choices of plan characteristics. Consumer-driven risk selection occurs when healthier individuals, by themselves, are more likely than less healthy individuals to find the Medicare Advantage plans (which have lower co-payments and deductibles and more extensive benefits, but more restricted HMO networks than the traditional Medicare) preferable to the traditional Medicare. Lustig (2011) studied how MA insurers may internally choose MA premiums and plan generosity to induce advantageous risk selection. Aizawa and Kim (2013) studied the role played by the advertising spending choice of the private insurers in the advantageous risk selection (favorable to the private

[bp] For example, many Medicare Advantage plans offer hearing, vision, and dental benefits, which are not covered by Medicare Part A or B. Before the introduction of Part D, prescription drug coverage was available in Medicare Advantage plans.

[bq] The pattern is common in all markets.

insurers) in the Medicare Advantage market. They found that consumer-driven risk selection accounts for about 85% of advantageous risk selection, while insurer-driven selection (via advertising) accounts for 15% of risk selection.

In 2004 Medicare began to base capitation payments on an individual's "risk score," generated by a risk-adjustment formula that accounts for over 70 disease conditions. Brown et al. (2011) showed, however, that this reform on the risk adjusted capitation payment formula in fact increased overpayments and thus the government's total cost of financing the care of Medicare enrollees. They argued that this occurs for the following reason. The risk adjustment in the capitation payment indeed decreases insurers' scope for advantageous selection along the dimensions included in the formula, but it increases their incentive to find individuals who are positively selected along dimensions excluded from the formula and are thus inexpensive for their risk score.

4.2.3 Medicare and Employer-Sponsored Health Insurance

Even though Medicare provides health insurance for those 65 years and older, it can nonetheless affect their health behavior when they are dealing with working age because of life-cycle matters, generating both a fiscal and health externality from ESHI of the working-age population to Medicare. Fang and Gavazza (2011) provided evidence that workers in high turnover industries spend less on medical care than workers in lower turnover industries during their working years; however, the low level of medical expenditures during working years increases medical expenditures during retirement.[br] Moreover, workers in high turnover industries are less likely to receive employer-sponsored insurance than their counterparts in low turnover industries. Overall, medical expenditures over individuals' *life cycle* in the United States seem to be rather inefficiently allocated. Based on their estimates, Fang and Gavazza (2011) found that overall medical expenditure in the United States is substantially increased as a result of the fragmented health insurance system: ESHI for the working-age population, but public Medicare for the elderly. Specifically, they found that one additional dollar of health expenditure during one's working years may lead to approximately 2.8 dollars of savings in health expenditure during retirement. An employment-based system, as compared to a national health insurance system, steepens the increase of health expenditure over an individual's life cycle, generating a substantial fiscal externality on Medicare, which covers retirees. An employment-based health system for workers also does not internalize the full long-term benefits of health investment, while workers are young, and this leads to an increase in the overall expenditure level.[bs]

[br] Interestingly, Fang and Gavazza (2011) do not find a statistically significant relationship between the turnover rate of the industry and the quantity of medical care in the United Kingdom, which has a national health insurance system.

[bs] Khwaja (2010) also found that Medicare leads to large increases in medical utilization because individuals defer their medical care prior to Medicare eligibility.

4.2.4 Medicaid and Medicaid Managed Care

The interaction between public and private health insurance also occurs in the Medicaid program. There is an increasing tendency for the state Medicaid program to contract the care of Medicaid beneficiaries to private insurance plans which are known as Medicaid Managed Care (MMC), instead of directly insuring them through a public FFS plan. These private insurers are regulated and receive a capitation payment for every Medicaid beneficiary they enroll.[bt] The MMC setting differs from the Medicare Advantage setting discussed previously in that the public FFS options are no longer available once MMC is adopted in a state, while in the MA setting, traditional Medicare is always available. Thus in the MMC setting, private insurers cannot engage in risk selection to leave unhealthy individuals on the public program, as occurs under the MA setting. Interestingly, Kuziemko et al. (2013) showed that insurers nonetheless try to retain low-cost clients and thus improve their care relative to high-cost clients, who they would prefer to switch to a competitor. Related to this, Duggan (2004) found that MMC increased Medicaid costs in California because competing MMC plans have limited ability to negotiate favorable rates with providers relative to a consolidated FFS system.

5. SUMMARY AND DIRECTIONS FOR FUTURE RESEARCH

In this chapter we described the risks faced by the aging population and surveyed the corresponding insurance markets for those risks. We focused on income risk, health expenditure risk, longevity/mortality risk, morbidity/long-term care expenditure risk, and the corresponding insurance markets. We also discussed the interactions between social insurance and private insurance markets. Because of the challenges from several demographic developments that lead to significant population aging, retirees are likely to increasingly rely on private insurance markets to meet all their insurance needs in old age because the aging population will undoubtedly worsen the fiscal condition of many of the important social insurance programs. This chapter provides a selective overview of the important research on some of the key insurance markets for the elderly.

Many open questions remain among the literature we discussed in detail in the survey. For example, for long-term care insurance, we presented several potential explanations for its small size: Brown and Finkelstein's (2008) explanation based on Medicaid's crowding out effect; Pauly's (1990) strategic rational nonpurchase; and Finkelstein and McGarry's (2006) and Hendren's (2013) informational barriers. However, the literature lacks a comprehensive evaluation about the contributions of the various potential factors to the small LTC insurance puzzle. For example, Brown and Finkelstein (2008) predicted that the LTC insurance purchase rate should be about one-third, which is still substantially

[bt] Most of the ACA Medicaid expansion will occur under this type of private, capitated insurance plans with substantial government subsidies and regulation, instead of the public FFS option.

higher than the 10% insurance rate in the data. What accounts for the 23% or so of the population who should have purchased despite Medicaid? Why don't the LTC insurance companies offer tailored insurance products to this population? Finkelstein and McGarry (2006) showed that adverse selection based on risk and advantageous selection based on risk aversion almost cancel each other out using their proxy measure of risk aversion, but then how does information asymmetry exactly create barriers to trade in this market? Building and estimating models that incorporate all these potential explanations, together with the possibility of informal care by children, will be an important area for future research. Similarly, we presented several potential explanations for the limited size of the voluntary annuity market in Section 3.2; yet it is fair to say that the literature still lacks a consensus. Developing more comprehensive data sets that reflect households' overall incomes, expenditures, and financial assets and liabilities, as well as the portfolio of their insurance holdings, which we will discuss, can be an important first step for us to resolve the underannuitization puzzle.

There are many interesting areas that pertain to the insurance markets for the elderly that we did not discuss in this chapter. Next we list three interesting areas for future research.

5.1 Interaction Between Insurance Markets and Labor Markets

Because of space constraints, we did not discuss the interaction between insurance markets and the labor market. Social insurance programs such as Social Security, Medicare, and Medicaid affect individuals' decisions regarding labor force participation, hours of work, retirement, and the equilibrium of the labor market in general. Of course, many interesting papers have already examined such interactions,[bu] but we believe that recent developments in the insurance markets, particularly the US health insurance reform, provide new opportunities and questions. Rust and Phelan (1997) studied how Social Security and Medicare affect retirement behavior in a world of incomplete markets. They found that Social Security creates significant disincentives to labor force participation, and Medicare eligibility at age 65 largely explains the peaks in retirement at ages 62 and 65 in an environment where there is significant market failure in the private health insurance market.[bv] The percentage of firms that offer retiree health insurance is declining—according to the Kaiser Family Foundation (2008), the percentage of firms with 200 or more employees offering retiree health insurance fell by more than half between 1988 and 2008—thus the incentives studied in Rust and Phelan (1997) are

[bu] See Chapter 8 by Blundell et al. (this volume) for extensive discussions on related issues.

[bv] French and Jones (2011) provided an empirical analysis of the effects of employer-provided health insurance, Medicare, and Social Security on retirement behavior. Using data from the Health and Retirement Study, they estimated a dynamic programming model of retirement that accounts for both saving and uncertain medical expenses. The key difference from Rust and Phelan (1997) is that this paper accounted for internal savings. Also see French (2005).

bound to be more important factors affecting the labor force participation rates for men at older ages. This drop in the percentage of firms that offer retiree health insurance dramatically changes the incentives facing workers in their late 50s and early 60s. If they stay with their employer, they will continue to receive health insurance. If they leave before 65 when they qualify for Medicare, they will be forced to purchase insurance on their own. Given the rapid rise in health care costs, the decline of retiree health insurance creates a strong incentive for workers to remain employed until 65.[bw]

Madrian (1994) tested the hypothesis that employer-provided health insurance may lead workers to be "locked" into their jobs because preexisting condition exclusions make it expensive for individuals with medical problems to relinquish their current health insurance. She used data from the 1987 National Medical Expenditure Survey to estimate the degree of job lock by comparing the difference in turnover rates of those with high and low medical expenses for those with and without employer-provided health insurance, and found that job lock reduces the voluntary turnover rate of those with employer-provided health insurance by about 25%. Dey and Flinn (2005) proposed and estimated an equilibrium model of the labor market in which firms and workers bargain over both wages and health insurance offerings to examine the question of whether the employer-provided health insurance system leads to inefficiencies in workers' mobility decisions (which are often referred to as "job lock" or "job push" effects). They found a relative small degree of job lock or job push.

Bruegemann and Manovskii (2010) developed a search and matching model to study firms' health insurance coverage decisions. In their model, firm sizes are discrete in order to highlight the effect of fluctuations in the health composition of employees on the dynamics of a firm's coverage decision, and they argue that the insurance market for small firms suffers from adverse selection because those firms try to purchase health insurance when most of their employees are unhealthy. Aizawa and Fang (2013) study the equilibrium impact of the health insurance reform described in Section 3.1.2 on the labor market.[bx] Also, several papers by Kolstad and Kowalski (2012a,b) use prereform and postreform data to study the effect of the Massachusetts Health Reform, implemented in 2006, on medical expenditure, selection in insurance markets, and labor markets.

Friedberg and Webb (2005) investigated how the decline in DB pension coverage in the United States influences retirement. Using HRS data, they found substantial changes in retirement patterns as a result of the spread of 401(k) and other DC plans in place of DB plans. Workers with DC plans are retiring significantly later, which helps explain why

[bw] See Chapter 8 by Blundell et al. (this volume) for a detailed analysis of the labor force participation and the retirement decisions.

[bx] One of the main reasons in Aizawa and Fang (2013) that more productive firms are more likely to offer health insurance to their workers are related to Fang and Gavazza (2011), which documents empirical evidence that worker turnover discourages a firm's health insurance provision.

employment rates recently have risen among people in their 60s, after decades of decline. Workers with DB plans retire 2 years earlier on average than workers with DC plans. The authors' simulation suggests that the continuing shift in pension structure will increase the median retirement age by about 10 months when comparing employees with pensions who will be aged 53–57 in 2015 vs those who were aged 53–57 in 1983. Friedberg and Webb argued that these changes arise because of major differences in accrual of pension wealth. Pension wealth in DC plans accrues smoothly, while gains to pension wealth in traditional DB plans spike sharply at older ages, then turn negative afterward, creating a financial incentive to retire at that point.

The recent reform to the US health insurance system, described in Section 3.1.2, offers many interesting venues for further research. For example, in both Rust and Phelan (1997) and French and Jones (2011), near-retirees can access group-rated private insurance only if they continue working for employers that offer ESHI. This plays an important role in their models to explain the peaks in retirement at ages 62 and 65. Health insurance exchange under the ACA provides an opportunity to near-retirees to purchase community-rated private insurance without having to work for an employer that offers ESHI. How will this impact the retirement behavior?

It is also important to study how the ACA can potentially impact employers' incentives to offer health insurance benefits to spouses of the employees. There are several reasons for this. The first is related to how the ACA specifies that individuals are eligible to receive tax credits: (1) They have to purchase health insurance from their states' health insurance marketplace. (2) Only individuals and families who make between 133% and 400% of the FPL are eligible for a tax credit. (3) The individuals do *not* have access to *affordable* ESHI, either from their own or from their spouses' employers, or from another government program. To the extent that the spouse of an employee can get similar insurance from the health insurance exchange, net of tax credits, at less than the full cost of the spousal insurance offered by the employer, the spouse would have preferred that the employer did not offer spousal insurance benefits. The same could happen even for the employees themselves. Second, the availability of health insurance from a regulated health insurance exchange under the ACA can fundamentally change workers' outside options and thus firms' decisions to offer spousal health insurance benefits. How will the interaction between households' job labor market decisions and firms' decisions to offer employee and spousal insurance benefits be affected by the ACA?[by]

5.2 A Portfolio Approach to Households' Insurance Demands

So far, we have discussed individual or household demands for an insurance product that corresponds to a particular risk. For example, we studied the health insurance market for health and health expenditure risks, the life insurance market for mortality risk, the

[by] See Fang and Shephard (2014) for some attempt to study these issues.

annuity insurance market for longevity risk, and the long-term care insurance market for morbidity/long-term care expenditure risk. However, households do not make insurance decisions to cover each risk in isolation. Instead, households most likely choose a portfolio of insurance products to address the insurance needs because of the multitude of risks they face. Yogo et al. (2010) provide a promising attempt to model individuals' choices of life insurance, health insurance, annuity insurance, and so on in a unified framework as a portfolio problem.[bz] They consider a life-cycle model in which a household faces health and mortality risks that affect life expectancy, health expenses, and the marginal utility of consumption or wealth. The household has access to a risk-free bond market, as well as a complete set of health- and longevity-related insurance products that includes life insurance, annuities, and health insurance. The key simplification for Yogo et al. (2010) to analyze the households' portfolio choice problem is to develop a pair of risk measures for the universe of life and health insurance products. Health delta measures the differential payoff that a product delivers in poor health, while mortality delta measures the differential payoff that a product delivers at death. This allows Yogo et al. (2010) to simplify a life-cycle model of insurance choice to replicate the optimal health and mortality delta through a portfolio of insurance products.[ca]

The portfolio perspective to households' insurance demands also calls for more innovation in insurance products. Umbrella or bundled, insurance products that offer policyholders protection against a multitude of risks are relatively rare. It is an interesting question of why the market for such insurance products, which may be called *livelihood insurance* products, is not yet emerging. It also calls for the need for collecting data that reflect households' overall incomes, expenditures, and financial assets and liabilities, as well as the portfolio of their insurance holdings.[cb]

It should also be noted that there is now substantial evidence that individuals experience cognitive declines as they age.[cc] For example, Fang et al. (2008) found that cognitive ability is the key driving force for advantageous selection in the Medigap insurance market (see Section 4.2). New insurance products must be easy to understand in both their benefits and their costs in order to be appealing to the aging population. Studying how the complexity of an insurance product design affects consumer demand is an important area of research for marketing.

[bz] See also Yogo (2007).

[ca] See Washawsky (2011) for a discussion of the various strategies to deal with retirement income risks.

[cb] For example, Webb and Gong (2010) evaluated the Advanced Life Deferred Annuity (ALDA), an annuity purchased at retirement that provides an income commencing in advanced old age, and they showed, using numerical optimization, that it would provide a substantial proportion of the longevity insurance provided by an immediate annuity, at much lower cost.

[cc] See Chapter 11 by Keane and Thorp (this volume) for detailed discussions about decision making and cognitive decline.

5.3 Insurer-Side Risks and Regulation

Finally, we have so far assumed that the insurance companies can rely on the laws of large numbers when it comes to meeting their payment obligations in the insurance products they sell. However, when it comes to forecasting the risks the insurers may be facing when they offer insurance products such as annuity insurance or long-term insurance, there is a significant level of aggregate uncertainty. For example, annuity insurers face significant aggregate risks regarding life expectancy, which could be affected by advances in new medical technology; and to the extent that insurers invest some of their premiums, they could face significant investment return risks.[cd] These risks faced by insurers in turn are intimately related to the aging population. How should government regulate the insurers when insurers face such aggregate risks that may impact their ability to meet payment obligations? What are the optimal strategies for life and annuity insurers to hedge against the aggregate longevity risks? These are interesting questions that deserve serious studies.[ce]

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REFERENCES

Abaluck, J., Gruber, J., 2009. Choice inconsistencies among the elderly: evidence from plan choice in the medicare part D program. NBER Working Paper 14759.

Agnew, J.R., Anderson, L.R., Gerlach, J.R., Szykman, L.R., 2008. Who chooses annuities? An experimental investigation of the role of gender, framing, and defaults. Am. Econ. Rev. Pap. Proc. 98 (2), 418–422.

Aizawa, N., 2013. Health insurance exchange design in an empirical equilibrium labor market model. Working Paper, University of Pennsylvania.

Aizawa, N., Fang, H., 2013. Equilibrium labor market search and health insurance reform. NBER Working Paper No. 18698.

Aizawa, N., Kim, Y.S., 2013. Advertising competition and risk selection in health insurance markets: evidence from medicare advantage. Working Paper, University of Pennsylvania.

[cd] see, eg, Bauer and Weber (2008) for a demonstration of the impact of longevity risk on life insurers.

[ce] See Blake et al. (2008) for discussions regarding how annuity providers and pension funds may be able to transfer longevity risks to capital markets through securitization of longevity risks. Also, see Wong et al. (2013) for a study of how insurers may be able to naturally hedge the longevity risk, ie, the offsetting of risks in life insurance and annuity business, by selling life insurance products and annuity products as part of a product portfolio.

Aizcorbe, A.M., Kennickell, A.B., Moore, K.B., 2003. Changes in U.S. family finances: evidence from the 1998 and 2001 survey of consumer finances. Fed. Reserv. Bull. 89, 1–32.
Akerlof, G.A., 1970. The market for 'lemons': quality uncertainty and the market mechanism. Q. J. Econ. 84 (3), 488–500.
American Council of Life Insurers, 2009. 2009 Life Insurers Fact Book.
Ameriks, J., Caplin, A., Laufer, S., Van Nieuwerburgh, S., 2011. The joy of giving or assisted living? Using strategic surveys to separate public care aversion from the bequest motive. J. Financ. 66 (2), 519–561.
Arrow, K., 1963. Uncertainty and the welfare economics of medical care. Am. Econ. Rev. 53 (6), 941–973.
Attanasio, O., Bonfatti, A., Kitao, S., Weber, G., this volume. Global demographic trends: consumption, saving, and international capital flows. In: Piggott, J., Woodland, A. (Eds.), Handbook of the Economics of Population Aging, vol. 1A. Elsevier, Amsterdam, pp. 179–235.
Auerbach, A.J., Kotlikoff, L.J., Hagemann, R., Nicoletti, G., 1989. The dynamics of an aging population: the case of four OECD countries. NBER Working Papers 2797, National Bureau of Economic Research, Inc.
Baily, M., 1978. Some aspects of optimal unemployment insurance. J. Public Econ. 10, 379–402.
Batata, A., 2004. The effect of HMOs on fee-for-service health care expenditures: evidence from Medicare revisited. J. Health Econ. 23 (5), 951–963.
Bauer, D., Weber, F., 2008. Assessing investment and longevity risks within immediate annuities. Asia-Pac. J. Risk Insur. 3 (1), 1–24.
Bell F.C., Miller M.L., 2005. Life Tables for the United States Social Security Area 1900–2100. Actuarial Study No. 120, Social Security Administration, SSA Pub. No. 11-11536.
Benartzi, S., Previtero, A., Thaler, R.H., 2011. Annuitization puzzle. J. Econ. Perspect. 25 (4), 143–164.
Bernheim, B.D., Levin, L., 1989. Social security and personal saving: an analysis of expectations. Am. Econ. Rev. Pap. Proc. 79 (2), 97–102.
Blake, D., Cairns, A., Dowd, K., 2008. The birth of the life market. Asia-Pac. J. Risk Insur. 3 (1), Article 2.
Blundell, R., French, E., Tetlow, G., this volume. Retirement incentives and labor supply. In: Piggott, J., Woodland, A. (Eds.), Handbook of the Economics of Population Aging, vol. 1B. Elsevier, Amsterdam, pp. 457–566.
Börsch-Supan, A., Härtl, K., Leite, D.N., this volume. Social security and public insurance. In: Piggott, J., Woodland, A. (Eds.), Handbook of the Economics of Population Aging, vol. 1B. Elsevier, Amsterdam, pp. 781–863.
Bottazzi, R., Jappelli, T., Padula, M., 2006. Retirement expectations, pension reforms, and their impact on private wealth accumulation. J. Public Econ. 90, 2187–2212.
Broadbent, J., Palumbo, M., Woodman, E., 2006. The shift from defined benefit to defined contribution pension plans: implications for asset allocation and risk management. Financial Markets Department Working Paper, Bank of Canada.
Brown, J.R., 2000. How Should We Insure Longevity Risk in Pensions and Social Security. Working Paper, Center for Retirement Research, Boston College, MA.
Brown, J.R., 2001. Are the elderly really over-annuitized? New evidence on life insurance and bequests. In: Wise, D. (Ed.), Themes in the Economics of Aging. University of Chicago Press, Chicago, IL.
Brown, J.R., 2007. Rational and behaviorial perspectives on the role of annuities in retirement planning. NBER Working Paper 13573.
Brown, J.R., Finkelstein, A., 2008. The interaction of public and private insurance: Medicaid and the long-term insurance market. Am. Econ. Rev. 98 (3), 1083–1102.
Brown, J.R., Finkelstein, A., 2009. The private market for long-term care insurance in the U.S.: a review of the evidence. J. Risk Insur. 76 (1), 5–29.
Brown, J.R., Poterba, J.M., 2000. Joint life annuities and annuity demand by married couples. J. Risk Insur. 67 (4), 527–553.
Brown, J.R., Kling, J.R., Mullainathan, S., Wrobel, M.V., 2008. Why don't people insure late-life consumption? A framing explanation of the under-annuitization puzzle. Am. Econ. Rev. Pap. Proc. 98 (2), 304–309.
Brown, J., Duggan, M., Kuziemko, I., Woolston, W., 2011. How does risk selection respond to risk adjustment? Evidence from the Medicare advantage program. NBER Working Paper 16977.

Bruegemann, B., Manovskii, I., 2010. Fragility: a quantitative analysis of the US health insurance system. Working Paper, University of Pennsylvania.
Bureau of Labor Statistics, January 2012a. Labor force projections to 2020: a more slowly growing workforce. Month. Labor Rev. 43–64.
Bureau of Labor Statistics, 2012b. Unemployed Persons by Age, Sex, Race, Hispanic or Latino Ethnicity, Marital Status, and Duration of Unemployment. U.S. Department of Labor, Washington, DC.
Byrne, D., Goeree, M., Hiedemann, B., Stern, S., 2009. Formal home health care, informal care, and family decision-making. Int. Econ. Rev. 50 (4), 1205–1242.
Capatina, E., 2012. Life-cycle effects of health risks. University of New South Wales Working Paper.
Cawley, J., Philipson, T., 1999. An empirical examination of information barriers to trade in insurance. Am. Econ. Rev. 89 (4), 827–846.
Centers for Medicare and Medicaid Services, 2010. National health expenditures by type of service and source of funds, CY 1960–2008. Accessed at: https://www.cms.gov/NationalHealthExpendData/downloads/nhe2008.zip.
Chan, S., Stevens, A.H., 1999. Employment and retirement following a late-career job loss. Am. Econ. Rev. 89 (2), 211–216.
Chan, S., Stevens, A.H., 2001. Job loss and employment patterns of older workers. J. Labor Econ. 19 (2), 484–521.
Chandik, M., 2008. The growing life settlement industry: is anyone watching out for consumers? Testimony presented at the California Senate Banking, Finance and Insurance Committee on Life Settlements. Available at: http://www.sen.ca.gov/ftp/sen/committee/standing/banking/infohearings/backgrounds/2-20-08lifesettlementbackground.
Coile, C., Milligan, K., 2009. How household portfolios evolve after retirement: the effect of aging and health shocks. Rev. Income Wealth 55 (2), 226–248.
Cole, H., Krueger, D., Kim, S., 2013. Analyzing the effects of insuring health risks: on the tradeoff between short run insurance benefits vs. long run incentive costs. Working Paper.
Congressional Budget Office, 2004. Financing long-term care for the elderly. A CBO Paper. Accessed at: http://www.cbo.gov/ftpdocs/54xx/doc5400/04-26-LongTermCare.pdf.
Couch, K.A., Jolly, N.A., Placzek, D.W., 2011. Earnings losses of displaced workers and the business cycle: an analysis with administrative data. Econ. Lett. 111 (1), 16–19, April 2011, Elsevier.
Cutler, D.M., Ghosh, K., Landrum, M.B., 2013. Evidence for significant compression of morbidity in the elderly U.S. population. NBER Working Paper 19268.
Daily, G., 2004. Lapse-Supported Pricing: Is It Worth the Risks? Glenndaily.com Information Services, Inc.
Daily, G., Hendel, I., Lizzeri, A., 2008. Does the secondary life insurance market threaten dynamic insurance? Am. Econ. Rev. Pap. Proc. 98 (2), 151–156.
Davidoff, T., Welke, G., 2004. Selection and moral hazard in the reverse mortgage market. Working Paper, University of British Columbia.
Davidoff, T., Brown, J.R., Diamond, P., 2005. Annuities and individual welfare. Am. Econ. Rev. 95, 1573–1590.
Decarolis, F., 2013. Medicare part D: are insurers gaming the low income subsidy design? Working Paper.
Delavande, A., Rohwedder, S., 2010. Individuals' uncertainty about future social security benefits and portfolio choice. Rand Working Paper WR-782.
Deloitte Report, 2005. The life settlement market: an actuarial perspective on consumer economic value.
De Nardi, M., French, E., Jones, J.B., 2009. Life expectancy and old age savings. Am. Econ. Rev. 99 (2), 110–115. Papers and Proceedings.
Dey, M.S., Flinn, C.J., 2005. An equilibrium model of health insurance provision and wage determination. Econometrica 73 (2), 571–627.
Doherty, N.A., Singer, H.J., 2002. The benefits of a secondary market for life insurance policies. Working Paper, Wharton Financial Institute Center, University of Pennsylvania.
Dominitz, J., Manski, C., 2006. Measuring pension-benefit expectations probabilistically. Labour 20, 201–236.
Duggan, M., 2004. Does contracting out increase the efficiency of government programs? Evidence from Medicaid HMOs. J. Public Econ. 88 (12), 2549–2572.

Duggan, M., Scott Morton, F., 2010. The impact of Medicare part D on pharmaceutical prices and utilization. Am. Econ. Rev. 100 (1), 590–607.
Duggan, M., Healey, P., Scott Morton, F., 2008. Providing prescription drug coverage to the elderly: America's experiment with Medicare part D. J. Econ. Perspect. 22, 69–92.
Einav, L., Finkelstein, A., Levin, J., 2010a. Beyond testing: empirical models of insurance markets. Annu. Rev. Econ. 2, 311–336.
Einav, L., Finkelstein, A., Schrimpf, P., 2010b. Optimal mandates and the welfare cost of asymmetric information: evidence from the U.K. annuity market. Econometrica 78 (3), 1031–1092.
Ericson, K.M., 2010. Market design when firms interact with inertial consumers: evidence from Medicare part D. Working Paper.
Fang, H., Gavazza, A., 2011. Dynamic inefficiencies in an employment-based health insurance system: theory and evidence. Am. Econ. Rev. 101 (7), 3047–3077.
Fang, H., Kung, E., 2010. How does the life settlement market affect the primary life insurance market? NBER Working Paper 15761.
Fang, H., Kung, E., 2012a. Why do life insurance policyholders lapse? Loss of bequest motives vs. liquidity shocks. NBER Working Paper No. 17899.
Fang, H., Kung, E., 2012b. The welfare effect of life settlement market: the case of income shocks. Working Paper, University of Pennsylvania and Duke University.
Fang, H., Shephard, A., 2014. Joint Household Labor Supply and Health Care Reform. Working Paper, Department of Economics, University of Pennsylvania.
Fang, H., Keane, M.P., Silverman, D., 2008. Sources of advantageous selection: evidence from the Medigap insurance market. J. Polit. Econ. 116 (2), 303–350.
Farber, H.S., 2005. What Do We Know about Job Loss in the United States? Evidence from the Displaced Workers Survey, 1984–2004. Princeton University, Princeton, NJ. Industrial Relations Section Working Paper No. 498.
Finkelstein, A., McGarry, K., 2006. Multiple dimensions of private information: evidence from the long-term care insurance market. Am. Econ. Rev. 96 (4), 938–958.
Finkelstein, A., Poterba, J., 2004. Adverse selection in insurance markets: policyholder evidence from the U.K. annuity market. J. Polit. Econ. 112, 183–208.
Fischer, S., 1973. A life cycle model of life insurance purchases. Int. Econ. Rev. 14 (1), 132–152.
French, E., 2005. The effects of health, wealth, and wages on labor supply and retirement behavior. Rev. Econ. Stud. 72 (2), 395–427.
French, E., Jones, J.B., 2011. The effect of health insurance and self-insurance on retirement behavior. Econometrica 79 (3), 693–732.
French, E., Jones, J.B., De Nardi, M., Baker, O., Doctor, P., 2006. Right before the end: asset decumulation at the end of life. Econ. Perspect. Third Quarter, 2–13.
French, E., De Nardi, M., Jones, J.B., Gooptu, A., 2012. Medicaid and the elderly. Econ. Perspect. First Quarter, 17–33.
Friedberg, L., Webb, A., 2005. Retirement and the evolution of pension structure. J. Hum. Resour. 40 (2), 281–308.
Friedberg, L., Sun, W., Webb, A., Hou, W., Li, Z., 2014. New evidence on the risk of requiring long-term care. Working Paper, Center for Retirement Research at Boston College.
Friedman, B., Warshawsky, M., 1990. The cost of annuities: implications for saving behavior and bequests. Q. J. Econ. 105 (1), 135–154.
Fries, J.F., 1980. Aging, natural death, and the compression of morbidity. N. Engl. J. Med. 303, 1369–1370.
Gilbert, J., Schultz, E., 1994. Consumer Reports Life Insurance Handbook. Consumer Reports Books, Yonkers, NY.
Glover, A., Heathcote, J., Krueger, D., Rios-Rull, J.-V., 2011. Intergenerational redistribution in the great recession. NBER Working Paper 16924.
Gustman, A.L., Steinmeier, T.L., Tabatabai, N., 2010. What the stock market decline means for the financial security and retirement choices of the near-retirement population. J. Econ. Perspect. 24 (1), 161–182 (Winter).
Handel, B., Hendel, I., Whinston, M.D., 2013. Equilibria in health exchanges: adverse selection vs. reclassification risk. Working Paper.

Heeringa, S.G., 1995. Technical Description of the Asset and Health Dynamics (AHEAD): Survey Sample Design. Survey Design and Analysis Unit. Institute for Social Research, University of Michigan, Ann Arbor, MI.
Heidkamp, M., Corre, N., Van Horn, C.E., 2010. The 'New Unemployables': Older Job Seekers Struggle to Find Work During the Great Recession. The Sloan Center on Aging & Work at Boston College, Boston College, MA.
Heiss, F., McFadden, D., Winter, J., 2007. Mind the gap! Consumer perceptions and choices of Medicare part D prescription drug plans. NBER Working Paper 13627.
Heiss, F., Leive, A., McFadden, D., Winter, J., 2012. Plan selection in Medicare part D: evidence from administrative data. NBER Working Paper 18166.
Hendel, I., Lizzeri, A., 2003. The role of commitment in dynamic contracts: evidence from life insurance. Q. J. Econ. 118 (1), 299–327.
Hendren, N., 2013. Private information and insurance rejections. Econometrica 81 (5), 1713–1762.
Hoffman, A.K., Jackson, H.E., 2012. Retiree out-of-pocket health care spending. Financial Literacy Center Working Paper WR-962-SSA.
James, E., Song, X., 2001. Annuities markets around the world: money's worth and risk intermediation. CeRP Working Paper 16.
Johnson, R.W., Kawachi, J., 2007. Job changes at older ages effects on wages, benefits, and other job attributes. The Program on Retirement Policy, Discussion Paper 07-03, The Urban Institute.
Johnson, R.W., Mommaerts, C., 2011. Age differences in job loss, job search, and reemployment. The Program on Retirement Policy, Discussion Paper 11-01, The Urban Institute.
Johnson, R.W., Burman, L.E., Kobes, D., 2004. Annuitized wealth at older age: evidence from the health and retirement study. Final Report to the Employee Benefits Security Administration, U.S. Department of Labor 9142. The Urban Institute, Washington, DC.
Kaiser Family Foundation, 2005. Medicare Chart Book. Kaiser Family Foundation, Washington, DC.
Kaiser Family Foundation, 2008. Employer Health Benefits: 2008 Annual Survey. Accessed online at: https://kaiserfamilyfoundation.files.wordpress.com/2013/04/7790.pdf.
Kaiser Family Foundation and the Health Research and Educational Trust, 2012. 2012 Employer Health Benefits Survey. Accessed online at: http://kff.org/private-insurance/report/.
Karni, E., Zilcha, I., 1986. Risk aversion in the theory of life insurance: the Fischerian model. J. Risk Insur. 53, 606–620.
Keane, M.P., Thorp, S., this volume. Complex decision making: the roles of cognitive limitations, cognitive decline, and aging. In: Piggott, J., Woodland, A. (Eds.), Handbook of the Economics of Population Aging, vol. 1B. Elsevier, Amsterdam, pp. 661–709.
Kelley, A.S., McGarry, K., Fahle, S., Marshall, S.M., Du, Q., Skinner, J.S., 2013. Out-of-pocket spending in the last five years of life. J. Gen. Intern. Med. 28 (2), 304–309.
Ketcham, J., Lucarelli, C., Miravete, E., Roebuck, M.C., 2010. Sinking, swimming, or learning to swim in Medicare part D. Working Paper.
Khwaja, A., 2010. Estimating willingness to pay for Medicare using a dynamic life-cycle model of demand for health insurance. J. Econ. 156 (1), 130–147.
Kling, J.R., Mullainathan, S., Shafir, E., Vermeulen, L., Wrobel, M.V., 2009. Misperception in choosing Medicare drug plans. Working Paper.
Kolstad, J.T., Kowalski, A.E., 2012a. Mandate-based health reform and the labor market: evidence from the Massachusetts reform. NBER Working Paper No. 17933.
Kolstad, J.T., Kowalski, A.E., 2012b. Health reform, health insurance, and selection: estimating selection into health insurance using the Massachusetts health reform. Am. Econ. Rev. Pap. Proc. 102 (3), 498–501.
Kopczuk, W., Lupton, J., 2007. To leave or not to leave: an empirical investigation of the distribution of bequest motives. Rev. Econ. Stud. 74 (1), 207–235.
Krebs, T., Kuhn, M., Wright, M.L.J., 2011. Human capital risk, contract enforcement, and the macroeconomy. NBER Working Paper No. 17714.
Kuziemko, I., Meckel, K., Rossin-Slater, M., 2013. Do insurers risk-select against each other? Evidence from medicaid and implications for health reform. NBER Working Paper 19198.
Langwell, K.M., Hadley, J.P., 1989. Evaluation of the Medicare competition demonstrations. Health Care Financ. Rev. 11 (2), 65–80.

LIMRA, 2009. U.S. Individual Life Persistency Update: A Joint Study Sponsored by LIMRA International and the Society of Actuaries. Windsor, CT.
Lockwood, L., 2011. Bequest motives and the annuity puzzle. Rev. Econ. Dyn. 15 (2), 226–243.
Lockwood, L., 2012. Incidental bequests: bequest motives and the choice to self-insure late-life risks. Working Paper, Northwestern University.
Lustig, J., 2011. Measuring welfare losses from adverse selection and imperfect competition in privatized Medicare. Working Paper, Boston University.
Madrian, B.C., 1994. Employment-based health insurance and job mobility: is there evidence of job lock? Q. J. Econ. 109 (1), 27–54.
Manton, K.G., Xiliang, G., Lamb, V.L., 2006. Long-term trends in life expectancy and active life expectancy in the United States. Popul. Dev. Rev. 32 (1), 81–105.
Marshall, S., McGarry, K., Skinner, J.S., 2011. The rise of out-of-pocket health expenditure at the end of life. In: Wise, D.A. (Ed.), Explorations in the Economics of Aging. University of Chicago Press, Chicago, pp. 101–128. http://www.nber.org/papers/w16170.
Meara, E., White, C., Cutler, D.M., 2004. Trends in medical spending by age, 1963–2000. Health Aff. 23 (4), 176–183.
Mello, M.M., Stearns, S.C., Norton, E.C., Ricketts, T.C., 2003. Understanding biased selection in Medicare HMOs. Health Serv. Res. 38 (3), 961–992.
MetLife Mature Market Institute, 2009. The 2009 MetLife market survey of nursing home, assisted living, adult day services, and home care costs. MetLife Mature Market Institute, Westport, CT.
MetLife Mature Market Institute, 2012. The 2012 metlife market survey of nursing home, assisted living, adult day services, and home care costs. MetLife Mature Market Institute, Westport, CT.
Mitchell, O.S., Piggott, J., this volume. Workplace-linked pensions for an aging demographic. In: Piggott, J., Woodland, A. (Eds.), Handbook of the Economics of Population Aging, vol. 1B. Elsevier, Amsterdam, pp. 865–904.
Mitchell, O.S., Poterba, J.M., Warshawsky, M., Brown, J.R., 1999. New evidence on the money's worth of individual annuities. Am. Econ. Rev. 89 (5), 1299–1318.
Modigliani, F., 1986. Life cycle, individual thrift, and the wealth of nations. Am. Econ. Rev. 76 (3), 297–313.
Monk, C., Munnell, A.H., 2009. The implications of declining retiree health insurance. Center for Retirement Research at Boston College Working Paper, 2009-15.
Muldoon, D., Kopcke, R.W., 2008. Are people claiming social security benefits later? Center for retirement research at Boston college. Issue in Brief No. 8–7.
Munnell, A.H., Sunden, A.E., 2004. Coming up Short: The Challenge of 401(k) Plans. Brookings Institution Press, Washington, DC.
Munnell, A.H., Muldoon, D., Sass, S.A., 2009. Recessions and Older Workers. Working Paper 200915, Center for Retirement Research, Boston College, MA.
Nakajima, M., 2012. Everything you always wanted to know about reverse mortgages but were afraid to ask. Fed. Reserv. Bank Philadelphia Business Rev. First Quarter, 19–31.
Nakajima, M., Telyukova, I.A., 2013. Reverse mortgage loans: a quantitative analysis. Working Paper, Federal Reserve Bank of Philadelphia.
Norton, E.C., 2000. Long-term care. In: Culyer, A.J., Newhouse, J.P. (Eds.), Handbook of Health Economics, vol. 1, Elsevier Science B.V., Amsterdam, The Netherlands.
Norton, E.C., this volume. Health and long-term care. In: Piggott, J., Woodland, A. (Eds.), Handbook of the Economics of Population Aging, vol. 1B. Elsevier, Amsterdam, pp. 951–989.
Norton, E.C., Wang, H., Stearns, S.C., 2006. Behavioral implications of out-of-pocket health care expenditures. Swiss J. Econ. Stat. 142 (Special Issue), 3–11.
OECD, 2011a. Health at Glance 2011: OECD Indicators. OECD Publishing, Paris, France. Accessed at: http://dx.doi.org/10.1787/health_glance-2011-en.
OECD, 2011b. Help Wanted? Providing and Paying for Long-Term Care. OECD Publishing, Paris, France.
Older Americans, 2012. Key indicators of well-being. Accessed at: http://agingstats.gov/agingstatsdotnet/main_site/.
Pashchenko, S., 2013. Accounting for non-annuitization. J. Public Econ. 98 (C), 53–67.

Pashchenko, S., Porapakkarm, P., 2013. Quantitative analysis of health insurance reform: separating regulation from redistribution. Rev. Econ. Dyn. 6 (3), 383–404.
Pauly, M., 1990. The rational nonpurchase of long-term-care insurance. J. Polit. Econ. 98 (1), 153–168.
Poterba, J.M., Samwick, A.A., 2001. Household portfolio allocation over the life cycle. In: Ogura, S., Tachibanaki, T., Wise, D.A. (Eds.), Aging Issues in the United States and Japan. University of Chicago Press, pp. 65–104.
Poterba, J.M., Venti, S.F., Wise, D.A., 2011. The composition and draw-down of wealth in retirement. NBER Working Paper 17536.
Robinson, J., 1996. A Long-Term Care Status Transition Model. The 1996 Bowles Symposium: The Old-Age Crisis: Actuarial Opportunities, Atlanta, GA.
Rothschild, M., Stiglitz, J.E., 1976. Equilibrium in competitive insurance markets: an essay on the economics of imperfect information. Q. J. Econ. 90 (November), 629–649.
Rust, J., Phelan, C., 1997. How social security and Medicare affect retirement behavior in a world of incomplete markets. Econometrica 65 (4), 781–831.
Shan, H., 2011. Reversing the trend: the recent expansion of the reverse mortgage market. Real Estate Econ. 39 (4), 743–768.
Sheshinski, E., 2008. The Economic Theory of Annuities. Princeton University Press, Princeton, NJ.
Singer, H.J., Stallard, E., 2005. Reply to 'The Life Settlement Market: An Actuarial Perspective on Consumer Economic Value'. Criterion Economics L.L.C., Washington, DC.
Sun, W., Webb, A., 2011. Valuing the longevity insurance acquired by delayed claiming of social security. J. Risk Insur. 78 (4), 907–929.
United Nations, 2010. World Population Prospects: The 2010 Revision. United Nations, New York.
Vanguard Report, 2008. How America Saves, 2008: A Report on Vanguard 2007 Defined Contribution Plan Data.
Venti, S.F., Wise, D.A., 2001. Aging and housing equity. In: Mitchell, O.S., Bodie, Z., Hammond, P.B., Zeldes, S. (Eds.), Innovations for Financing Retirement. Pension Research Council Publications. University of Pennsylvania Press, Philadelphia, pp. 254–281.
Venti, S.F., Wise, D.A., 2004. Aging and housing equity: another look. In: Wise, D.A. (Ed.), Perspectives on the Economics of Aging. University of Chicago Press, Chicago, IL, pp. 127–180.
Vidal-Melia, C., Lejarraga-Garcia, A., 2006. Demand for life annuities from married couples with a bequest motive. J. Pension Econ. Financ. 5 (2), 197–229.
Villeneuve, B., 2000. Life insurance. In: Dionne, G. (Ed.), Handbook of Insurance. Kluwer, Norwell, MA (Chapter 27).
Washawsky, M.J., 2011. Retirement Income: Risks and Strategies. MIT Press, Cambridge, MA.
Webb, A., Gong, G., 2010. Evaluating the advanced life deferred annuity—an annuity people might actually buy. Insur. Math. Econ. 46, 210–221.
Wong, A., Sherris, M., Stevens, R., 2013. Managing life insurer risk and profitability: annuity market development using natural hedging strategies. Australian School of Business Research Paper No. 2013ACTL04, University of New South Wales.
Yaari, M.E., 1965. Uncertain lifetime, life insurance, and the theory of the consumer. Rev. Econ. Stud. 32 (2), 137–150.
Yogo, M., 2007. Portfolio choice in retirement: health risk and the demand for annuities, housing, and risky assets. Working Paper, Federal Reserve Bank of Minneapolis.
Yogo, M., Koijen, R.S.J., Van Nieuwerburgh, S., 2010. Health and mortality delta: assessing the welfare cost of household insurance choice. Working Paper, Federal Reserve Bank of Minneapolis.