Enhancing Risk Management for an Aging World

Olivia S. Mitchell

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Pension Research Council
The Wharton School, University of Pennsylvania
3620 Locust Walk, 3302 SH-DH
Philadelphia, PA 19104-6302
Tel: 215.573.3414 Fax: 215.573.3418
Email: prc@wharton.upenn.edu
http://www.pensionresearchcouncil.org

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Abstract

As the world confronts unprecedented global aging, academics and policymakers are growing increasingly aware of the need for better risk management tools to handle the demographic transition. It is therefore imperative to identify innovative insurance and financial market products that can enrich the range of options for households, firms, and governments facing the challenge of an aging population. After outlining thoughts on how rising longevity might shape financial markets, we discuss opportunities for the finance and insurance industries in this arena. We also highlight how policymakers could respond to improve efforts to better manage risk.

Keywords: aging, longevity, risk management

Olivia S. Mitchell
International Foundation of Employee Benefits Professor
Professor of Insurance/Risk Management and Business Economics/Policy
The Wharton School of the University of Pennsylvania
3620 Locust Walk, Steinberg Hall-Dietrich Hall
Philadelphia, PA 19104
E-mail: mitchelo@wharton.upenn.edu

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I. Introduction

A recent World Economic Forum report warned that the largest economies around the world were sitting on "pension time bombs" requiring massive financing to defuse, to the tune of $400 trillion by 2050 (WEF 2017). In the report release, WEF's head of financial and infrastructure systems asserted that the twin challenges of falling fertility and rising longevity are bringing the world the "financial equivalent of global climate change" (Meredith 2017). Against this dismal backdrop of failing pension system finances, it is crucial to evaluate what can be learned from the risk management, finance, and economics literature regarding how financial and insurance markets might help the world better handle the risks of global aging. The present paper takes on this challenge, seeking to broaden perspectives about better ways to manage risk as the world ages. [1]

We begin with a brief overview on the compression of mortality and morbidity, so as to set the stage for a discussion of how population aging might influence labor, capital, and housing markets. Next we indicate how developments in insurance and financial markets can help manage key risks borne primarily by the elderly, particularly longevity, sickness, and frailty. These can include annuities, pensions, and long term care protection, as well as longevity risk securitization and derivative contracts on residential property as well as reverse mortgages. We then turn to some warnings about how governments might exacerbate old-age risk, as well as some suggestions as to how they can potentially mitigate, help finance, and insure against the vagaries of old age.

[1] This discussion updates and substantially extends Mitchell et al. (2006).

II. **The Demography of Longer and Healthier Worklives**

Two demographic trends have served as the engines of population aging: falling birthrates and rising longevity. There is little disagreement about the persistence of the first trend: women in most nations have been having fewer offspring for many years, attributed to women's improved access to education and birth control over time (Barro et al., 2015). An outstanding question is what persistently low fertility will imply in terms of long-term economic and social consequences. International evidence indicates that decreased fertility has been associated with much higher rates of women's attachment to the paid labor force (Bloom et al. 2009; Bloom and Canning 2008; Bloom and Sousa-Poza, 2010). In turn, declining fertility also tends to drive up labor earnings and per capita income, particularly when the workforce is well-educated and trained to meet changing skill needs. In other words, falling birthrates have had, and are likely to continue to have, a positive impact on long run labor earnings (Ashraf et al. 2013).

Evaluating the impact of rising longevity is more complicated. It is clear that more people are living longer in most developed and emerging nations, yet debates rage over aspects of this phenomenon. For instance, Dong et al. (2016) and Lenart and Vaupel (2017) recently crossed swords in the scientific journal *Nature* regarding whether there is an upper limit to the human lifespan, or whether people may eventually live to age 500 or beyond. Another controversy regards the degree to which longevity extension has accrued to the population at large versus only some subgroups. For instance, in the US, premature mortality rates are well above average for non-Whites and the least-educated (e.g., Shiels et al. 2017). The OECD (2016a) has also documented what it calls "fragmentation" of life expectancy tables by socio-economic status (see also Currie and Schwandt 2016). And it is as yet unclear whether rising rates of obesity and attendant health

problems around the world will be offset by medical advances that treat these and other chronic problems besetting the aging population (e.g., Korevaar et al. 2016).

A closely-related dispute has to do with whether longer lifespans will be accompanied by more years of good versus poor health. Some analysts confirm that the number of healthy life years has risen (Chernew et al. 2016), but others argue that more people are living longer with a variety of diseases (Crimmins and Beltrán 2011). In an influential recent cross-national study (Wise 2017), experts deployed a variety of approaches and datasets to estimate peoples' ability to remain gainfully employed at older ages, or what the authors termed the "health capacity to work." The authors concluded that substantial additional capacity to work – at least until age 70 – is feasible in much of the developed world.

What will these trends imply from a macroeconomic perspective? The National Academy of Sciences (NAS 2012) identified several approaches to better manage the world's rapidly aging populations. First, it will be necessary for people to work longer and retire later, since the tax-financed old age programs on which the elderly traditionally relied face insolvency. Second, workers will need to save more, invest more efficiently, and insure themselves more thoughtfully, if they are to thrive at older ages. And at the aggregate level, nations must find ways to boost labor productivity so as to ensure continued economic growth despite low (or even negative) population growth.[2] The good news is that declining fertility and rising longevity are apparently endowing many with additional years of good health during which they can work. Moreover, it is now evident that extending older persons' worklives does not "crowd out" labor market opportunities for younger workers (Gruber and Wise 2010; Munnell and Wu nd), so delayed retirement is a

[2] Also there is little evidence that pro-fertility policies in the context of democracies would reverse the long-term decline in fertility rates (Sundström, 2001), even if it were deemed socially and economically desirable.

reasonable and viable option for many. The main challenge, then, is to encourage longer and more productive worklives, more efficient saving and insurance, and government policy that enhances growth rather than curtailing it.

III. Population Aging and Wellbeing at Older Ages

Older persons in most countries rely on a mix of family transfers, labor earnings, asset drawdowns and owner-occupied housing, and pension income from employer plans and government social security programs. Each of these may be shaped by potentially important consequences of population aging, as we discuss in turn.

Family Transfers. In the past, family transfers of time and money were often a key source of older persons' support, and the tradition of "filial piety" is still pronounced in some Asian countries (e.g., Japan, China) and in Latin American (more so that in Western Europe and North America). Yet these traditional family relationships have eroded over time in many societies, partly as a result of lower fertility. Indeed China's tradition of a one-child policy implies that today's youth will need to support six or more elderly relatives (Reynolds 2007). Moreover, the upward trend in divorce rates is also leaving older women more exposed to poverty, compared to the past (Smeeding et al. 2008). And in many nations, especially in Asia, the elderly have become increasingly geographically separated as the young have migrated to urban areas for work (Gong et al. 2013, Remes 2017). These trends, taken together, imply that older persons must look to different risk pools such as their communities and insurers, rather than to family relationships as in the past.

Labor Earnings. Longer lifespans afford more years of paid employment, particularly when older people are healthier at older ages, as noted above. Moreover, jobs have also grown less physically

demanding over time, such that delayed retirement and work at older ages are increasingly feasible. The rise of the so-called "gig economy" also offers older persons ways to engage in flexible, part-time, and other on-demand work opportunities (AARP 2016). Interestingly, the trend to early retirement among older men in the US has reversed itself, and older women are far more likely to remain employed now than at any time in the past (Quinn and Cahill, forthcoming; Lusardi and Mitchell forthcoming). This is likely to be a continuing trend as there is growing evidence that deferring retirement may enhance older persons' health (Fitzpatrick and Moore 2016; Wu et al. 2016).

Pension and Social Security Income. The pension and social security programs on which older persons traditionally relied are in relatively poor shape, as attested to by the WEF report cited at the outset. Public pension systems often were operated as pay-as-you-go systems (PAYGO), and they relied on current tax revenue to pay benefits to today's elders. Even when they had a partially-funded component, they still required ongoing tax financing. But as many countries are now discovering, unfunded pension promises are weighing heavily on aging economies (Elmendorf and Sheiner 2015). For instance, the U.S. Social Security System is projected to run short of cash required to pay benefits within 15 years; if the system is not reformed, benefits for everyone will need to be cut by about one-third or taxes raised 50-80% (Social Security Trustees 2017). In some instances (e.g., Australia, Chile, and Singapore), defined contribution systems have generated substantial assets to cover promised retiree benefits, and the Japanese government's partially funded pension scheme has accumulated close to $2.7 trillion or 43% of Japan's pension assets (WTW 2016). Yet even so, people reaching old age with little savings in the majority of nations will turn to welfare (means-tested) social transfer programs operated on a PAYGO basis, and the

pressures on these systems will increase. Accordingly, population aging represents an existential threat to many national social security systems around the world.

Corporate and public sector pensions in many countries fare little better, as they too face deep financial problems which threaten their ability to make good on their old-age promises. In the US, for instance, it has been estimated that retirement systems operated by states and municipalities are underfunded by $4 trillion (Rauh 2017). While no US states have yet declared bankruptcy, several cities have reduced benefits for retired public sector employees, and Puerto Rico's 2017 bankruptcy may result in substantial retiree benefit cuts (Coto 2017). And while funded pensions are growing over time (see Figure 1), these appear unlikely to be able to meet expectations in what appears to be a permanently low-return environment. In fact, only a 1% lower long-term return can cut final pension amounts by approximately 25%, and today many industrialized countries have negative interest rates, including Japan, Denmark, Sweden, and Switzerland (Clark et al. 2010, forthcoming). In other words, personal saving and delayed retirement are likely to become increasingly important for improving older people's economic wellbeing.

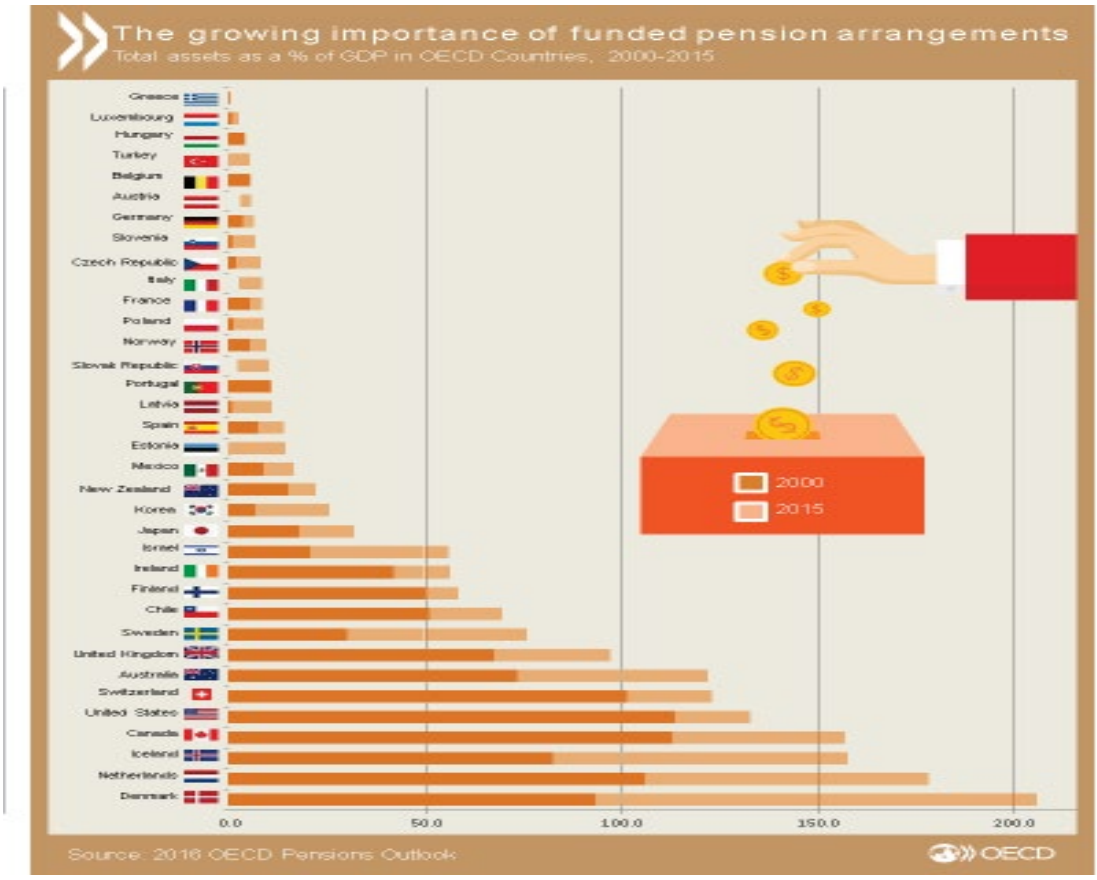


Figure 1. The Growing Importance of Funded Pension Arrangements (Total Assets as % of GDP in OECD Countries, 2000 versus 2015).
Source: OECD (2016b).

Asset Drawdowns and Owner-Occupied Housing. Older households in most countries tend to reduce their reliance on labor earnings as they age, turning instead to asset drawdowns to cover retirement consumption needs. Accordingly, it is useful to evaluate how population aging may affect older persons' ability to manage these assets into a potentially longer retirement. Not surprisingly, there is a large literature on the topic, which we summarize briefly next.

The traditional life cycle model familiar to economic analysts holds that individuals save and invest during their worklives so they can decumulate their assets to finance retirement consumption. Logically, older persons would also dispose of net home equity (i.e., the value of the owner-occupied home minus the mortgage) at older ages, to help finance their old-age needs. The

extent to which people actually draw down their assets in old age is, however, a matter of some debate. Poterba et al. (2011) used data from the Health and Retirement Study (HRS) to update previous analyses of US household wealth patterns in old age, reporting that very little home equity was tapped to support consumption by the elderly. Similarly, the longitudinal nature of the HRS permits long-term tracking of other assets held by the elderly, and here too, households did not generally draw down their financial assets over time. Instead, there was a relatively stable pattern of household net worth overall, with two-person households even increasing their net asset positions at older ages.

Despite the overall indication of asset preservation at older ages, health and other shocks may dramatically alter older households' spending patterns, depending on how well they are insured. For instance DeNardi et al. (2010) and Hubbard et al. (1995) found that medical out-of-pocket costs could erode lifetime savings dramatically, particularly when the household lacked good medical insurance coverage. Long-term care can also be extremely expensive, currently costing over $60,000 per year in the US. Moreover, between 50 and 70 percent of Americans will require long-term care at some point, with an average 65-year old requiring long-term care for about three years on average (Hurd et al., 2013; 2014; Brown and Finkelstein, 2008). Accordingly, it is rather surprising that only about eight percent of the older US population has purchased long-term care insurance (RWJ 2014). Various explanations have been offered for the lack of insurance coverage among the elderly, prominent among them the belief that means-tested government programs will pick up a large portion of these costs. Another reason may be "narrow framing," or peoples' tendency to view insurance premiums as expensive up-front costs versus the far-off and uncertain chance of receiving the insurance payoff (Gottlieb and Mitchell, 2015).

The evidence cited above undermines the notion that population aging will generate massive equity sales, precipitating a "market meltdown" as Baby Boomers unwind their investments. Moreover, economic theory and evidence provide only limited support for the meltdown prediction. For instance Poterba (2001, 2005), Abel (2001) and Brooks (2003) draw on various models to simulate possible outcomes, with the more elaborate overlapping generations (OLG) approach of Geanakoplos et al. (2004) implying some depressive effect of Baby Boomer retirement on equity prices. Nevertheless, that evidence indicated that demographic cycles could account for at most half of observed volatility in the equity market, and mainly in the context of a "closed economy" where international trade was disallowed. In a setting that allowed for cross-national capital flows, regions with an aging populations are predicted to export capital to younger regions, providing a cushion to equity returns (Brooks 2003, 2006; Davis 2006). Moreover, immigration flows can further reduce the drag on equity returns.

While it is reasonable to argue that equity markets are flexible enough to ensure that international flows will equalize returns globally, the impact of aging on housing markets is unclear inasmuch as housing is less fungible than other assets. This is particularly important since, around the world, the elderly tend to have most if not all of their savings in the form of owner-occupied housing. Early research on the topic by Mankiw and Weil (1989) related U.S. housing values to homeowners' age, and it concluded that housing demand and hence values would decline dramatically due to population aging. Subsequent economic studies with more complex specifications of the model come to weaker and even null results regarding the relationship between housing prices and population age structure (c.f., Hamilton 1991 and other studies cited in Mitchell et al. 2006). Additionally, a report by Takáts (2012) used data on 22 developed nations and the author concluded that population aging over the next four decades may erode housing

values by about 0.8 percent per annum, though there was little danger of a housing price "meltdown." Accordingly, there is little reason to believe that population aging will greatly depress housing values, particularly if longer and healthier lifetimes induce people to "trade up" instead of downsizing later in life.

IV. How Insurance and Financial Markets Can Protect Against Aging Risks

Global aging confronts growing segments of the population with numerous often-expensive surprises that befall an older population, including longevity risk, healthcare cost risk, and other shocks to peoples' standard of living. Though rational and foresighted individuals can save, invest, and therefore self-finance much of their consumption needs in old age, there remains an important role for risk-pooling to help cover idiosyncratic, or individual-level, risks. More complex is the question of how to protect against systematic risk affecting the overall economy. In this section we discuss how insurance and financial markets can enhance old-age wellbeing.

Longevity Protection. An important role for insurers in an aging world is to help individuals pool their longevity risk by offering payout annuities. These are financial products which pay to the policyholder a lifetime income stream contingent on his survival, in exchange for an up-front premium payment. In the past, many employers offered defined benefit (DB) pension promises which met this need for longevity protection, but now DB plans are increasingly being phased out, and replaced with defined contribution (DC) plans which usually pay lump sums rather than income streams.

Though this trend might suggest that private annuity markets would grow to fill the gap, the reality has been disappointing to date (Mitchell et al. 2011b). Explanations for the shortfall in annuity demand include the possibility that people fail to understand longevity risk (Brown et al.

2001), as well as the fact that annuity products are simply too complex for people to understand (Brown et al. 2017). Other authors have noted that, in a voluntary purchase market, only those expecting to live long would buy the product, leading to adverse selection and hence higher pricing (Finkelstein and Poterba 2002, 2014; McCarthy and Mitchell 2002a). And still other analysts have noted the fact that most industrialized nations provide the elderly with a subsistence floor in the form of means-tested benefits, which disincentives retirees from converting their retirement nest eggs into annuities (Bütler et al. 2016).

Not only is longevity rising, but there is also substantial uncertainty around future survival distributions. This point was nicely made by Blake et al. (2008) with "fan charts" representing the degree of uncertainty regarding survival to a given age over a future forecast period. Figure 2 shows the central 10% prediction intervals (heaviest shading) followed by successively greater intervals (20%, 30%,…, 90%) for survival probabilities of males at the given ages. As is clear from these charts (based on data from England and Wales), longevity risk is not particularly dispersed during the first 20 years. Thereafter, the range of uncertainty regarding survival rises markedly between ages 75 and 90: at age 90, for instance, the 90% prediction interval lies between 0.15 and 0.45. This highlights the very wide age range over which older persons would have to plan to finance longevity if they were to do it on their own.

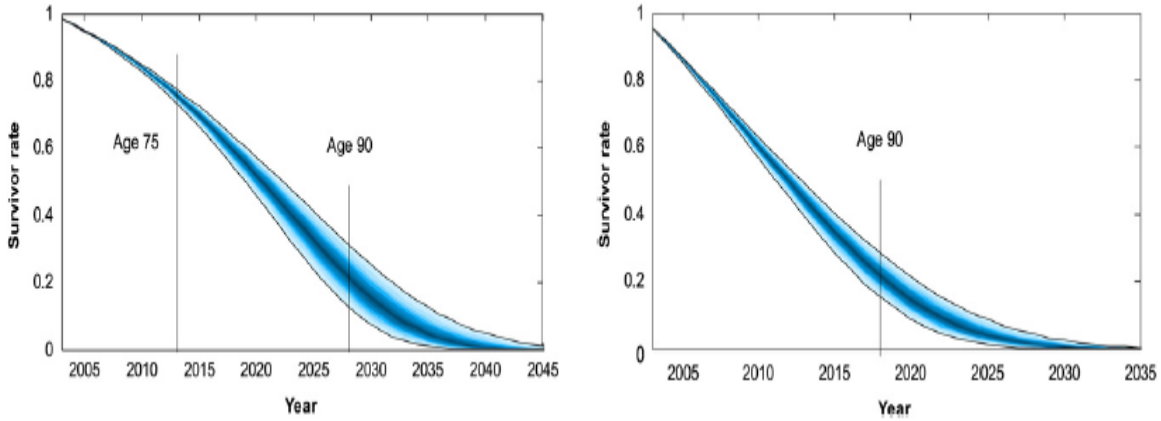


Figure 2. Survivor Fan Charts for Men Age 55 (L) and Age 75 (R)
Source: Derived from Blake et al. (2008), Figures 2 and 3 with uncertain parameters

Annuity providers could explore more ways to protect themselves against the uncertainty of future prospective survival density functions. One way is that life insurers, which pay off in the event of premature death, might exchange risk with annuity providers who will make money if too few people survive. Yet McCarthy and Mitchell (2006) found that this risk exchange was not easy to do, due to differential adverse selection: that is, people who voluntarily buy life insurance differ from those who voluntarily purchase annuities. Other approaches garnering recent attention include a wide range of mortality derivatives including survivor (or mortality) swaps, longevity bonds, and other financial instruments (e.g., Blake and Burrows 2001; Blake et al. 2006; Cairns et al. 2004; Cox and Lin 2005, 2007). Recently, a market overview by Blake and Morales (2017) reported some important new product developments in this arena over the past several years, though there have also been some notable failures due to insufficient demand. A key explanation for the slow development of this marketplace has been a concern over insurer insolvency (MacMinn and Brockett 2017); similarly Biffis et al. (2016) note that counterparty risk in this marketplace has become a growing concern in the wake of the 2008-9 financial crisis.

Still another different way to manage systematic longevity risk in the annuity market would be for policyholders to share mortality shocks using payout adjustments in a risk-pooling fund. In the "group self-annuitization" approach (Piggott et al. 2005), policyholders would take on their own systematic mortality risk, while the participant pool would share idiosyncratic risk. In such a case, no insurance company would be needed to hedge mortality shocks. A tontine-like model with similar features has been explored by Milevsky (2005) and Milevsky and Salisbury (2016), where annuitants bear both the systematic and unsystematic components of longevity risk.

A different approach uses "participating" or "with-profit payout life annuities" (PLAs), where retirees are promised both a guaranteed lifetime income as well as variable (non-guarantee) payments that vary with investment returns and mortality experiences of the insurance pool (Maurer et al. 2012, 2013, 2016 a and b). Here the insurer avoids taking systematic longevity risk by adjusting benefits in response to unanticipated mortality shocks. PLAs require insurers to hold much less equity capital than would normally be the cased with fixed annuities, so premiums on these products are much lower. As a result, even risk-averse households are much better off than they would be in a nonparticipating annuity market: for instance, younger households average one-third more consumption and 80-year-olds about 75 percent more consumption, compared to the no-PLA alternative. Moreover, the smoothing techniques used by insurance company actuaries and accountants yield PLAs that also satisfy insurer profitability requirements and regulator solvency guidelines.

Retirees can also gain enhanced protection against longevity risk if DC plan sponsors would add deferred annuities into the defined contribution menu. This could be spurred by a recent regulatory change in the US which supports including longevity income annuities (LIAs) in the DC menu when purchased around age 65, and if they start paying benefits not later than age 85.

Additionally the rules require that they cost less than 25% of the retiree's account balance up to a limit. An analysis using a lifecycle portfolio setup reveals that these greatly enhance retiree welfare, even after taking account of mortality heterogeneity by education and sex. In the optimal case, a worker who devoted devote 8-15% of his 401(k) plan balance to a LIA that paid out from age 85 would experience a welfare improvement of 5-20% of average retirement plan accruals, compared to not having access to the LIA (Horneff et al. 2015, 2017; also see Figure 3). Moreover, plan sponsors can sensibly default workers into a LIA worth 10% of the account value over a dollar threshold automatically, which would improve wellbeing almost as much as would the fully optimal solution.

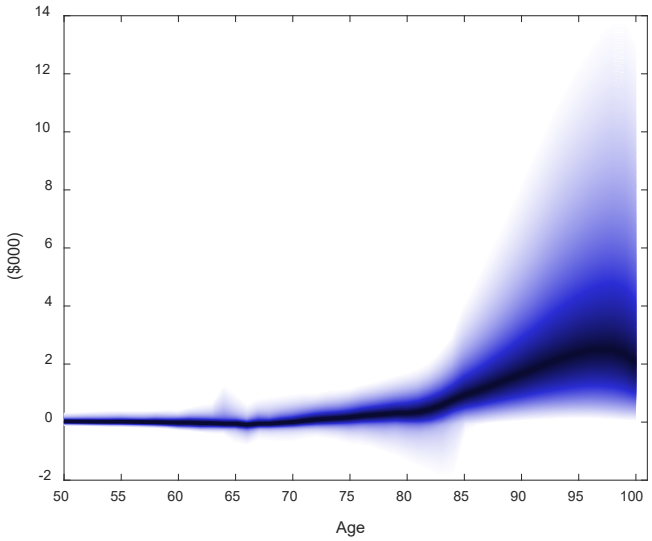


Figure 3. Consumption Differences over the Life Cycle With Versus Without Access to a Longevity Income Annuity (LIA)
Note: This figure shows the 95th% and 5th% iles of consumption differences for 100,000 life-cycles for average US workers with 401(k) plans, with and without access to LIAs starting benefits at age 85. Darker areas represent higher probability mass. Males and females of three educational groups (College+, High School, and less than High School) are modeled.
Source: Horneff et al. (2017)

Protection from Health Cost Shocks. As the world's population ages, this is sure to drive increased healthcare costs, which are already high in many countries. Yet these costs are far from fully insured around the world. In the US, for instance, older persons having government-run Medicare

and Medicaid insurance receive coverage for hospital care, doctor visits, and prescription drugs, but their lifetime exposure to out-of-pocket medical costs (premiums and co-pays) remains very high, estimated at $350,000 (Fronstein and VanDerhei 2017).[3] In other words, elderly medical care insurance is quite partial in the US, and, as noted above, very few retirees have private long-term care insurance coverage. Other countries have implemented different models for managing extreme healthcare costs of the elderly, but these too are proving to be imperfect and increasingly expensive over time. For instance, Japan established a national means-tested long-term care system financed by taxes on workers and premiums/copays from beneficiaries in 2000 (Mitchell et al. 2006). Initially it was anticipated that 2.7 million people would receive benefits, but that estimate proved to be 60% too low within the first five years of the program, and concerns regarding cost increases continue (Rhee et al. 2015). Germany instituted a LTC program in 1995 covering all disabled individuals – that is, not just the elderly – financed by payroll taxes, with benefits intended to cover a portion but not all of care costs. Then in 2013, the government began subsidizing private purchases of supplemental LTC insurance as a means to fill the gap between public benefit payments and LTC costs (Nadash and Cuellar 2017).

It is clear that population aging will boost demand for medical care and LTC coverage in the coming years, depending in part on how effectively costs can be controlled and how sensitive demand is to the cost of coverage. Notably, Finkelstein and McGarry (2005) reported little evidence of a link between peoples' LTC coverage and their self-assessed chances of needing nursing home coverage. Additionally, the relative roles of public versus private insurance protection will continue to vary across countries. There has been some interesting US

[3]This represented the expected value of Medicare premiums and out of pocket costs for a 65-year old couple age 65 seeking to cover a 90% expense with 90% confidence.

experimentation on this front via the "Partnership Program," whereby individuals in some states have been encouraged to buy a relatively limited and hence inexpensive private LTC insurance policy (Ahlstrom et al. 2004). This, in turn, allows policyholders to access the means-tested Medicaid program without having to exhaust all of their assets (as would be the case otherwise). While this would seem to be an interesting example of public/private collaborative ventures in the LTC insurance arena, there is some concern that it will boost LTC insurance coverage by only a small amount (Sun and Webb 2013). Moreover, it also appears that subsidized private purchases of LTC insurance go mainly to the wealthy who would have bought unsubsidized coverage anyhow (Lin and Prince 2013). In sum, this approach may not do a better job of protecting those at most financial risk of expensive medical costs in their later years.

A different approach to the problem could be to embed LTC coverage into annuity products, called by Brown and Warshawsky (2013) the "life care annuity." This product would seem to be appealing in that it could attract those concerned about longevity as well as those worried about healthcare cost risk. Accordingly, it would reduce the potential for adverse selection that otherwise serves as a barrier to life annuity sales (Brown et al. 2001). This idea has been in the literature for some time (Murtaugh et al. 2001), and four insurers have recently brought to market hybrid deferred annuities consistent with this approach (Phipps 2010). Understanding how this emerging market works and how insurers evolve the products over time would be a useful topic of future research.[4]

Protection Against Wealth Shocks. Worldwide ageing will surely imply that markets and policymakers must devote renewed attention to the factors driving wealth shocks, inasmuch as those unable to work rely heavily on their assets to finance consumption at older ages. In particular,

[4] A description of several European nations' LTC systems is provided by Bocquaire (2016).

it will be important to better manage and protect the elderly against sudden changes in capital market returns, interest rates, and inflation, as well as the value of peoples' homes (their main asset).

One risk-management tool especially relevant in recent years is to delay retirement and save more, in response to low market returns and lower labor earnings levels (Horneff et al. forthcoming). Many Americans who lived through the Global Financial Crisis of 2008-9 are also delaying retirement due to their elevated debt, higher than seen in the past (Lusardi et al. 2017).

Another tool might be retirement plan guarantees, particularly in light of the global move toward DC retirement schemes where workers and retirees bear the investment risk associated with their investment portfolios. This topic has attracted a number of researchers around the world including Maurer and Schlag (2004) in the German context, Lachance and Mitchell (2003) and Lachance et al. (2003) in the US public pension setting, and Mitchell (2015b) in the US corporate pension environment, among others. Yet a problem with such guarantees is that they are generally quite expensive to provide: a recent review by Golub-Sass et al. (2009) concluded that they were prohibitively costly and hence unlikely to be adopted without government subsidies.

Reverse mortgages have also been proposed by numerous housing experts as a means to help older persons 'unlock' the value of their homes without having to move out (c.f., McCarthy et al. 2002b; Alai et al. 2004). The idea is that people who are "house rich but cash poor" could use this financial vehicle to tap their home equity to pay for old-age consumption; in turn, the lender earns interest and receives a return of principal when the borrower leaves the home. These should be particularly appealing to the elderly in the US, since reverse mortgages operate in a non-recourse setting, meaning that if the value of the loan exceeds the sale price of the house, the borrower (and his heirs) are not liable. Despite the theoretical appeal of these products, there has been little

demand for them around the world.[5] One explanation may be that lenders are reluctant to offer the products as they bear longevity risk, interest rate risk, and house price risk, and in the US at least, insurers offering such products have experienced substantial defaults (McKim 2017). Another explanation is that consumers lack adequate information about the financial contract, including the fact that reverse mortgage give them a put option protecting them from home price risk (Davidoff et al. 2016).[6]

Other innovations could also be envisioned that would help the elderly better protect against shocks to their home values, as in many countries this comprises their primary, albeit illiquid, asset. Fabozzi et al. (2012) and Shiller (2014) review a variety of real estate derivatives that, if developed, could help with real estate risk management and improve the efficiency of the housing market. Though the financial crisis of 2008-9 indicated that some of these derivatives may have been mispriced, there is sure to be rising demand for better methods to price residential (as well as commercial) real estate risk.

Finally, it is worth touching on the problem of inflation risk in this section on protection against wealth shocks. Depending on the inflationary environment, this may be of central interest to retirees who confront the possibility that they may not earn enough on their assets to keep up with the cost of living. Bodie (1990) proposed that governments should issue bonds linked to the Consumer Price Index (CPI-linked bonds), arguing that these are needed to help protect retirees against falling consumption due to inflation. In a recent study building on Campbell et al. (2003),

[5] See the useful literature reviews in Davidoff (2004) and Davidoff et al. (2016).

[6] A related problem is that lenders will foreclose if the borrowers fail to stay current on their insurance premiums, property taxes, and maintenance. This causes negative publicity for obvious reasons. The US Housing and Urban Development (HUD) agency has determined that 18 percent of reverse mortgages taken out in the 2009-2016 time span will default, and HUD's program is already almost $8B in deficit (McKim 2017).

Illeditsch (2017) concluded that investors should hold only Treasury inflation-protected bonds (TIPS) in order to avoid cash flow and residual inflation risk, rather than holding any nominal bonds in their investment portfolios. Doing so, he argued, would increase welfare substantially, such that risk averse investors would be willing to give up from 15-50% of their wealth to access TIPS. While that study focused on the US, the author noted that households in countries with higher inflation risk would benefit even more.

V. The Growing Importance of Financial Literacy, Cognitive Aging, and Finance Advice

Another reason that population aging will require better risk management flows from the global trend toward *disintermediation* in financial and insurance markets. That is, in many nations, employers, financial institutions, and governments promised lifetime pension and healthcare coverage in the past, but they now realize they cannot make good on all promises made. In turn, individuals are increasingly having to manage their own life cycle saving, investment, and decumulation responsibilities, without the benefit of institutional guidance. This, in turn, has given rise to ever-greater access to financial credit, new and complex financial products, and many more opportunities to spend instead of save (Lusardi et al. 2017).

This confluence of factors is especially challenging given evidence that many people lack the financial know-how to transact such challenges. One area in which they fall notably short is in planning for retirement. Indeed, Lusardi and Mitchell (2007) reported that fewer than one-third of Americans over the age of 50 had ever tried to figure out how much they needed to save for retirement, and fewer than one-fifth believed that they succeeded in developing a saving plan. When people were asked where they went for financial advice, most tended to rely on their "own judgment" or asked relatives and friends.

Such shortcomings are compounded by profound and widespread illiteracy regarding basic financial economics. Lusardi and Mitchell (2014) summarized peoples' answers to the 'Big Three' Financial Literacy questions which they fielded on a wide range of respondents around the world. These questions were as follows (Lusardi and Mitchell 2007; correct responses indicated in **bold**):

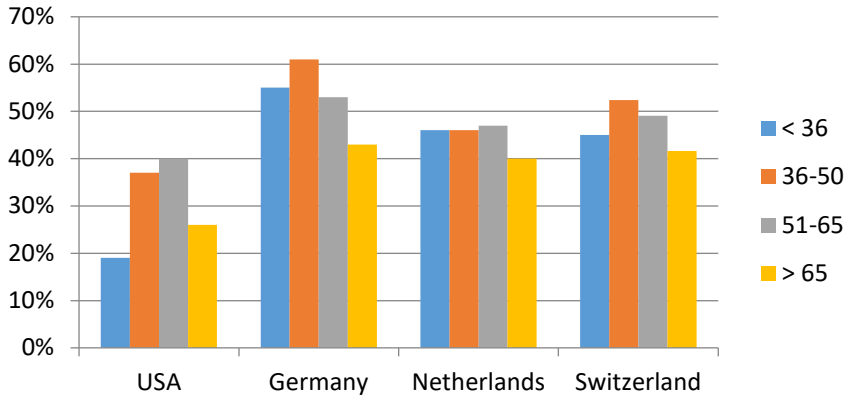
- Suppose you had $100 in a savings account and the interest rate was 2% per year. After 5 years, how much do you think you would have in the account if you left the money to grow: [**more than $102**, exactly $102, less than $102? Do not know, refuse to answer.]
- Imagine that the interest rate on your savings account was 1% per year and inflation was 2% per year. After 1 year, would you be able to buy: [more than, exactly the same as, or **less than today** with the money in this account? Do not know; refuse to answer.]
- Do you think that the following statement is true or **false**? 'Buying a single company stock usually provides a safer return than a stock mutual fund.' [Do not know; refuse to answer.]

The first question measures the capacity to undertake a simple calculation related to interest rate compounding; the second focuses on understanding inflation; and the third is a joint test of knowledge about 'stocks' and 'stock mutual funds' as well as risk diversification. All three are critical to being able to save, invest, and decumulate one's assets successfully. Sadly, results summarized in Figure 3 show that very few people can answer all three of these questions correctly. Moreover, proportionately more women than men respond that they "do not know" the answers to the questions, highlighting the need for more financial education for women – who after all, usually outlive their spouses. Follow-on surveys by Lusardi et al. (2013) and Lusardi and

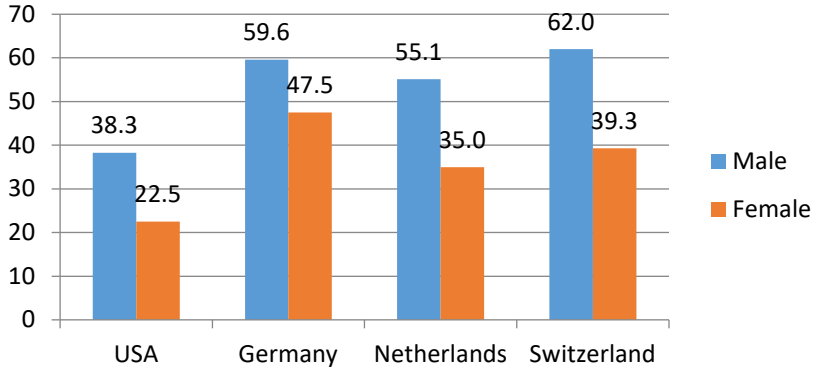
Tufano (2009) as well as many others delved further into peoples' knowledge of risk, debt, and the terms and conditions of consumer loans and mortgages. Overall, this research shows that the more financially informed are also much more likely to save, avoid expensive debt, protect against longevity risk, and accumulate more retirement wealth.[7]

[7] Several studies reviewed in Lusardi and Mitchell (2014) examine whether the measured impact could be attributable to reverse causality. They conclude, with others, that the preponderance of the evidence is consistent with the directional effects running from financial knowledge to better retirement preparedness.

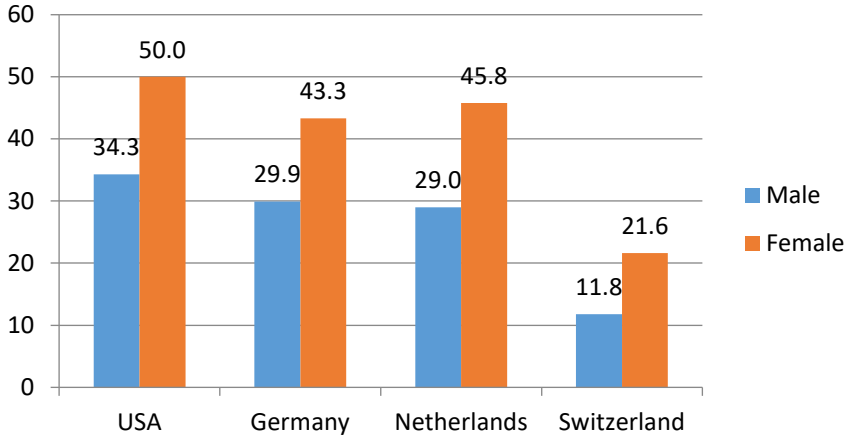
Figure 3: Financial Literacy Scores in Four Nations
Panel A. By Age Group: % providing correct answers to all three financial literacy questions



Panel B: By Sex**:** (% providing correct answers to all three financial literacy questions)



Panel C. % responding "do not know" at least once to any of the three financial literacy questions)



Source: Lusardi and Mitchell (2014), Figure 1.

A related and growing concern for policymakers is that peoples' cognitive ability tends to decline at older ages. Though the medical profession is strenuously working to mitigate this pattern, about half of all adults age 80+ already suffer from cognitive impairment (Bernard 2015), making it difficult for them to process and follow up on financial decisions. Moreover, research suggests that older individuals may be more likely to act on poor advice or accept fraudulent offers (DeLiema and Deevy forthcoming). And behavioral traits such as overconfidence, ambiguity aversion, lack of self-control, regret aversion, and impatience make it more difficult for people to manage investments and withdraw sensibly from their retirement savings (Mitchell et al. forthcoming; Dimmock et al. 2016). Studies on these behavioral attributes to date have mainly been conducted on prime-age individuals, so more research is needed on how older people make many of the most consequential financial decisions of their lives (e.g., Huffman et al. 2017). In tandem, it will be important to formulate methods to ensure greater consumer financial protection as the population ages (Campbell et al. 2011).

We recognize that an alternative to educating workers and retirees on fundamental economic and finance questions could be to "outsource" the job, turning to either human or "robo" financial advisors. Indeed Kim et al. (2016) pointed out that workers should engage financial advisors to manage their money for them when self-management is costly in terms of foregone on-the-job skill investment. Nonetheless, very few people indicate that they are willing to use professional investment advice, and of those, most state they might implement only those recommendations that conform to their own ideas (Hung and Yoong 2013). Indeed Collins (2011) and Finke (2013) have found that financial literacy and financial advice tend to be complements rather than substitutes, so advice absent knowledge may not help shape financial decisions and behavior.

VI. Discussion

Our goal in this paper has been to highlight some of the key risks facing an aging world, as well as to draw implications for ways in which financial and insurance markets could improve the wellbeing of an older population. As we have emphasized, it will be imperative for more people to work longer, during which period they must save more, continue to invest in capital markets and in themselves, and delay decumulation. Efforts to boost labor productivity, including enhancing health, education, and financial literacy, will be complementary to this process.

Another need is to devise better products that help value, price, and insure against old-age risk. This includes hybrid mechanisms that can cover longevity as well as healthcare cost shocks, inflation risk, and wealth shocks. There is much room for improvement in this arena, inasmuch as households have little experience with the sorts of longevity that are forecasted, and also because the products themselves are complex. There is also information asymmetry on the side of finance and insurance providers who have not yet built up extensive information needed to price reverse mortgages, long-deferred annuities, housing derivatives, and other related tools.

In turn this highlights important roles for policymakers who can assist in making markets function better for old-age risk management. Of paramount importance is the need to reform failing social insurance systems on which many older persons rely. “Parametric” system reforms often involve cutting benefits and raising contributions, as well as increases in retirement ages and the number of years required to become eligible for benefits (OECD 2016b). Yet more profound and system-wide restructuring may also be needed, and diverse new possibilities are available. For instance, Chile, Australia, Singapore, and several other countries have moved to funded private account defined contribution schemes. Ever here, however, these programs have been challenged

by those who favor redistributing accumulated assets and returning to a PAYGO system, as occurred in Argentina (Rofman 2015) and as is now threatened in Chile (Mitchell 2015a). The Dutch advocate a combination approach they have adopted termed a "defined ambition" plan where workers are promised variable deferred annuities based on pension assets and a mortality risk pool (Bovenberg et al. 2016). Other new models include some favored by labor unions (Blitzstein 2016), public sector entities (Rappaport and Peterson 2016), and many others detailed in Mitchell and Shea (2016).

Thinking even more broadly, an alternative approach suggested by Valdes-Prieto (2005) might be to find a way to securitize future tax revenues and formally dedicate them to national PAYGO pension plans. Implementing such a proposal would likely require government support for the development of a national wage index (Shiller 1993, Athanasoulis et al. 1999). Other products that would help protect households against political risk include longer-dated inflation-indexed bonds, as in the UK, and private/public sector collaboration in generating data for the purpose of creating mortality indexes. Exciting new technological and digital technologies also offer ways to enable insurers to narrow gaps in insurance protection around the world by cutting costs, curtailing information asymmetries, and limiting moral hazard (Geneva Association nd). Recently the World Bank joined with private insurer Swiss Re to issue catastrophe bonds covering epidemics in Mexico (Swiss Re 2017), and it stands to reason that other ways to manage mortality shocks could benefit from international agencies' insights and oversight.

Finally, it is worth emphasizing that additional research and much better data will be required to inform industry and policymakers seeking to manage risks in an aging world. While this will be expensive, so too will be the costs of doing nothing. Without reforms, many nations will face rising numbers of under-insured and over-extended elderly.

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