Adverse Selection in the Group Life Insurance Market

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The employer-sponsored life insurance (ESLI) market is particularly susceptible to adverse selection due to community-rated premiums, guaranteed issue coverage, and the existence of a well-functioning individual market as a substitute. Using administrative data from a large university, I analyze the existence and welfare costs of adverse selection in the ESLI market. Despite the vulnerable structure of ESLI, I do not find evidence of economically significant adverse selection in general. Nonetheless, the most highly educated employees—faculty members—do exhibit significant adverse selection. These results together suggest that a lack of financial sophistication likely keeps the ESLI market from unraveling. Other possible explanations include the availability of accelerated death benefits, employee inertia, and financial complexities in comparing group and individual coverage. (JEL: D82, D31, G22, J33)

I. Introduction

Life insurance is one of the largest private insurance markets in the United States. In 2014, life insurance coverage totaled $20.1 trillion (ACLI, 2015) and individuals paid $132.2 billion in life insurance premiums (Federal Insurance Office, 2015).[1] Notwithstanding widespread coverage, large disparities still exist between life insurance holdings and underlying vulnerabilities with some estimates exceeding $15 trillion (Bernheim et al., 2003; Conning, 2014; LIMRA, 2015*c*). In addition, life insurance ownership is at a 50-year low and sales have declined 45 percent since the mid-1980s (Prudential, 2013; Scism, 2014). Adverse selection in life insurance—where higher risk individuals are more likely to purchase coverage leading to market failure—could be one of the causes of these uninsured vulnerabilities.

I use detailed administrative data from a large public university ("the University" henceforth) to test for adverse selection in employer-sponsored life insurance (ESLI). Supplemental ESLI at the University is particularly susceptible to adverse selection for several reasons. First, supplemental ESLI is "guaranteed issue" (cannot deny coverage based on health) and priced based on the characteristics of the group rather than individual health characteristics. Second, employees at the University may increase supplemental ESLI coverage on

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[1]For comparison, accident and health premiums jointly totaled $157.1 billion in 2014 (Federal Insurance Office, 2015).

an annual basis without individual underwriting (health screening) in many instances. As a result, individuals that receive negative health shocks (e.g., diagnosis of cancer) may increase coverage prior to death and receive significantly higher payouts. Third, there are large differences in the levels of coverage available at the University, which allows for adverse selection on not only the extensive margin (participation) but also on the intensive margin (level of coverage). Fourth, individual term life insurance represents a viable alternative to ESLI. In contrast to the ESLI, term life insurance is individually underwritten (experience rated) and is not guaranteed issue. Consequently, term life insurance offers significantly cheaper premiums in comparison to ESLI for healthy University employees potentially drawing away the good risks from the ESLI pool.[2] Overall, these factors could exacerbate adverse selection in ESLI at the University and potentially lead to an unraveling of the ESLI market. Despite these factors, supplemental ESLI with similarly structured policies are widespread indicating a lack of crippling adverse selection. Nonetheless, even in the absence of complete market failure, adverse selection can still lead to welfare loss and underinsurance.

Using the widely implemented positive correlation test, I find some evidence of adverse selection in supplemental ESLI at the University. However, following the work of Einav, Finkelstein and Cullen (2010), I show that the resulting welfare loss is economically insignificant. Nonetheless, I do find significant adverse selection among highly educated employees. Faculty are more likely to purchase coverage and have higher levels of coverage as their probability of death increases whereas staff appear to be unresponsive to differences in probability of death. Although beneficial for faculty that adversely select coverage, this behavior decreases the welfare of other employees who experience higher prices due to faculty's actions. Given that the highly educated exhibit adverse selection, a plausible explanation for the overall lack of adverse selection could be lack of financial sophistication.

In addition to the previously described test for adverse selection, I analyze the behavior of University employees who eventually died to see if they took advantage of the ability to increase coverage without underwriting. Of those individuals, very few maxed-out guaranteed issue coverage or ramped up coverage prior to death. In fact, these employees behaved similarly to other employees after conditioning on individual characteristics. A possible explanation for the lack of adverse selection among this group is accelerated death benefits (ADB). These ADB allow families to receive a life insurance payout prior to an individual's death but disqualifies them from increased coverage. This option is attractive for individuals that are liquidity constrained or have a reduced bequest motive relative to when they originally elected coverage. Consistent with this, individuals that increased coverage had a higher salary and contributed to a retirement account more often than those that did

[2]This is demonstrated in section IV.D.

not increase coverage, perhaps reflecting less liquidity constraints. Another explanation could once again be financial sophistication as faculty that pass away are also more likely to increase coverage consistent with the behavior observed in the positive correlation test.

To further understand adverse selection in ESLI, I also analyze whether the term life insurance market draws healthy employees away from supplemental ESLI, consequently increasing adverse selection. The University data do not contain information on term life insurance elections. Consequently, I turn to the Survey of Income and Program Participation (SIPP), which is unique in that it has information on both ESLI and individual market coverage. Nonetheless, the SIPP does not differentiate between coverage automatically provided by employers (basic coverage) and supplemental coverage elected by employees, which is essential for adverse selection analysis. Therefore, I restrict the sample to federal employees for whom the structure of ESLI is well-documented. This allows for differentiation between federal employees with only basic coverage and those that elected supplemental ESLI. Looking at a sample of federal employees that elected additional coverage (either supplemental ESLI or term life insurance), I show that health status does not significantly influence the decision to purchase term rather than supplemental ESLI even though there are large potential savings for the healthy. Despite the overall lack of adverse selection on this feature and consistent with the other tests, I once again find that highly educated employees (those with graduate degrees) take advantage of the available substitute exhibiting adverse selection. In addition to financial sophistication, other possible explanations for the lack of a significant influence of the term market include salience, and time costs associated with individual underwriting.

This paper contributes to the significant literature on adverse selection in insurance markets. Adverse selection has been analyzed in health insurance (Cutler and Reber, 1998; Cardon and Hendel, 2001; Cutler, 2002; Einav, Finkelstein and Cullen, 2010), long-term care insurance (Finkelstein and McGarry, 2006), and annuities (Finkelstein and Poterba, 2004). This literature illustrates the heterogeneous influence of adverse selection on markets and the importance of contractual arrangements in insurance plans. With regards to life insurance, previous empirical work on adverse selection focuses almost exclusively on the individual market. The seminal paper by Cawley and Philipson (1999) finds no evidence of adverse selection in the term life insurance market. Subsequent work has mixed results (He, 2009, 2011; Harris and Yelowitz, 2014; Hedengren and Stratmann, 2016). These studies provide useful insights into one portion of the life insurance market but little attention has been given to the ESLI market, which constitutes 41 percent of total life insurance coverage (ACLI, 2015).

Hedengren and Stratmann (2016) provide the only empirical study of adverse selection in the ESLI market and find some evidence of adverse selection. However, their data do not contain information on offerings or differences in benefit plans, only holdings. Furthermore, their data do not differentiate between basic and supplemental coverage. Basic coverage—which constitutes half of the total value of ESLI coverage—is irrelevant for the typical discussion of adverse selection as it is generally provided automatically at no cost to the employee.[3,4] Supplemental coverage, however, is susceptible to adverse selection as employees both elect the coverage and bear the cost. Nonetheless, only half of all workers have the option of purchasing supplemental ESLI (LIMRA, 2015*b*). Consequently, their finding is likely driven by differences in provision/availability across industries and occupations rather than individual adverse selection.[5]

This paper advances the literature by using detailed individual level data to analyze adverse selection in ESLI across two different settings, and by testing the individual and institutional components that in theory should lead to adverse selection. In addition, the paper contributes to the literature on welfare costs of adverse selection in insurance markets (e.g., see Bundorf, Levin and Mahoney, 2012; Einav, Finkelstein and Schrimpf, 2010; Beauchamp, Wagner et al., 2013; Hackmann, Kolstad and Kowalski, 2015). Furthermore, this study contributes to research on the interaction between community-rated premiums and adverse selection (Buchmueller and Dinardo, 2002). More specifically, the findings increase understanding of the importance of education, specifically graduate degrees as a determinant for adverse selection. Lastly, this paper advances the knowledge of end of life decisions including the potential for liquidity constraints and ADB to mitigate anticipatory adverse selection.

The remainder of the paper is organized as follows. Section II provides a brief overview of life insurance markets, Section III describes the data, Section IV highlights features that could induce adverse selection, Section V sets up the empirical models to test for adverse selection, Section VI presents results and the welfare analysis, Section VII discusses the findings and provided additional tests for adverse selection, and Section VIII concludes.

II. Life Insurance Overview

In 2014, 120 million employees were covered by ESLI with coverage totaling $8.2 trillion (ACLI, 2015). ESLI customarily has an automatic portion provided by the employer (basic coverage) and an option to purchase additional coverage through payroll deductions (supplemental coverage). Three-quarters of all full-time workers had access to ESLI (U.S. Department of Labor, 2015) and about half of all workers had access to supplemental ESLI

[3]The statistic on the relative value of basic life insurance coverage is based on data from the 2008 SIPP panel in conjunction with the assumption of levels of basic coverage reported in the March 2013 National Compensation Survey.

[4]For 95 percent of covered workers, employers that provided basic coverage did not require employee contributions (U.S. Department of Labor, 2015). The provision of such coverage, however, does seem to help mitigate the incidence of poverty among surviving spouses (Harris and Yelowitz, forthcoming b).

[5]Hedengren and Stratmann (2016) could be picking up adverse selection into a firm that offers ESLI. However, it is very unlikely that a significant portion of the population chooses employment based on the availability of ESLI.

coverage (LIMRA, 2015*b*). Based on SIPP data, 51 percent of employed adults have life insurance coverage. Of those with coverage, 58 percent have some ESLI coverage and 34 percent exclusively have ESLI coverage.[6] As mentioned, ESLI is generally community-rated meaning that premiums are a function of the expected costs of the insured group rather than a single individual's probability of death.

The individual market accounts for 59 percent of life insurance coverage. Within the individual market, policies are differentiated by term and whole life insurance.[7] Term life insurance provides coverage for a specified period of time (typically ranging from 10 to 30 years) and pays the face value of the policy upon death of the policyholder. Term life insurance accounts for 70 percent of the face value of individual life insurance policies (ACLI, 2015) and is a close substitute for supplemental ESLI. In contrast to ESLI, term life insurance is experience rated meaning that premiums vary based on individual characteristics including age, gender, smoking status, health status, family history, and participation in risky behaviors. This underwriting represents a cost to applicants as it commonly requires a medical examination, blood work, and detailed medical history. The most common form of term life insurance is a level term policy, which keeps premiums constant over the life of the policy.

III. Data

I use administrative (payroll) panel data from the University from 2008 to 2014 as the primary data source. To analyze adverse selection in the ESLI market, it is essential to be able to differentiate between basic coverage and supplemental elections. The data document complete benefit and retirement elections including basic and supplemental ESLI for 21,723 unique individuals. Employees make benefit elections during the open enrollment period for the University or after a qualifying event, which include birth, adoption, marriage, divorce, or employment status change.[8] All elections made during the open enrollment period take effect within two to three months and continue until a new election is made. In general, employees cannot add or drop coverage during the year except in the case of a qualifying event.

Qualified employees at the university are automatically provided basic life insurance coverage of 1x annual salary.[9,10] In addition to this coverage, employees may elect supplemental

[6] Percentages were calculated from tabulations of the Survey of Income and Program Participation (SIPP) from 1990 to 2008.

[7] Whole or permanent life insurance provides coverage for life and has an investment portion that accumulates a cash value over time. Given the investment nature of whole life insurance, it is much less of a substitute for supplemental ESLI and consequently not a focus of this paper.

[8] The open enrollment period is approximately 30 days from mid-April to mid-May. In the case of a qualifying event, all changes must be made within 30 days of the event.

[9] Qualified employees include full-time and >.75 full-time equivalent. For brevity, I refer to these employees as full-time workers.

[10] Basic premiums paid by the employer for the first $50,000 worth of coverage are not classified as a taxable

life insurance up to 5x their annual salary through payroll deductions on an after-tax basis. Employees may elect up to 3x annual salary after initially being hired without "evidence of insurability" up to the guaranteed issue amount of $375,000.[11] Evidence of insurability consists of filling out a medical history form and in some cases a medical examination to verify the employee is "insurable." For each subsequent year following the initial hiring, employees may increase coverage by 1x salary without evidence of insurability unless the increased coverage exceeds the guaranteed issue amount. Therefore, within two years of being hired, employees can have 5x annual salary in supplemental ESLI without providing proof of insurability (conditional on it being less than $375,000). Additionally, if employees increase coverage by more than 1x annual salary during open enrollment then they must provide evidence of insurability. The maximum supplemental coverage is the lesser of 5x annual salary or $1,000,000. Premiums for supplemental coverage are differentiated solely by 5-year age group.

Generally, if the employee is no longer employed by the University then ESLI coverage lapses. However, if the employee qualifies for long-term disability (LTD) then the employee may continue coverage at the same rate until reaching age 67. If the employee wishes to continue coverage but does not qualify for LTD, he or she may convert the group policy into a whole life policy. Alternatively, the employee may continue group coverage, but at a premium that reflects the risk of the group of employees that continue coverage after leaving employment at the University. According to a Human Resource representative, the worker will "pay dearly" in premiums for the portable coverage. Therefore, employees may continue to have some type of coverage after leaving the employment at the University, but it will be more expensive and/or a different type of coverage. Consequently, employees that wish to continue ESLI coverage might experience "lock-in" similar to lock-in exhibited in employer-sponsored health insurance and cliff vesting for defined benefit pensions (Madrian, 1994; Kotlikoff and Wise, 1987).

Table 1 shows summary statistics for full-time workers. The sample is majority white and 63 percent female. In addition, about half of the sample is married and about half have at least one child. I do not observe marital status or children directly in the data but infer these characteristics from elections for health, dental, vision, and dependent life insurance as well as the existence of a dependent flexible spending account (FSA). For example, if an employee ever elects spousal health insurance then he or she is labeled as married.[12] The

fringe benefit. For example, a 40-year old employee does not pay income taxes on the first $60 the employer pays toward basic life insurance per year. See https://www.irs.gov/government-entities/federal-state-local-governments/group-term-life-insurance.

[11] In 2014, 19.9 percent of employees earned enough to elect more than $375,000 in coverage and only 3.2 percent of all employees had supplemental coverage that exceeded $375,000 in that same year.

[12] This measure will not pick up individuals who have alternative sources of health insurance such as a spouse's employer (Ritter, 2013). In addition, this variable will miss individuals with children who are no longer considered dependents. See Harris and Yelowitz (forthcoming a) for a more complete discussion of the accuracy of these metrics.

University operates a hospital in addition to the main campus with the healthcare sector accounting for 42 percent of workers in 2014. Additionally, in 2014 faculty make up 15 percent of workers and the median salary was $46,000 for all workers. Table 1 also shows that roughly half of full-time employees elect supplemental ESLI. Conditional on electing supplemental ESLI, mean supplemental coverage in 2014 was $164,842 or a multiple of 2.68 x salary. Overall, supplemental coverage represents 56.6 percent of the total face value of ESLI at the University in 2014.

Table 2 further compares employees with and without supplemental ESLI. As illustrated, the main differences are that those with supplemental ESLI are more likely to have children and be married, consistent with theoretical models of life insurance demand (Lewis, 1989; Hong and Ríos-Rull, 2012). There do not appear to be any substantive differences in gender, race/ethnicity, or salary for those that have coverage relative to those that do not.

A. Representativeness

Given that I primarily analyze a single university in this study, it is important to understand how representative the University is of other universities and firms to gauge the external validity of the findings. Using the National Compensation Survey (NCS) conducted by the Bureau of Labor Statistics (BLS), Harris and Yelowitz (forthcoming a) show that the basic ESLI coverage for the University is within the norm for other colleges and universities. However, the NCS does not have information about supplemental ESLI coverage. To get a sense of common features in supplemental ESLI policies, I use benefit books collected from more than 400 universities. The benefit booklets for many institutions were missing details on life insurance and I am hesitant to conclude that such institutions do not offer coverage. Of all the universities surveyed, 70 universities had well documented information on both basic and supplemental coverage. The average guaranteed issue amount (amount available without proof of insurability) for those universities is $254,344 with a maximum guaranteed issue amount of $750,000.[13] The University's guaranteed issue amount of $375,000 is not out of the ordinary in comparison to the other universities and colleges sampled. From the survey of benefit books, all but one University adjust supplemental premiums based solely on age.[14] Roughly half of plans with requisite details allow employees to increase coverage without proof of insurability during open enrollment periods with the allowed increases ranging from $5,000 to $300,000 with the mode of 1x annual salary. It is less common for employees to be able to elect coverage without evidence of insurability if they did not elect supplemental ESLI when they were initially hired. Overall, it appears that the ESLI at the University in this study fits within the norm for colleges and universities in regards to

[13] A small minority of the Universities specified the guaranteed issue amount as a multiple of salary. For those universities the multiple of guaranteed issue ranged from 2x to 7x salary.

[14] Purdue University adjusts premiums based on age and tobacco use.

guaranteed issue amounts and underwriting, but is on the more generous side of allowing employees to enroll/increase coverage during open enrollments. Consequently, if there is not evidence of significant adverse selection at the University with a vulnerable ESLI structure, then it is likely that there is not significant adverse selection at less generous institutions.

B. *Probability of Death*

To gauge adverse selection in life insurance, a metric for probability of death is required. Previous studies have used sample attrition (Cawley and Philipson, 1999), actual mortality of an older sample (He, 2009; Harris and Yelowitz, 2014), or administrative records with large sample sizes (Hedengren and Stratmann, 2016).[15] Although, the University data contain information on actual deaths, mortality for the employed working age population is a rare event. Additionally, the data are censored by termination of employment so there is no information on longevity following employment at the University. Cawley and Philipson (1999) use the fitted value from a logit regression as their measure of probability of death given that they do not observe mortality for a long window. A similar approach is not feasible given the small number of actual recorded deaths at the University. Furthermore, although mortality of coworkers is an important determination of expectations, individuals likely form expectations of longevity based on the probability of death of individuals of similar demographics in general rather than relying solely on the probability of death of coworkers. Consequently, I use a much larger population, the entire United States, to impute the probability of death for employees at the university.

For the numerator of the probability of death metric, I use data from the CDC National Vital Statistics System Mortality Multiple Cause-of-Death Files for years 2003 to 2014. These data document the universe of deaths in the United States from 2003 to 2014 (30 million) with information on race/ethnicity, gender, marital status, education.[16] From the education variable, I define faculty to be those with 5+ years of college education and staff ranging from high school graduates to a bachelor's degree when merging to the University data.[17] For the denominator I use the American Community Survey (ACS) from corresponding years. The metric is obtained by totaling deaths by each unique socioeconomic group and dividing the counts by the corresponding population for the each socioeconomic group as measured in the ACS. For example, there is an average of 3,709 deaths per year for individuals that are age 50, male, not married, white, and have staff level education.

[15]In Cawley and Philipson (1999), the authors used the fitted values from a logit regression making assumptions about sample attrition and death. He (2009) use an indicator for mortality within a 12-year window of observation. Both of these studies use the HRS that initially interviews individuals aged 51 to 61. Hedengren and Stratmann (2016) merge administrative records from the Social Security Administration (that contain individual mortality) onto the SIPP, which has large sample sizes.

[16]I exclude individuals with an unknown or missing marital status, education level, and race/ethnicity, which constitutes 5.1 percent of the total working age sample.

[17]Similarly, for healthcare workers that make more than $100,000 I assume that they have 5+ years of education strictly for purposes of assigning probability of death.

On average, there are 441,603 individuals in the U.S. per year for this sociodemographic group. Therefore, for this group the one-year probability of death is 840 in 100,000.

This metric is subject to measurement error and fails to fully capture idiosyncrasies in mortality risk. Nonetheless, this metric is likely highly correlated with actual probability of death. To test the usefulness of the constructed probability of death metric, I compare the measure with self-reported health status as measured in the SIPP. Studies have shown that self-reported health is a reasonable measure because it captures not only health status, but also individual interpretation of health status (Bound, 1991; Wallace and Herzog, 1995). As reported in Appendix Table A1, the mean imputed probability of death consistently increases as the self-reported health worsens. Nonetheless, this metric is imprecise and consequently the results are likely attenuated. Later on, I show that the results using this metric are consistent with results using self-reported health, which add credibility to its use.

IV. Expected Adverse Selection in ESLI

As discussed in the introduction, there are several aspects of ESLI that could lead to high levels of adverse selection. In this section, I provide further motivation for adverse selection in the ESLI market.

A. Heterogeneity in Underlying Probability of Death: Community-Rated/Guaranteed Issue

Guaranteed issue coverage and community rated premiums that only adjust based on age could cause significant adverse selection in ESLI at the University. These features imply that employees in the same age bin of varying health can purchase policies for equal amounts. For example, an employee who is age 49, male, African-American, obese, smokes, drinks, has diabetes and earns $30,000 a year pays the same premium as an employee who is age 45, female, white, makes $150,000, and is a health conscious athlete. The guaranteed issue aspect in addition to the community-rated premiums could lead to adverse selection. If all employees purchase coverage, then the relatively healthy employees subsidize the relatively unhealthy employees.

To illustrate, Figure 1 shows the probability of death for white, female, married, college educated individuals in comparison to African-American, male, high school graduates, who are not married. A 40-year old individual in the latter group is more than 10 times as likely to die that year as individuals in the former group (459 deaths compared to 43 deaths per 100,000). Additionally, Figure 2 shows the variation in probability of death by race, education, gender, and marital status respectively. Given this heterogeneity in risk and the homogeneity in premium within age groups, employees in higher risk groups should purchase coverage more often than those in lower risk socioeconomic groups. Despite this variation, death is a rare event for University employees with an average of 333 deaths per 100,000.[18]

B. Ability to Increase Coverage with Health Shocks

Another feature of the University ESLI policy that should exacerbate adverse selection is the ability to ratchet up coverage without medical underwriting. University employees can increase coverage by 1x salary each year without proof of insurability, which means that on average they can increase coverage within 6 months of a negative health shock or diagnosis with the elected higher coverage going into effect shortly thereafter.[19] Consequently, individuals that receive negative health shocks or are diagnosed with a life threatening condition may increase coverage. A simple example helps illustrate how only a few employees with anticipated deaths can cause significant adverse selection. Suppose that a typical employer plan that covers 15,000 employees has 50 deaths per year and that half of all employees who die have supplemental coverage and equal salaries. Further suppose that the average employee receives a payout of 1x salary. Given these assumptions, only six employees would have to increase coverage to the maximum of 5x salary to cause payouts to double.

However, employees will only ratchet up coverage inasmuch as they are aware of pending death. Data on 1,367 deaths as reported in the Health and Retirement Study (HRS) shed light on the degree of anticipation of death.[20] Follow-up exit interviews of surviving relatives show that 44.7 percent of deaths were expected and that roughly a quarter of all deaths resulted from an illness that was diagnosed at least a year prior to the individual's death.[21,22] Additionally, based on CDC data and given the demographics of the University, only an estimated 17 percent of employee deaths were a result of accidents.

Cancer represents a likely example where individuals might have forewarning prior to death. The 5-year survival rate for cancer (based on the age and gender profile at the University) is approximately 78 percent, which indicates that a significant portion of cancer patients have forewarning prior to death.[23] There is significant heterogeneity in survival rates depending on the cancer site and stage of cancer with cases where a diagnosis of cancer

[18]Probability of death ranges from 9 to 3,158 per 100,000 for University employees with a standard deviation of 365 deaths per 100,000.

[19]Open enrollment is in April and May and coverage goes into effect July 1.

[20]I use exit interviews conducted between 1996 and 2014. The HRS surveys initially interviews individuals between age 51 and 61 in addition to their spouses, which are not required to meet the age restrictions. Consequently, the data record deaths of spouses as young as 38, but as expected the majority of recorded deaths occurs at older ages both due to probability of death and the sample selection. Nonetheless, the sample should illustrate the likely distribution of deaths of working age individuals.

[21]The exact questions asked were: "Was the death expected at about the time it occurred, or was it unexpected?" and "About how long was it between the start of the final illness and the death?".

[22]Restricting the sample to those that worked within the last couple of years prior to death does not significantly change the proportion of deaths that were expected or the time from diagnosis to death.

[23]Five-year survival rate data from the SEER Cancer Statistics Review 1975-2013 http://seer.cancer.gov/csr/1975_2013/results_merged/topic_survival.pdf. The 5-year survival rate for all cancer types in the U.S. is 66.9 percent, which is lower than the University specific measure largely due to different age distributions.

is quickly followed by death (pancreatic cancer) and cases where individuals fully recover. Nonetheless, any diagnosis of cancer significantly increases an individual's likelihood of death in the immediate future.

To better approximate the potential influence of anticipated deaths on adverse selection at the University, I simulate deaths based on individual age, race, ethnicity, gender, marital status, and education using data from the CDC and the American Community Survey (ACS).[24] Given the characteristics of employees at the University, approximately 46 employees die each year of which 12 (roughly a quarter) result from cancer. Weighing the sample by the probability of death and probability of dying from cancer, I repeatedly assign death and death from cancer to employees.[25] Table 3 shows the results from repeated simulations. The first panel shows that given the coverage levels of employees in 2014, the assigned 46 total deaths would result in life insurance payouts totaling \$3.16 million conditional on all deaths being unanticipated (e.g. car accident). The second panel shows how much total payouts from the life insurance company would increase if the 12 employees diagnosed with terminal cancer had time to adjust coverage taking into account the guaranteed issue amount of \$375,000. As illustrated, total payouts would increase by 18.2 percent to 62.8 percent depending on the number of open enrollment periods the employees live through. The life insurance company would consequently have to increase premiums by a similar amount in order to continue offering life insurance coverage. Given that the simulated deaths are weighted by probabilities of death, it is possible that some of the individuals assigned already increased coverage making the estimate of increased payout smaller.

When employees with cancer increase supplemental coverage, they also pay more in premiums. However, this increase in premiums paid is a small fraction of the increase in payouts. The last panel of Table 3 shows the total premiums paid in 2014 and how much premiums would increase if everyone that was diagnosed with cancer increased coverage to the maximum (which could take up to 5-years).[26] Based on the CDC data on cancer diagnoses and assuming a 50 percent 10-year survival rate with average employment of 10 years, there are 475 individuals with the diagnosis of cancer employed at the university. If every individual with the diagnosis of cancer increased supplemental coverage to the maximum guaranteed issue amount, (i.e. they all had five years to adjust coverage) then premiums received would only increase by \$366,758. This increased premium payment reported likely overestimates the actual increase due to individuals ramping up coverage as it assumes all employees with cancer have time to increase coverage to the maximum guaranteed issue

[24] I use the education level available in the CDC data as a proxy for faculty/staff positions as previously described to merge with the university data.

[25] Hambel et al. (2015) similarly use German cancer data to simulate health shocks.

[26] As shown in Table 3, total payouts exceed collected premiums in 2014. This likely comes from University employees having a lower probability of deaths than predicted based on their demographics. Nonetheless, these numbers are indicative of potential behavior of employees with the diagnosis of cancer.

amount. Even with this overestimation, the reaction of employees diagnosed with cancer still only accounts for a fraction of the increase in total payouts from adverse selection due to cancer. Overall, it appears that the guaranteed issue and ability to increase coverage at the University should significantly increase adverse selection as employees anticipate their own deaths and respond by increasing coverage.

C. Vast Differences in Benefit Levels

Another important aspect of ESLI that could increase adverse selection is the wide range of coverage offered. Employees at the University may ultimately elect supplemental coverage from 1x salary to 5x salary without medical underwriting inasmuch as the policy does not exceed the guaranteed issue amount ($375,000). Cutler and Reber (1998) illustrate how adverse selection across different levels of generosity can significantly affect health insurance markets. They document an insurance "death spiral" where adverse selection led to the discontinuation of the most generous health insurance plan (PPO) at Harvard University after the university stopped subsidizing the plan. They noted that this problem is not an isolated occurrence and many such employer-sponsored health insurance (ESHI) plans cannot maintain a significantly more generous option without it being subsidized, primarily due to adverse selection.[27] As a result, there is relatively little difference in the generosity of coverage across ESHI plans for employers with equal contribution rules. Nonetheless, plans similar to the one studied in this paper (where the highest coverage can be 5x more generous than the lowest coverage option) are common.

D. Outside Option: Non-group Life Insurance

The last major factor that influences adverse selection in the ESLI market is the existence of a functioning, competitive term market. In stark contrast to ESLI, term policies are individually underwritten in varying degrees based on the term length and face value (amount payable at death) of the policy. Consequently, healthy employees may purchase term life insurance for lower rates than supplemental ESLI. Similarly, under the Affordable Care Act (ACA) the health care exchange offers an alternative to ESHI for employees with available ESHI even though they are generally not subsidized.[28] However, insurers in the health care exchange cannot legally price discriminate based on preexisting conditions, which greatly lessens the "cream skimming" from the ESHI market.

To understand the difference in premiums between ESLI and term coverage I use scraped premiums from term4sale.com (N=5.85 million quotes). Term4sale is a life insurance quot-

[27] See Strombom, Buchmueller and Feldstein (2002) for another example of a death spiral resulting from a shift to a fixed dollar contribution policy.

[28] Employees may qualify for subsidies from the premium tax credit if ESHI is deemed unaffordable. See https://www.healthcare.gov/have-job-based-coverage/options/.

ing website run by CompuLife that provides life insurance quoting software to insurance agents.[29] The website uses age, gender, along with health and smoking status and matches the characteristics with insurance products currently on the market.[30] Using the raw scraped premiums from term4sale, Figure 3 compares the present value of premiums for a 20-year $250,000 policy purchased though the University to a comparable term policy for a healthy, non-smoking, female employee.[31] As shown, healthy employees may get a substantial discount by purchasing coverage through the individual market, which only increases with age. For example, a healthy 40-year old female employee working at the University could save $6,314 (64.5 percent of the cost of supplemental ESLI) by purchasing a 20-year $250,000 term policy rather than electing supplemental ESLI of equal face value for the next 20 years.[32]

To gauge the influence of the term market on adverse selection in the ESLI market it is important to understand the fraction of employees that face lower premiums in the term market. The University data does not have information on self-reported health or smoking status so I cannot directly obtain individual quotes through term4sale. Nonetheless, the University data contains information on race, education, and income level, which are highly correlated with smoking and health status. For example, comparing 40 year old individuals, 4.6 percent of those with a college degree, income greater than $75,000, that are female and non-white smoke whereas 66.8 percent of those that did not graduate from high school, with income less than $10,000, that are male and white smoke.

To leverage these correlations, I use data from the Behavioral Risk Factor Surveillance System (BRFSS) from 2006 to 2014, which contains information on all the metrics used on term4sale in addition to variables on race, education and income level (N=1.5 million). I run each surveyed individual from the BRFSS through term4sale to get premiums for individual term policies. I then take random draws of individuals from in the BRFSS within income, race, gender, faculty/staff, and 5 year age bins to assign term premiums to University employees of the same socioeconomic group. Looking at 20-year $150,000 term policies, with repeated simulations I find that 77.5 percent of University employees age 45 and younger in 2014 could have saved money by purchasing a term policy rather than ESLI. For these individuals who can get cheaper coverage by purchasing term life insurance, the average savings is $1,680 or 42.0 percent of the cost of ESLI. Furthermore, 43.4 percent

[29] A potential concern of using Internet pricing data is that not all consumers purchase life insurance online. However, a recent study shows that 71 percent of Americans report researching life insurance online http://www.limra.com/uploadedFiles/limra.com/LIMRA_Root/Posts/PR/_Media/PDFs/2015-LIAM-Fact-Sheet.pdf. Additionally, Brown and Goolsbee (2002) find that the advent of insurance pricing websites reduced term life prices (including off-line pricing) by 8-15 percent. Consequently, even if not all individuals use the Internet to purchase life insurance, offline premiums are highly correlated with online premiums.

[30] See appendix Figure A1 for a screen shot of the required fields from the website.

[31] Term life insurance is typically purchased for 10 to 30 year periods with 20-year policies being the most common. See http://www.iii.org/article/what-are-different-types-term-life-insurance-policies.

[32] Costs are reported in present value using a 3 percent discount rate.

could have saved more than $1,000 by purchasing a term policy rather than supplemental ESLI. Table 4 shows the proportion of University employees that could get cheaper coverage through the term market, conditional on term length and face value. As expected, as the face value increases the fixed costs associated with underwriting become less important making term comparatively cheaper per unit. Longer terms are only advantageous given that the term does not exceed normal retirement age when term life insurance become increasingly expensive. Overall, it appears that there are significant potential savings for a large portion of employees at the University from purchasing term life insurance rather than supplemental ESLI.

In addition to cheaper coverage, another advantage of term life insurance is the policy is only contingent on premium payments. In contrast, ESLI coverage is conditional on employment at the given institution. For example, if an individual has ESLI coverage but switches jobs, he or she will generally not be able to continue the same coverage.[33] If the new employment does not offer ESLI the individual will need to turn to the term market for coverage. If an individual purchases term coverage later in life (due to lapsing ESLI coverage) he or she is more likely to have some medical condition that triggers higher rates. Therefore, the conditional nature of ESLI should also influence employees to purchase term coverage rather than ESLI.

Even though there are significant potential savings depending on the employee's age, term of the policy, and face value, there are also higher fixed costs associated with term life insurance relative to supplemental ESLI. Supplemental ESLI has the advantage of payroll deductions, simplified choice set, and generally no medical underwriting. In addition, since supplemental ESLI is elected in multiples of income, coverage automatically adjusts for changes in salary. The implicit costs associated with determining the correct policy from a wide array of options, in addition to the inconvenience of medical exams and intrusive questions might be a rational justification for purchasing the simplified ESLI policy. Nonetheless, the significant savings from the term market have the potential to overcome these costs. Overall, the nature of ESLI in addition to the existence of the term market allows for significant adverse selection in the ESLI market.

V. Empirical Models

A. Positive Correlation Test

To determine the existence of adverse selection in the ESLI market, I use the commonly implemented positive correlation test (Cawley and Philipson, 1999; Chiappori and Salanie, 2000; Harris and Yelowitz, 2014; Finkelstein and McGarry, 2006; Einav, Finkelstein and

[33]As explained earlier, there are some options that allow employees to continue coverage, but they are more expensive and/or require a change in insurance type.

Cullen, 2010). The model tests if individuals that are more likely to use insurance are also more likely to purchase coverage. A positive correlation indicates either the existence of moral hazard or adverse selection. Moral hazard in life insurance is unlikely given the steep requirement to receive a payout along with policy exemptions for suicide.[34] Consequently, a "positive correlation" finding for supplemental ESLI is likely indicative of adverse selection.[35] The model is given by:

$$Supplemental\ ESLI_i = \beta_0 + \beta_1 ProbDeath_i + \beta_2 AgeBin_i + \beta_3 X_i + \varepsilon_i \tag{1}$$

where $Supplemental\ ESLI_i$ is one if they have any supplemental coverage and zero otherwise. $ProbDeath_i$ is the imputed probability of death from the CDC and ACS. $AgeBin_i$ is an indicator for individual i's age bin. By controlling for age bin, the specification compares individuals offered identical prices and allows for analysis within the risk class assigned by the insurance company (He, 2009; Einav and Finkelstein, 2011). Adverse selection resulting in increased premiums from a welfare perspective is only relevant for those individuals whose decision to purchase coverage or whose cost of coverage is influenced by an increased price due to adverse selection. In other words, the mortality risk of individuals that do not desire life insurance coverage even at actuarially fair premiums should not cause welfare loss. Therefore, following the work of Cawley and Philipson (1999) and Hedengren and Stratmann (2016) I include controls, X_i, for the main demand-side determinants of life insurance coverage: marital status and children.

B. *Welfare Estimation*

The positive correlation test is useful for identifying adverse selection but falls short of estimating the welfare consequences of asymmetric information. In addition, even after controlling for the main demand-side covariates, the positive correlation test still compares individuals that want coverage to those individuals that potentially have little need for life insurance. For example, even some employees without children might have need for life insurance and some low income employees with dependents might choose to rely on the social safety net rather than purchase supplemental ESLI.[36]

To overcome both of these limitations, I follow the work of Einav, Finkelstein and Cullen (2010) to estimate welfare loss from adverse selection in supplemental ESLI. Similar to other goods commonly modeled, quantity demanded for life insurance is a function of price. However, unlike traditional goods, the average cost faced by the insurance company is a function of the composition of purchasers and not just the quantity. Consequently, the

[34] Most life insurance policies exclude payouts from suicide within a specified time frame from purchase. At the University, the policy excludes payouts for deaths caused by suicide within 2 years of purchasing the policy.

[35] Inasmuch as moral hazard is present, it will bias the results toward finding more adverse selection.

[36] For example, Social Security Survivors Benefits.

average cost is also a function of the price. Einav, Finkelstein and Cullen (2010) show that a measure of welfare loss can be obtained in an insurance market if there is sufficient price variation to identify the demand and average cost curves. They further illustrate that estimates of the demand and average cost curves enable derivation of the marginal cost curve. Efficiency and equilibrium conditions under the assumption of perfect competition can then be derived using the estimated demand, average cost, and marginal cost curves.

The source of price variation used to identify both the demand and cost curves comes from age bins that determine premiums in the ESLI market at the University. Figure 4 shows the discontinuous prices that jump at 5-year increments for University employees. In contrast, both term premiums (experience rated) and probability of death increase smoothly with age. Therefore, the discontinuous jumps in ESLI pricing do not accurately reflect actuarial adjustments for a *one year* increase in age and can be used as exogenous price variation. For example, an individual that ages from 44 to 45 experiences a slight (almost negligible) increase in the probability of death whereas the ESLI premium increases by 50 percent. Ultimately, this test compares the average cost of the pool of employees that had coverage prior to the premium increase to the average cost of the endogenous sample of employees that have coverage following a premium increase.

For this analysis, I use employees that are employed continuously for 5 years around the premium change (2 years before, the year of, and 2 years after the price change). However, I exclude the observation for the year of the premium increase for the employee. The premium change goes into effect starting the month after the employee's birthday, elections only occur at the start of the fiscal year, employees may decrease coverage at any point in time, and the data is reported annually. All of these factors make it unclear whether employees who exhibit adverse selection should drop coverage in the year of the premium increase. For example, I include observations for employees who I see from age 48 to 52 but I omit the employee's observation at age 50. Given the small window, it is unlikely that there are other discontinuous changes to demand for life insurance other than the change through the premium.

The price changes allows for a simple approach to the demand estimation. All covariates, except age, such as gender, marital status, income, are orthogonal to the price change. Therefore, their inclusion should not affect the slope coefficient for the demand estimation. As well, Einav, Finkelstein and Cullen (2010) prescribe only using variables that are explicitly priced by the insurance company. With that in mind, the following fixed effects equation will be used to estimate demand for ESLI:

$$D_{it} = \beta p_{it} + \tau age_{it} + a_i + \varepsilon_{it} \tag{2}$$

where D_{it} is an indicator variable for having supplemental life insurance, p_{it} is the annual premium per \$1,000 in coverage, age_{it} is the employee's age, and a_i is the individual fixed effect. The model presented here uses the extensive margin—whether one has supplemental ESLI or not—as the measure of life insurance participation.[37]

To estimate the average cost curve, I use probability of death multiplied by the payout for the median policy (\$100,000). Ideally, the model could take into account the different levels of supplemental ESLI elections, but in order to be consistent with the demand estimation that looks at participation only (due to model limitations) I use the median level of coverage multiplied by probability of death for the average cost. Additionally, to verify that any increased average costs are not a result of increased probability of death from aging, I keep the probability of death metric constant across the 5 years surrounding the change. For example, the probability of death measure used is the same for a 44-year old employee and a 46-year old employee holding other characteristics constant. If not, merely aging two years would modestly increase the probability of death and would bias the results toward finding adverse selection.

The following equation relies on the same identifying assumption used in the demand estimation. However, in contrast to the demand estimation, the cost estimation includes only the endogenous sample of employees with supplemental ESLI. This allows the model to capture the change in average cost of the endogenously selected sample due to the change in premium. The model is given by:

$$C_{it} = \Gamma + \delta p_{it} + \lambda AgeBin_i + u_{it} \tag{3}$$

where C_{it} is the expected cost per individual with a supplemental life insurance policy of \$100,000 and p_{it} is once again the annual premium per \$1,000 in life insurance coverage. $AgeBin_i$ is a vector of indicator variables for the age bins surrounding the price changes. A positive δ indicates that as premiums increase, the average cost of remaining endogenous sample of life insurance holders has increased relative to the average cost of life insurance holders prior to the premium increase. A positive coefficient would therefore indicate adverse selection (the relatively unhealthy individuals are more likely to keep coverage with an increase in premiums). Changes in the composition of faculty/staff, race, gender, etc. are not controlled for, as these changes are what constitute the selection the specification is meant to estimate.

The estimated demand and average costs curves are given respectively by $D = \alpha + \beta p$ and $C = \gamma + \delta p$ where α is the average fixed effect plus $\tau \cdot E[age_i]$ and γ is defined as $\Gamma + \lambda * E[AgeBin_i]$. Given the demand and average cost curves, the marginal cost curve

[37]The framework does not support continuous measures of insurance. The assumption that individuals react by turning off coverage rather than reducing coverage seems reasonable given the relatively small cost of coverage. Of those that decrease coverage at the University, 48.0 percent completely turn off supplemental coverage. Therefore, this model does fail to capture the full influence of selection due to the changing premium.

can be derived as shown in Einav, Finkelstein and Cullen (2010) by the following expression:

$$MC(p) = \frac{\partial TC(p)}{\partial D(p)} = \frac{\partial (AC(p) \cdot D(p))}{\partial D(p)} = \left(\frac{\partial D(p)}{\partial p}\right)^{-1} \frac{\partial (AC(p) \cdot D(p))}{\partial p} \tag{4}$$

Substituting the estimated coefficients yields:

$$MC = \frac{1}{\beta}\left(\frac{\partial(\alpha + \beta p)(\gamma + \delta p)}{\partial p}\right) = \frac{\alpha\delta}{\beta} + \gamma + 2\delta p \tag{5}$$

Using the equilibrium condition $AC(p)=p$ with the estimated cost gives $P_{eq}=\gamma/(1-\delta)$ and consequently $Q_{eq}=\alpha + \beta(\gamma/(1-\delta))$. Equation (5) and the efficiency condition $MC(p)=p$ yield $P_{eff}=1/(1-2\delta)(\frac{\alpha\delta}{\beta} + \gamma)$ and consequently $Q_{eff}=\alpha + 1/(1-2\delta)(\alpha\delta + \beta\gamma)$.

Combining the equilibrium conditions gives the following equation that measures the efficiency cost due to adverse selection.

$$DWL = \frac{1}{2}(Q_{eff} - Q_{eq})(P_{eq} - MC(P_{eq})) = \frac{-\delta^2}{2(1-2\delta)\beta}\left(\alpha + \frac{\beta\gamma}{1-\delta}\right)^2 \tag{6}$$

VI. Results

A. *Positive Correlation Test*

Table 5 presents the results from the positive correlation test for the most recent year of data, 2014, for the University from equation (1). The main result is robust to performing the positive correlation test on other years. On the extensive margin, only controlling for age bin, the first column shows that a one standard deviation increase in probability of death is correlated with a 5.6 percentage point decrease in the probability of having supplemental ESLI, indicative of advantageous selection. However, after controlling for bequest motive proxied by marital status and having a child, the results provide evidence of adverse selection with a one standard deviation increase in probability of death being correlated with a 3.1 percentage point increase in the probability of having supplemental ESLI. This stark contrast in results across the two specification highlights the importance of including major demand side covariates. Similar qualitative results hold on the intensive margin estimated using a Tobit to account for individuals without any coverage as shown in the latter two columns of Table 5. Comparing the magnitudes of the coefficient on probability of death in columns (2) and (4) indicates that participation seems to be much more responsive to changes in probability of death than changes in multiples of coverage, which increases less than a tenth of a multiple for a one standard deviation increase in probability of death.

Given the complexities associated with financial planning, it is possible that more educated employees understand and are more likely to take advantage of the structure of ESLI. The first column of Table 6 illustrates that as probability of death increases by one standard deviation, faculty members are 16.6 percentage points more likely than staff to have supplemental ESLI controlling for bequest motive. The second column shows that this result is robust to including interactions of probability of death with different levels of salary, which indicates that the result is not just capturing differences in income. Similar results were obtained looking at the multiple of supplemental coverage as depicted in the last two columns of Table 6. Inasmuch as being a faculty member is correlated with financial literacy this finding is consistent with the literature on retirement planning (Hilgert, Hogarth and Beverly, 2003; Bernheim, 1998; Lusardi and Mitchell, 2007*a*). This result implies that even though faculty take advantage of the structure of supplemental ESLI, the overall effect of adverse selection is mitigated by staff not responding as much to higher risk of death with increased participation/levels of life insurance coverage. Consequently, the lack of individual underwriting implicitly benefits the more educated at the cost of those that do not take advantage of the policies. Therefore, increasing underwriting at the University would likely disproportionately benefit staff who are not as sensitive to the implications of increased probability of death.

B. Welfare Analysis

In order to gauge any welfare loss associated with adverse selection I apply the framework of Einav, Finkelstein and Cullen (2010) as previously described.[38] The first column of Table 7 gives the results for the demand estimation from equation (2). As shown, a \$100 increase in annual premiums results in a 2.5 percentage point decrease in supplemental ESLI participation. The inelastic response seems reasonable given the budget share associated with life insurance coverage and inertia from past decisions (Harris and Yelowitz, forthcoming a). The second column of Table 7 presents the results from estimating the average cost. The estimation implies that a \$100 increase in the annual premium causes the average cost per employee to increase by \$3.03. The statistically significant positive coefficient on premiums in the second column indicates adverse selection; as premiums increase, the endogenously decreased sample of insured employees has a higher average cost than before the premium increase.

Using the framework previously described, I use the demand and average cost estimation to determine welfare loss. The bottom panel of Table 7 and Figure 5 report the equilibrium and efficient prices and quantities using the framework of Einav, Finkelstein and Cullen (2010). As shown, the equilibrium quantity is only slightly less than the efficient quantity with a difference of only 2 percentage points. However, the equilibrium price of \$308 is

[38]Inefficiencies may also arise from advantageous selection which result in over-insurance where individual marginal cost exceeds willingness to pay (De Meza and Webb, 2001).

considerably higher than the efficient price of $230 due to adverse selection. While the difference between the efficient and equilibrium premiums are economically significant, the resulting welfare loss is economically insignificant at a cost of only $0.71 per employee per year. For comparison, Einav, Finkelstein and Cullen (2010) estimate the welfare loss of ESHI at Alcoa to be $9.55, which they describe as "quantitatively small." This result highlights the importance of moving beyond the standard positive correlation test in determining the influence of adverse selection in insurance markets.

VII. Discussion of Results and Further Tests

Given that the welfare analysis shows negligible losses due to adverse selection, the question remains as to why there is not a greater selection issue. A possible explanation for the lack of adverse selection is a negative correlation between risky behaviors and risk aversion (Anderson and Mellor, 2008). Cutler, Finkelstein and McGarry (2008) find that individuals that engage in risky behavior (smoking) are less likely to purchase term life insurance. In addition, they find that those that take part in preventative medical care and that always wear seat belts are more likely to purchase term life insurance. However, unlike ESLI, term life insurance is directly priced based on smoking status. Therefore, some of the relationship is likely caused by underwriting and rejection of risky applicants. Inasmuch as there is a negative correlation between risky behaviors and risk aversion, it could help explain the lack of adverse selection. Another likely explanation is that employees do not change life insurance elections in response to changes in health due to inertia lessening adverse selection (Handel, 2013; Harris and Yelowitz, forthcoming a).

Nonetheless, the guaranteed issue with ability to increase coverage and the existence of the individual life insurance market still has a great potential of causing debilitating adverse selection in the ESLI market. In this section, I directly examine these two mechanisms.

A. Anticipatory Responses to Death

As discussed, death can be a random event such as a car accident, but many deaths at the University are likely anticipated. How do employees react in the years preceding their own death? Although the University data is incomplete with regards to mortality of employees due to censoring, the data does contain information on 106 total observed deaths from 2006 to 2014.[39]

I analyze the response of full-time employees in the last year of life. Theory suggests that they should be more likely to increase coverage and also more likely to have the maximum face value allowed under guaranteed issue. Of the 106 employees that died for whom I

[39] I use data from 2006 and 2007 in this section in order to increase the sample size. These two years were excluded earlier due to a policy change that increased basic coverage starting in 2008 that could potentially confound the interpretation of the results for the demand estimation.

observe elections, only 10 had the maximum guaranteed issue amount of coverage. Of the 89 employees who died for whom I observe 2 years worth of elections, only 8 increase coverage in the last year of available increased coverage. Additionally, for the 69 employees that I observe 3 years worth of elections prior to death that were unconstrained by the guaranteed issue limit, none increased coverage consecutively for the last two year of available increased coverage.

Unsurprisingly, these 106 employees differ on observable characteristics, in particular age; average age was 52 for this group compared to 44 for the full-sample. To see if these elections differ from similar employees that did not die in the sample period, I estimate the average treatment effect using nearest neighbor matching (NNM) based on age, salary, race, employment position, marital status, children, gender, and year. The results, presented in Table 8 indicate that individuals that die are not more likely to have coverage, increase coverage in the last year, or have the maximum guaranteed coverage.

A possible reason for why individuals did not increase coverage is that death was unanticipated (accidental, sudden heart attack, etc.). However, as explained, there is a nontrivial number of employees that likely anticipated death. Another possible explanation is a moral objection to increasing deathbed coverage. Although this might apply to some individuals, it is likely that when faced with the decision of preserving profits for a multimillion-dollar corporation or leaving a sizable bequest to dependents, most employees would ramp up coverage.

Yet another possible explanation for the lack of employees ramping up coverage could be that they leave their employment when faced with life threatening illness. However, conditional on the employee physically being able to perform the job, the employee might continue employment because of financial need or health insurance.[40] To gauge the employment response prior to death, I turn once again to the HRS. I isolate individuals that passed away prior to age 65 that were employed 4-5 years prior to death (N=311).[41] Of those individuals, 76.4 percent were employed 2-3 years prior to death and 64.1 percent were employed in the last observation before they passed away. The main question is what proportion of the decreased labor force participation is due to anticipated death rather than the usual retirement process. Given that the average age of death for this group of working age individuals is 59.5, it is likely that a significant portion retired independent of anticipated death. To gauge to what extent anticipated death is the cause of the decreased labor force participation I split the sample based on the time from diagnosis to death. For individuals that had over a year from initial diagnosis to death 70 percent were employed

[40]Employees may continue health insurance coverage through the Consolidated Omnibus Budget Reconciliation Act (COBRA), but they forgo any subsidy provided by the employer for health insurance, which could significantly increase the cost of health insurance. Individuals may continue coverage for up to 18 months through COBRA. See https://www.dol.gov/sites/default/files/ebsa/laws-and-regulations/laws/cobra/COBRAemployee.pdf.

[41]The survey is conducted biennially hence the two year grouping.

in the last observation prior to death. For those that were diagnosed within a month of death, 64 percent were employed in their last year. This result indicates that individuals that anticipated death did not leave the labor force more than those that did not and if anything, they are more likely to remain employed. Therefore, even though it is feasible that individuals leave the employer and consequently do not increase life insurance coverage due to pending death, it does not appear to be the case, on average at least, for the limited sample analyzed from the HRS.

Perhaps the most likely reason for the lack of increase in the year preceding death is Accelerated Death Benefits (ADB).[42] As highlighted by Finkelstein and Poterba (2004) study of annuities, detailed features of insurance contracts are important for understanding adverse selection. ADB or "living benefits" allow employees with a terminal diagnosis to receive a portion of the life insurance payout prior to death in a lump sum payment. The remaining portion is paid to the beneficiary at the time of death. For the University, employees may receive up to 75 percent of the face value of the policy conditional on a life expectancy of less than a year.[43] These ADB are especially attractive for employees that have liquidity constraints, medical costs, and the loss of a bequest motive (Januário and Naik, 2013). Once an employee uses ADB, they forgo the option of increasing coverage prior to death consequently lessening adverse selection from anticipated deaths.[44]

Employees that are more liquidity constrained likely have lower incomes and are less likely to contribute to voluntary retirement accounts. Those that increased coverage in the last year of life voluntarily contributed to a 403(b) retirement account two years before death more than twice as often as those that did not. Additionally, those that increased coverage had average earnings two years before death that were $29,188 more than those that did not increase. Both of these findings are consistent with the explanation of ADB being used by those that are more liquidity constrained consequently precluding them from increasing coverage. For these comparisons, it is important to qualify that they are based on a small sample of deaths. Nonetheless, these findings are consistent with the idea that ADB lessen the anticipatory adverse selection that would occur otherwise. Ideally, the influence of ADB could be determined by comparing these adverse selection findings with results from a similar university with ESLI that does not offer ADB.

An alternative explanation is that increasing coverage in the last years of life is related to education and financial literacy. The employees for whom I observe elections in the

[42]A survey of twelve large providers of group life insurance indicates that ADB are very prevalent for supplemental ESLI. Over 80 percent offer coverage as a standard feature without an additional premium while the remainder offer it as an optional rider (Shah, 2005). In part, ADB are meant to reduce the lost profits resulting from the growth of the secondary market of life settlements. See Daily, Hendel and Lizzeri (2008) for a discussion on life settlements.

[43]At the University, an employee must be employed for 60 days and be certified as terminally ill with a life expectancy of less than a year. The employee must be insured for more than $20,000 and can request a maximum of $500,000.

[44]Once the beneficiary receives ADB, the structure of the insurance contract fundamentally changes. The individual no longer pays premiums for the policy and active work is no longer required for continued coverage.

last year of life are disproportionately staff likely originating from differences in underlying probability of death and relatively higher staff employment at the University. However, for faculty that I observe prior to death, 44 percent increased coverage in their last year of life whereas only 5 percent of staff increased ESLI coverage. This result is consistent with the earlier findings from the positive correlation test that faculty are more likely to exhibit adverse selection.

B. Market Interaction: Term and Supplemental ESLI

As discussed, another potential contributor of adverse selection in the ESLI market is the availability of the term life insurance market. The University data does not have information on term life insurance coverage. Therefore, to test the hypothesis that healthier individuals avail themselves of the term market (experience rated) in lieu of supplemental ESLI, I turn to a sample of federal employees from the SIPP. This sample is unique in that I can identify individuals who elected supplemental ESLI and those that elected individual term life insurance.

This secondary dataset is constructed using nine panels of the SIPP ranging from 1990 to 2008. The SIPP has been used in several recent studies on life insurance (Harris and Yelowitz, 2014, 2016, forthcoming a; Hedengren and Stratmann, 2016). While the survey does explicitly ask about ESLI coverage, it does not differentiate between basic and supplemental elections. Consequently, I cannot use the full SIPP sample to analyze who purchases term life insurance coverage rather than supplemental ESLI. Nonetheless, the survey does ask about employment through the federal government, which is the largest provider of ESLI in the United States. Information is readily available regarding the level of basic coverage for Federal Employees' Group Life Insurance (FEGLI). Consequently, supplemental ESLI participation may be inferred from the difference between total ESLI coverage and the basic amount provided for federal employees.[45]

FEGLI has several different options for ESLI. Employees are defaulted into basic life insurance coverage but they can choose opt-out of the coverage. Basic coverage is equal to 1x the employee's annual salary plus $2,000. The employer pays for one-third of the cost of coverage and the employee pays the remaining two-thirds equal to $0.33 a month for each $1,000 of your Basic Insurance Amount (BIA) for all federal workers except postal workers who receive the coverage free of charge. The employee's age does not affect the cost of basic insurance. However, employees under age 35 receive an "extra benefit" equal to double the BIA. This amount is linearly reduced until the employee is 45 and receives no extra benefit. The employee does not pay any additional premiums for the extra benefit essentially making basic coverage cheaper per unit for younger employees.

[45]This approach of identifying an individual employer within survey data has been done using the Panel Study of Income Dynamics (PSID) (Shea, 1995).

Federal employees have two options for supplemental coverage. Option A gives $10,000 in coverage with premiums based on 5-year age bins. Through Option B, employees may elect between 1x and 5x annual salary with premiums based on 5-year age bins similar to the structure of ESLI at the University. Presumably with the intent of curbing adverse selection, outside of a qualifying event or initial hiring employees may only change coverage during infrequent open seasons.[46] In addition, ESLI elections made during open seasons do not become effective until one year later. These two aspects should greatly reduce or eliminate adverse selection from employees with terminal illnesses increasing coverage prior to death. This is in contrast to the University's ELSI policy that allows for annual increases with quick implementation of increased coverage. Similar to University coverage, FEGLI coverage can be converted to whole life insurance policies after leaving employment. However, FEGLI is not portable (cannot continue group coverage after leaving). Also, in contrast to ESLI at the University, ADB are not available for supplemental life insurance for federal employees. This lack of ADB for supplemental ESLI from FEGLI, but with other protections from adverse selection, is consistent with the idea that the offering of supplemental ADB for University employees is meant to reduce adverse selection from anticipatory increases in coverage.

From the SIPP, there are 5,845 Federal employees between ages 18 and 64. Summary statistics are presented in Table 9. The sample is comparable in age and income with the University sample, but has a greater percent male. The sample also has more married individuals and more that have children possibly coming from the under representation in the University data as these metrics are inferred though elections for the University sample. The SIPP asks about total life insurance holdings, which in conjunction with total ESLI coverage gives total individual life insurance coverage. For the federal employees, 77 percent had some life insurance, 61 percent had ESLI, and 37 percent had individual life insurance. Given that employees are defaulted into ESLI coverage, reported participation in ESLI coverage seems low. As a benchmark, conditional on being offered ESLI, 80 percent of U.S. employees take up the coverage (LIMRA, 2015*b*). Federal employees, however, are defaulted into basic coverage, which should increase participation relative to the average U.S. worker. In contrast to most basic coverage, federal employees have to pay for the coverage, which could decrease participation. However, only 68.2 percent of federal postal workers—who do not have to pay for basic coverage—report having ESLI indicating that it is not just payment that lowers reported ESLI for federal workers in general. Another possible explanation for relatively low levels of reported ESLI coverage for federal employees is that many employees are ignorant that they are actually receiving coverage and consequently misreport in the survey.[47] Regardless, employees that actively elect supplemental coverage, who are the

[46] The most recent open seasons occurred in 1999, 2004, and 2016.

[47] LIMRA (2015*a*) found that 14 percent of full-time employees did not know if they had the option of ESLI.

focus of this analysis, should be much less likely to misreport ESLI coverage. For those that did report having life insurance coverage, 50 percent only had ESLI, 21 percent only had individual, and the remaining 28 percent had both types of coverage.

For comparability with the finding presented for University employees, I perform the positive correlation test on the sample of federal employees in the SIPP. The first two columns of Table 10 use imputed probability of death from the CDC and ACS as the main independent variable. The results show some advantageous selection in the specification that just controls for age bins used in pricing and then some evidence of adverse selection in the specification with controls for family structure consistent with the findings from the University sample. One advantage of the SIPP is that it has information on self-reported health, which is useful because it captures both knowledge of health status as well as individual interpretation (Bound, 1991; Wallace and Herzog, 1995). Additionally, this metric does capture idiosyncrasies that the probability of death metric misses. A priori, those individuals with a worse self-reported health status should be more likely to have supplemental ESLI coverage. The latter two columns of Table 10 show no evidence of adverse selection using this metric. Those with worse self-reported health status are not any more likely to elect supplemental ESLI than those in excellent health. Table 11 presents results for the intensive margin from the Tobit estimation with no evidence of adverse selection using both probability of death and self-reported health metrics after controlling for bequest motive.

Once again, for comparison purposes, I analyze the differential behavior of the highly educated federal employees in relation to lesser-educated employees. Table 12 shows results from specifications that interact probability of death with having a graduate degree. Consistent with the results from the regression that interacted faculty status with probability of death for the University, I find that federal employees with a graduate degree are more likely to have coverage and have more coverage as their probability of death increases relative to other employees.

With those preliminaries aside, the main reason for introducing the SIPP data is to test for substitution between term life insurance and supplemental ESLI. To do this, I further restrict the sample to federal employees that either elected supplemental ESLI or term life insurance.[48] Table 13 compares those that elect term coverage with those that elect

[48]Employees that selected both options account for 11.7 percent of employees with supplemental or term life insurance. These employees could represent individuals that had term coverage, had a negative health shock and then elected additional coverage through the employer. Alternatively, employees could have both types of life insurance to diversify their life insurance portfolio. Another possible option is that employees had the maximum allowed under ESLI and turned to the individual market to have the desired level of coverage even though the individual market had higher premiums. Given the structure of FEGLI, individuals are automatically enrolled in basic life insurance and have to actively opt out. Even though employees mostly pay for this coverage, inertia could cause employees to not opt out of basic coverage even though they elect term life insurance coverage. Consequently, I define extra coverage to be supplemental ESLI or term life insurance notwithstanding basic coverage technically being optional since employees pay for it.

supplemental ESLI. As shown, those who elect term life insurance are more educated and have higher earnings and net worth. In addition, the face value of the policy is larger for those that elect term life insurance possibly coming from insuring higher incomes.[49] However, there is no statistical difference between the self-reported health of the two groups.

The following model formally tests the hypothesis that individuals are less likely to have supplemental ESLI who face lower premiums in the term life insurance market.

$$(7) \qquad Term_i = \theta_0 + \theta_1 Risk_i + \theta_2 AgeBin_i + e_i$$

$Term_i$ is an indicator variable for having term life insurance rather than supplemental ESLI (since the sample only consists of those with supplemental ESLI or term life insurance). $Risk_i$ is probability of death, self-reported health, or the premium that the individual would face in expectation in the term life insurance market for a $250,000 20-year policy imputed using term4sale.com and BRFSS data.[50] The term premium is a metric that not only is a measure of the explicit cost of term life insurance, but it also captures the insurance company's assessment of risk for the individual. A negative coefficient for θ_1 would provide evidence for adverse selection originating from the option for term life insurance. In this specification, I just control for age bin (which corresponds to the pricing for supplemental ESLI). There is not a need to control for demand-side determinants since the sample is already constrained to individuals that purchased additional coverage.

The first column of Table 14 presents the results from estimating equation (7). The results in the first column indicate that term premiums do not significantly influence the decision to purchase term life insurance rather than supplemental ESLI.[51] For robustness, in the latter two columns I include estimations that use the constructed probability of death measure and self-reported health status respectively as the main independent variables. The results from these two specifications are consistent with the findings from the main specification.[52]

This result begs the question of why individuals do not take advantage of these potential savings. A possible explanation includes the lack of salience of term life insurance. A recent study found that 80 percent of Americans misjudged the cost of life insurance (LIMRA, 2015*a*). Other possible explanations include time costs and disutility associated with the underwriting including medical exams, extensive family history forms, and blood work. In

[49] See appendix Figure A2 for the distribution of additional coverage for federal employees.

[50] The measure is obtained by running the full BRFSS sample through the term4sale.com quoting system and then averaging the premium for each socioeconomic group determined by income bin, gender, race/ethnicity, education, age, and for later panels self-reported health status. This average is then applied to each federal employee within the socioeconomic group.

[51] For this specification I restrict the sample to panels 1996 to 2008 for whom there is self-reported health. This limits the measurement error associated with imputing self-reported health used by term4sale.

[52] These results are also robust to excluding employees with life insurance policies that exceed the maximum coverage available through FEGLI who might have selected term coverage because they could not elect the desired level of coverage through ESLI.

addition, ESLI represents a simplified decision in which employees typically only have to select a level of coverage. In contrast, the individual market choice set involves numerous types and variants of policies including type of coverage (term or whole), term length, face value, and insurance company.

Another potential reason why individuals do not purchase more term coverage is the complexity in comparing the products. Many individuals struggle to correctly answer even rudimentary financial questions (Lusardi and Mitchell, 2006, 2007*b*), which might cause them to incorrectly compare the two coverage options. The most common form of term life insurance is "level term," which has constant premiums for the life of the policy. Consequently, premiums are inherently front loaded because of inflation and the fact that individual risk increases with age. Therefore, a naive or myopic consumer might compare the premiums in the first year rather than comparing the present value of premiums for the entire policy. In many circumstances, this type of comparison would lead to the incorrect conclusion that supplemental ESLI is cheaper than term life insurance. As education increases, these types of errors could decrease. In Table 15, I interact having a graduate degree with the independent variable of interest. The specification that uses annual term premiums does not show adverse selection—those in better health purchasing term life insurance–among federal employees with a graduate degree. However, the specification that uses probability of death does indicate that federal employees with a graduate degree are less likely to purchase term life insurance (more likely to purchase supplemental ESLI) as there probability of death increases. Therefore, there appears to be adverse selection by highly educated federal employees coming from the available substitute of term life insurance, but the finding is sensitive to the specification.

One potential concern for this analysis is the timing of life insurance purchases. This analysis uses a cross-section, which might miss information. For example, individuals could have purchased term coverage at a younger age when they were healthy and could get a cheaper policy, yet when they appear in the sample, their health could have deteriorated. Ideally, I would restrict the sample to new federal employees that did not have life insurance coverage prior to taking the position to see if they elect term or supplemental ESLI. Nonetheless, sample sizes for federal employees in the SIPP are prohibitively small for such an analysis. Given the uncertainty of job duration and ESLI at a subsequent employer, an alternative explanation could be that employees in worse health have increased demand for stable coverage and consequently elect term coverage rather than supplemental ESLI. Regardless of the reason for the selection, there does not appear to be adverse selection in general coming from healthy employees purchasing term life insurance instead of supplemental ESLI coverage.

VIII. Conclusion

Supplemental ESLI provides a textbook example of a market that could have ruinous adverse selection. At the University analyzed in this study, premiums are community-rated, coverage is mainly guaranteed issue, individuals can increase coverage after a negative health shock, and there exists a competitive term life insurance market that offers lower premiums for the healthy. All of these features of supplemental ESLI should exacerbate adverse selection. Nonetheless, across several different tests for adverse selection, I do not find evidence of economically significant adverse selection in the supplemental ESLI at the University. Furthermore, I find consistent result analyzing a sample of federal employees.

Even though there is not significant adverse selection in general, across both the University and federal employee samples, highly educated individuals, faculty members or those with graduate degrees respectively, do exhibit adverse selection. This finding points to the importance of education and—inasmuch as it is correlated—financial acumen in the existence of adverse selection in ESLI. Another explanation for the lack of meaningful adverse selection in general in ESLI is the availability of accelerated death benefits (ADB), which allow families to receive payouts prior to the death of the breadwinner but precludes them from increasing coverage. Other possibilities include salience of term life insurance pricing, fixed costs, and complexities associated with evaluating different policies, employee inertia, and a negative correlation between risk aversion and actual risk.

Given that University ESLI is ripe for adverse selection and I do not find evidence of it in general, it is likely that other ESLI plans with features that discourage adverse selection also would not have significant adverse selection. The results also indicate that the educational composition of workers covered by ESLI is also important for determining the influence of adverse selection. For example, firms that primarily consisting of highly educated employees could potentially have significant welfare loss from adverse selection. However, these results are derived using a metric for probability of death that misses some idiosyncrasies in individual risk and likely attenuates the results. Nonetheless, the results hold when using measures of self-reported health and while directly observing the behavior of employees just prior to death, which gives credibility to the main findings. Furthermore, there continues to be widespread supplemental ESLI coverage despite the vulnerable nature of the coverage. This indicates that there are not sufficiently high levels of adverse selection in supplemental ESLI to unravel the market.

These results shed light on the effectiveness of contractual features designed to curb adverse selection in ESLI that are not modeled in most economic analyses. For example, federal employee life insurance, FEGLI, limits employees to electing coverage during rare open seasons likely to deter adverse selection. Given the results, these types of policies might be unnecessarily restrictive and lead to welfare loss for individuals that might want coverage merely due to changing preferences rather than because of negative health shocks.

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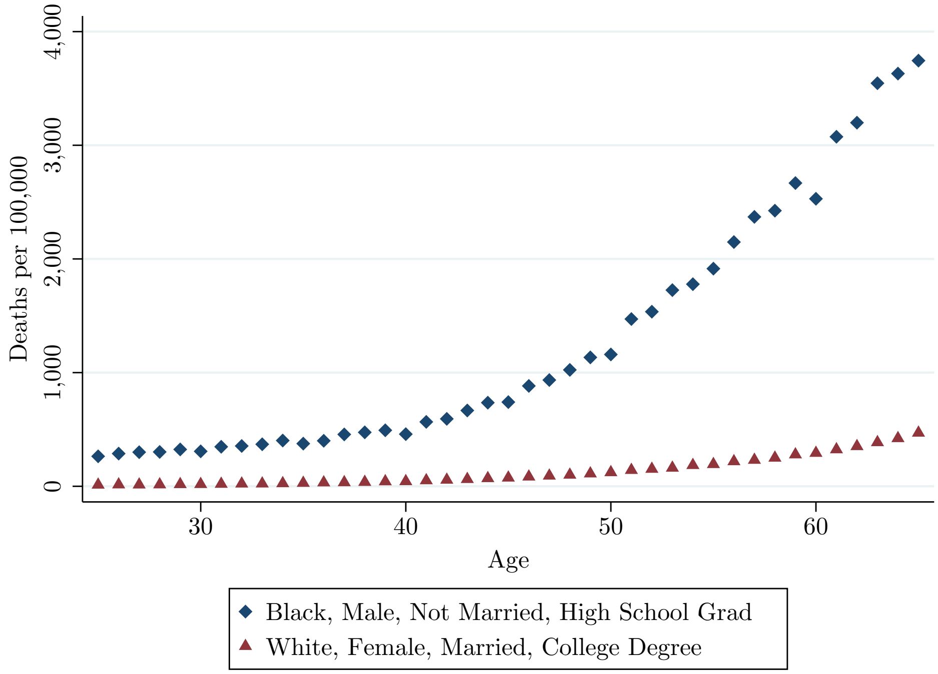

Figure 1. Heterogeneity in underlying probability of death

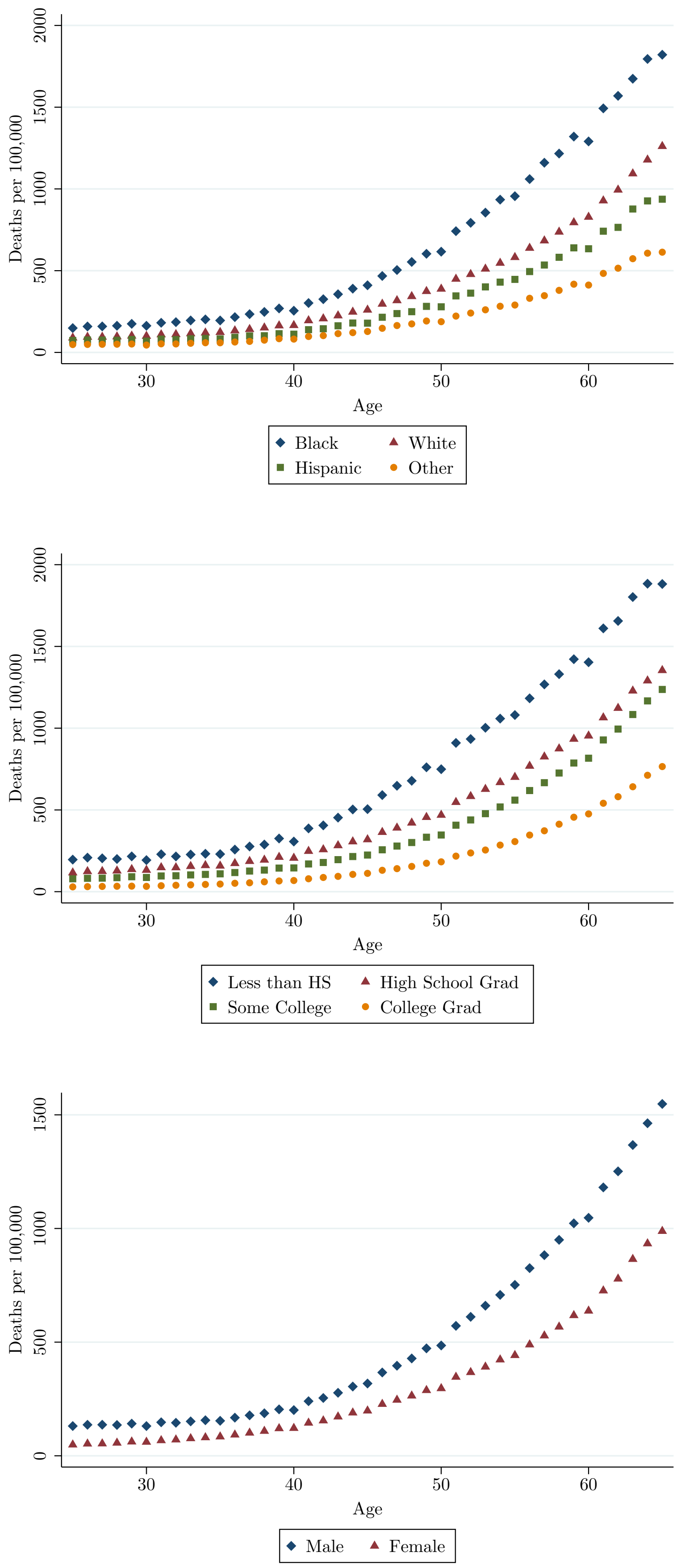

Figure 2. Heterogeneity in Probability of Death

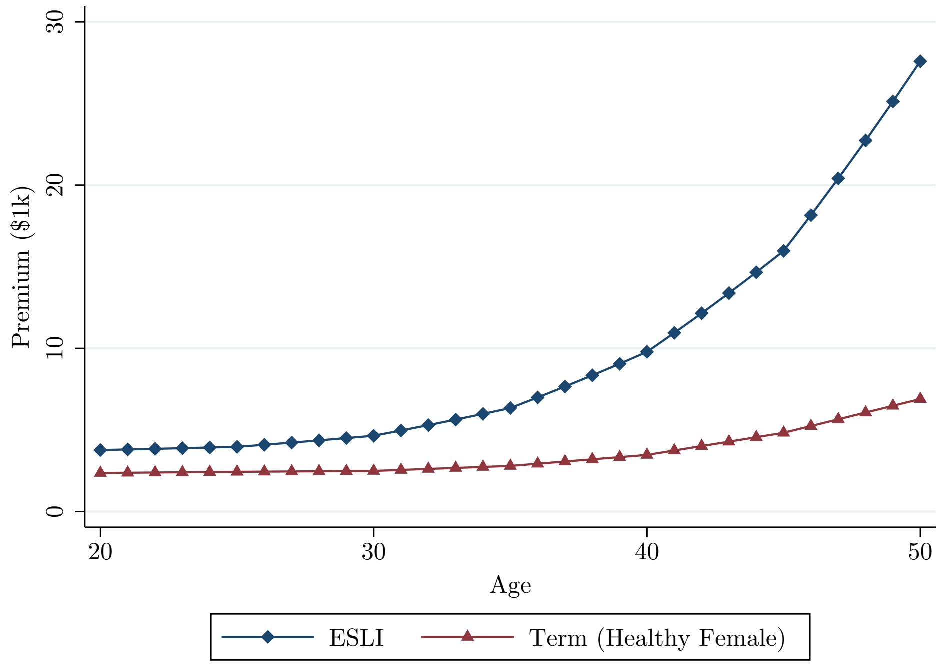

FIGURE 3. PRESENT VALUE OF PREMIUMS FOR A 20-YEAR $250,000 POLICY

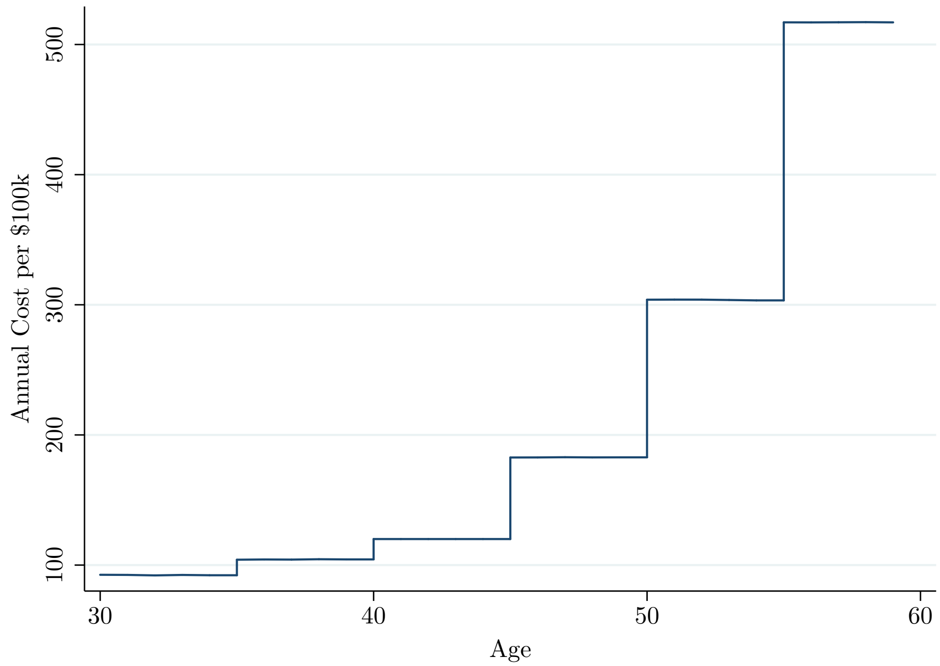

Figure 4. University Supplemental ESLI Premiums

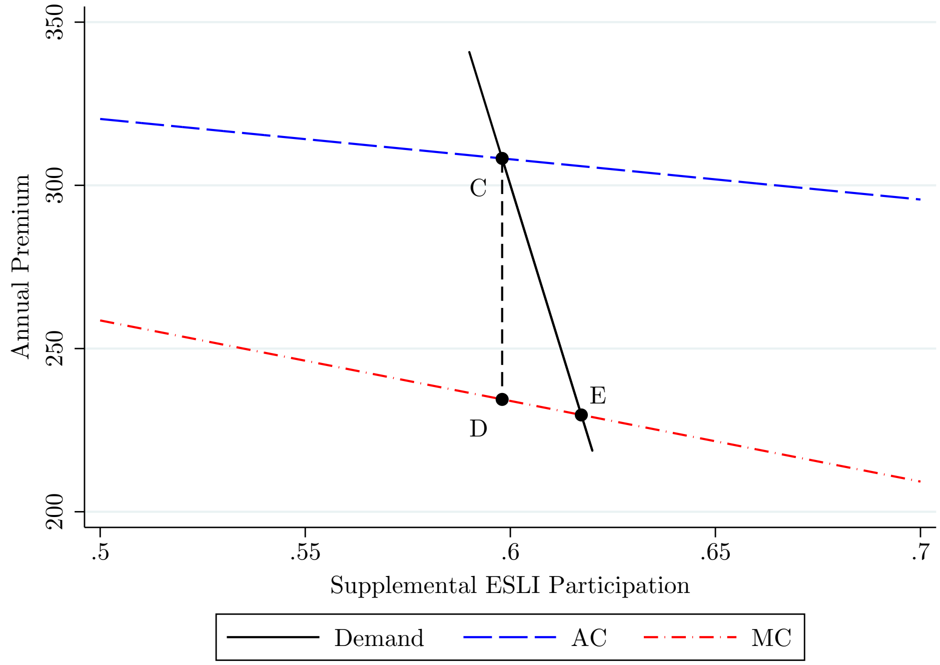

Figure 5. Life Insurance Selection

Table 1—Summary Stats-University Employees

	2008	2009	2010	2011	2012	2013	2014
Demographics							
Age	43.72	43.79	43.74	43.86	43.67	43.85	43.73
Male	0.37	0.37	0.37	0.37	0.36	0.37	0.36
White	0.86	0.86	0.86	0.86	0.86	0.86	0.86
Black	0.10	0.09	0.09	0.09	0.09	0.09	0.09
Other race/ethnicity	0.05	0.05	0.05	0.05	0.05	0.06	0.06
Family							
Ever Married	0.49	0.50	0.49	0.49	0.49	0.48	0.48
Has Child	0.47	0.48	0.48	0.49	0.49	0.50	0.49
Employment							
Faculty	0.16	0.16	0.16	0.16	0.16	0.16	0.15
Healthcare	0.27	0.36	0.38	0.38	0.40	0.40	0.42
Salary ($1k)	53.41	54.61	55.43	55.77	57.73	59.07	60.96
Supplemental ESLI							
Has Supplemental	0.56	0.54	0.52	0.51	0.50	0.49	0.48
Face Value if >0 ($1k)	140.24	146.81	148.48	151.08	155.75	159.25	164.84
Multiple if >0	2.56	2.63	2.63	2.66	2.67	2.69	2.68
Observations	12,023	12,509	13,112	13,210	13,581	13,630	13,720

Note: The sample includes full-time university employees age 18 to 64 from 2008 to 2014.

Table 2—Mean Comparison: University Supplemental ESLI Coverage

	No Supp. ESLI	Has Supp. ESLI
Demographics		
Age	41.86	45.76***
Male	0.36	0.36
White	0.85	0.87**
Black	0.08	0.09
Other race/ethnicity	0.06	0.05***
Family		
Ever Married	0.36	0.60***
Has Child	0.37	0.62***
Employment		
Faculty	0.16	0.14***
Healthcare	0.41	0.42
Salary ($1k)	60.54	61.43
Observations	7,160	6,560

Note: Sample consists of University employees in 2014. Indicators for statistical difference between means are given by *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 3—Simulated Adverse Selection from Cancer 2014

	(1)
Total payout (46 deaths) without time to adjust ESLI ($1)	3,159,946 (682,885)
Increased total payout from cancer deaths (12/46) if survive for:	
1 open enrollment ($1)	575,766 (112,056)
2 open enrollments ($1)	1,074,814 (175,509)
3 open enrollments ($1)	1,460,937 (235,713)
4 open enrollments ($1)	1,767,627 (288,021)
5 open enrollments ($1)	1,983,734 (326,717)
Total premiums collected in 2014	2,970,317 (.)
Increased total premiums from employees with cancer (475)	366,758 (15,723)

Note: The sample includes 13,720 employees aged 18 to 64 in 2014. Random sampling weighted by probability of death and probability of dying from cancer for each demographic group (age, race, gender, marital status, faculty/staff) were used to assign deaths. The hypothetical increase in payouts assumes employees will increase coverage until the guaranteed issue limit. Standard errors are shown in parentheses based on 1000 repetitions.

Table 4—Proportion of University Employees who could get term coverage cheaper

Face Value ($1k)	10-year	20-year	30-year
25	0.24	0.31	0.33
50	0.40	0.53	0.45
100	0.79	0.74	0.67
150	0.84	0.85	0.72
200	0.84	0.86	0.75
500	0.91	0.92	0.82
1000	0.93	0.93	0.83

Table 5—ESLI Positive Correlation Test: University Employees 2014

Dependent Variable:	Has Supplemental		Supplemental Multi.	
	(1)	(2)	(3)	(4)
Probability of Death (Z-score)	−0.056***	0.031***	−0.079***	0.057***
	(0.008)	(0.009)	(0.011)	(0.012)
Age 35-39	0.203***	0.117***	0.299***	0.205***
	(0.033)	(0.021)	(0.047)	(0.032)
Age 40-44	0.308***	0.202***	0.438***	0.322***
	(0.036)	(0.021)	(0.052)	(0.032)
Age 45-49	0.338***	0.215***	0.471***	0.329***
	(0.030)	(0.020)	(0.045)	(0.031)
Age 50-54	0.356***	0.213***	0.470***	0.294***
	(0.030)	(0.021)	(0.045)	(0.032)
Age 55-59	0.330***	0.154***	0.413***	0.181***
	(0.029)	(0.025)	(0.042)	(0.035)
Age 60-64	0.281***	0.056*	0.339***	0.030
	(0.035)	(0.032)	(0.047)	(0.042)
Ever Married		0.162***		0.255***
		(0.014)		(0.020)
Indicator for Children		0.153***		0.223***
		(0.012)		(0.015)
Model	OLS	OLS	Tobit	Tobit

Note: There are 13,720 observations for each regression. Standard errors are clustered at the demographic level used to match with CDC probability of death (age, gender, marital status, race, and faculty/staff) and are shown in parentheses *** p<0.01, ** p<0.05, * p<0.1.

Table 6—ESLI Positive Correlation Test, University Employees 2014: Faculty Interaction

Dependent Variable:	Has Supplemental		Supplemental Multi.	
	(1)	(2)	(3)	(4)
Probability of Death (Z-score)	0.027***	0.022	0.050***	0.030
	(0.009)	(0.020)	(0.011)	(0.025)
Probability of Death × Faculty	0.166***	0.169***	0.241***	0.252***
	(0.024)	(0.023)	(0.032)	(0.032)
Probability of Death × Salary < $25k		−0.025		−0.025
		(0.022)		(0.029)
Probability of Death × Salary $25k-$49k		0.014		0.034
		(0.018)		(0.024)
Probability of Death × Salary $50k-$99k		0.008		0.023
		(0.020)		(0.025)
Model	OLS	OLS	Tobit	Tobit

Note: Marginal effects for the tobit analysis are reported. There are 13,720 observations for each regression. Controls for age bin, marital status, and any child were included but not reported. Standard errors are clustered at the demographic level used to match with CDC probability of death (age, gender, marital status, race, and faculty/staff) and are shown in parentheses *** p<0.01, ** p<0.05, * p<0.1.

Table 7—Welfare Costs of Adverse Selection

Dependent Variable (sample)	1 if has supplemental ESLI (both with and without) (1)	Incremental cost (only with supplemental) (2)
Annual Premium ($100)	−0.025***	3.033**
	(0.003)	(1.380)
Age	0.010***	
	(0.001)	
Age 38-42		35.090***
		(5.995)
Age 43-47		129.986***
		(8.349)
Age 48-52		264.313***
		(11.043)
Age 53-57		432.958***
		(15.259)
Constant	0.208***	105.164***
	(0.045)	(4.510)
Obs.	15,088	9,354
Individuals	3,772	
Mean Dependent Variable	0.620	305.42
Competitive outcome (see Point C in Figure 5)		Q=0.598, P=308.24
Efficient outcome (see Point E in Figure 5)		Q=0.617, P=229.66
Efficiency cost from selection (triangle CDE)		0.71

Note: Sample 1 includes both employees with and without supplemental ESLI. Sample 2 is restricted to employees that endogenously choose supplemental ESLI. Both samples are further restricted to employees that were continuous employed for the year prior to the price change to at least one year after the price change. For example, for the price change associated with turning 50, an employee would need to be continuously employed from age 49 to 51 to be included. The price change occurs on the employees' birthday while elections occur at the start of the fiscal year. Consequently, we drop the observation for the individual in the year of the price change. Standard errors are shown in parentheses *** p<0.01, ** p<0.05, * p<0.1. We clustered at the individual level for the cost estimation.

Table 8—Response to death, Nearest Neighbor Matching

Dependent Variable:	Has Supplemental	Multiple	Increase Coverage	Max Coverage
ATE				
Last Year to Increase	0.046	0.068	0.031	0.036
	(0.059)	(0.154)	(0.039)	(0.023)
Obs.	90,889	90,889	73,796	90,889

Note: 1:3 nearest neighbor matching was used with matching on age, gender, year, salary, race, faculty status, main campus/healthcare, marriage, and children. Standard errors are clustered at the individual level and shown in parentheses *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table 9—Summary Stats SIPP-Federal Employees

	(1)
Demographics	
Age	41.15
Male	0.60
White	0.69
Black	0.16
Other race/ethnicity	0.15
Income	
Earned Income ($1k)	57.82
Household Net Worth ($1k)	192.18
Family	
Married	0.67
Has Child	0.60
Education	
Less than High School	0.03
High School Grad.	0.61
Bachelor's Degree	0.21
Graduate Degree	0.15
Health	
Excellent	0.36
Very Good	0.36
Good	0.23
Fair	0.05
Poor	0.01
Life Insurance	
Has Life Insurance	0.77
Has ESLI	0.61
Has Individual Life Ins.	0.37
If Life Insurance>0	
Basic	0.19
Basic+Supplemental	0.31
Basic+Individual	0.15
Basic+Supplemental+Indiv.	0.13
Individual	0.21
Value if >0	
Supplemental ESLI ($1k)	160.71
Individual Life ($1k)	169.44
Observations	5,845

The sample includes federal employees between age 18 and 64 from the SIPP. Monetary variables are measured in 2014 dollars.

Table 10—FEGLI Positive Correlation Test: Has Supplemental ESLI

	(1)	(2)	(3)	(4)
Probability of Death (Z-score)	−0.033***	0.023**		
	(0.011)	(0.011)		
Poor Health			−0.008	0.004
			(0.084)	(0.082)
Fair Health			−0.076**	−0.044
			(0.036)	(0.035)
Good Health			−0.048**	−0.039**
			(0.020)	(0.019)
Very Good Health			−0.031*	−0.029*
			(0.017)	(0.017)
Age 35-39	0.039	−0.018	0.015	−0.038*
	(0.029)	(0.026)	(0.023)	(0.023)
Age 40-44	0.082***	0.014	0.040*	−0.020
	(0.028)	(0.026)	(0.024)	(0.024)
Age 45-49	0.080***	−0.008	0.037	−0.022
	(0.030)	(0.028)	(0.023)	(0.023)
Age 50-54	0.068**	−0.047*	0.008	−0.050**
	(0.030)	(0.028)	(0.024)	(0.025)
Age 55-59	0.075**	−0.077**	−0.015	−0.079***
	(0.036)	(0.036)	(0.028)	(0.029)
Age 60-64	0.049	−0.157***	−0.031	−0.097**
	(0.047)	(0.049)	(0.038)	(0.038)
Married		0.279***		0.290***
		(0.019)		(0.020)
Widowed		0.039		0.074
		(0.049)		(0.066)
Divorced		0.132***		0.136***
		(0.023)		(0.027)
Has Child		0.020		0.012
		(0.014)		(0.016)

Note: The sample includes 5,845 federal employees between age 18 and 64 for each regression. The omitted category for self-reported health is Excellent. Panel fixed effects are included, but not reported. Standard errors are clustered at the demographic level used to impute probability of death and are shown in parentheses *** p<0.01, ** p<0.05, * p<0.1.

Table 11—FEGLI Positive Correlation Test: Supplemental Face Value ($1k), Tobit

	(1)	(2)	(3)	(4)
Probability of Death (Z-score)	−7.765***	2.511		
	(1.931)	(1.659)		
Poor Health			−3.709	−1.198
			(15.325)	(14.549)
Fair Health			−15.469**	−9.335
			(6.844)	(6.537)
Good Health			−10.919***	−8.943**
			(3.684)	(3.508)
Very Good Health			−6.355**	−5.626*
			(3.169)	(3.018)
Age 35-39	5.502	−3.445	1.616	−7.325*
	(4.969)	(4.400)	(4.302)	(4.177)
Age 40-44	13.096***	2.232	5.432	−4.250
	(4.929)	(4.487)	(4.440)	(4.324)
Age 45-49	15.360***	1.098	7.795*	−1.862
	(5.179)	(4.620)	(4.362)	(4.257)
Age 50-54	15.139***	−4.135	2.196	−7.127
	(5.360)	(4.805)	(4.482)	(4.418)
Age 55-59	13.105**	−11.933**	−6.476	−16.005***
	(6.441)	(5.724)	(5.044)	(4.930)
Age 60-64	11.858	−21.891***	−10.314	−19.809***
	(8.156)	(7.038)	(6.709)	(6.431)
Married		53.861***		60.709***
		(3.809)		(4.009)
Widowed		13.206		18.046
		(8.871)		(13.109)
Divorced		27.762***		29.217***
		(4.338)		(5.276)
Has Child		4.141*		3.268
		(2.341)		(2.839)

Note: Marginal effects for the Tobit analysis are reported. The sample includes 5,845 federal employees between age 18 and 64 for each regression. The omitted category for self-reported health is Excellent. Panel fixed effects are included, but not reported. Standard errors are clustered at the demographic level used to impute probability of death and are shown in parentheses *** p<0.01, ** p<0.05, * p<0.1.

Table 12—FEGLI Positive Correlation Test: Graduate Degree Interaction

Dependent Variable:	Has Supplemental (1)	Supplemental ($1k) (2)
Probability of Death (Z-score)	0.022**	2.366
	(0.011)	(1.683)
Prob. of Death × Graduate Degree	0.071***	12.903***
	(0.027)	(4.658)
Age 35-39	−0.016	−3.040
	(0.026)	(4.424)
Age 40-44	0.015	2.536
	(0.026)	(4.603)
Age 45-49	−0.009	1.073
	(0.028)	(4.662)
Age 50-54	−0.052*	−4.963
	(0.028)	(4.816)
Age 55-59	−0.087**	−13.654**
	(0.035)	(5.631)
Age 60-64	−0.175***	−24.698***
	(0.048)	(6.720)
Married	0.283***	54.543***
	(0.019)	(3.784)
Widowed	0.038	12.687
	(0.049)	(8.857)
Divorced	0.131***	27.453***
	(0.023)	(4.317)
Has Child	0.018	3.881*
	(0.014)	(2.321)
Model:	OLS	Tobit

Note: Marginal effects for the Tobit analysis are reported. The sample includes 5,845 federal employees between age 18 and 64 for each regression. Panel fixed effects are included, but not reported. Standard errors are clustered at the demographic level used to impute probability of death and are shown in parentheses *** p<0.01, ** p<0.05, * p<0.1.

Table 13—Source of Life Insurance Comparison

	Supplemental ESLI	Term Life Insurance
Demographics		
Age	40.39	44.33***
Male	0.74	0.57***
White	0.72	0.71
Black	0.16	0.15
Other race/ethnicity	0.12	0.14
Family		
Married	0.78	0.75
Has Child	0.64	0.60
Finances		
Earnings ($1k)	60.59	68.99***
Net Worth ($10k)	16.02	27.85***
Education		
No High School Diploma	0.01	0.02
High School Grad.	0.65	0.54***
Bachelor's Degree	0.20	0.24*
Graduate Degree	0.14	0.19***
Health		
Excellent	0.40	0.37
Very Good	0.34	0.37
Good	0.22	0.21
Fair	0.04	0.04
Poor	0.00	0.01
Life Insurance		
Extra Life Ins. Face ($1k)	136.78	166.35***
Observations	901	738

Note: Sample consists of Federal employees from the 1990 to 2008 panels of the SIPP. Monetary units are measured in 2014 dollars. Indicators for statistical difference between means are given by *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 14—Market Interaction Analysis, Dependent Variable: Has Term Life Ins.

	(1)	(2)	(3)
Annual Term Premium ($100)	−0.014		
	(0.009)		
Probability of Death (Z-score)		−0.015	
		(0.018)	
Excellent Health			−0.116
			(0.186)
Very Good Health			−0.122
			(0.186)
Good Health			−0.165
			(0.186)
Fair Health			−0.182
			(0.197)
Age 35-39	0.101**	0.078*	0.099**
	(0.046)	(0.042)	(0.045)
Age 40-44	0.141***	0.101**	0.130***
	(0.046)	(0.042)	(0.045)
Age 45-49	0.170***	0.120***	0.142***
	(0.049)	(0.044)	(0.043)
Age 50-54	0.228***	0.124***	0.170***
	(0.062)	(0.044)	(0.046)
Age 55-59	0.322***	0.205***	0.231***
	(0.086)	(0.054)	(0.053)
Age 60-65	0.461***	0.299***	0.296***
	(0.136)	(0.084)	(0.075)
Obs.	1,269	1,639	1,269

Note: The sample includes federal employees that elected either supplemental ESLI or individual life insurance. The omitted health category is Poor. Non-reported covariates include panel fixed effects, and age. Columns (1) and (3) are restricted to panels 1996 to 2008 that contain self-reported health metrics. Standard errors are shown in parentheses *** $p<0.01$, ** $p<0.05$, * $p<0.1$ and are clustered at the demographic level used to impute annual term premium and probability of death respectively for specification (1) and (2).

Table 15—Market Interaction, Graduate Degree Effect; Dependent Variable: Has Term Life Ins.

	(1)	(2)
Annual Term Premium ($100)	−0.014	
	(0.009)	
Annual Term Premium × Graduate Degree	−0.002	
	(0.007)	
Probability of Death (Z-score)		−0.010
		(0.018)
Prob. of Death × Graduate Degree		−0.184***
		(0.051)
Obs.	1,269	1,639

Note: The sample includes federal employees that elected either supplemental ESLI or individual life insurance. Non-reported covariates include age bin and panel fixed effects. Columns (1) is restricted to panels 1996 to 2008 that contain self-reported health metrics. Standard errors are shown in parentheses *** p<0.01, ** p<0.05, * p<0.1 and are clustered at the demographic level used to impute annual term premium and probability of death respectively for specification (1) and (2).

Appendix

Table A1—Probability of Death Mean Comparison by Self-reported Health

	Mean (x100)	s.d.	N
Excellent	0.18	0.26	110,682
Very Good	0.25	0.34	130,892
Good	0.37	0.45	97,923
Fair	0.57	0.63	35,584
Poor	0.74	0.72	13,685

The sample includes individuals between age 18 and 64 from the SIPP.

FIGURE A1. TERM4SALE

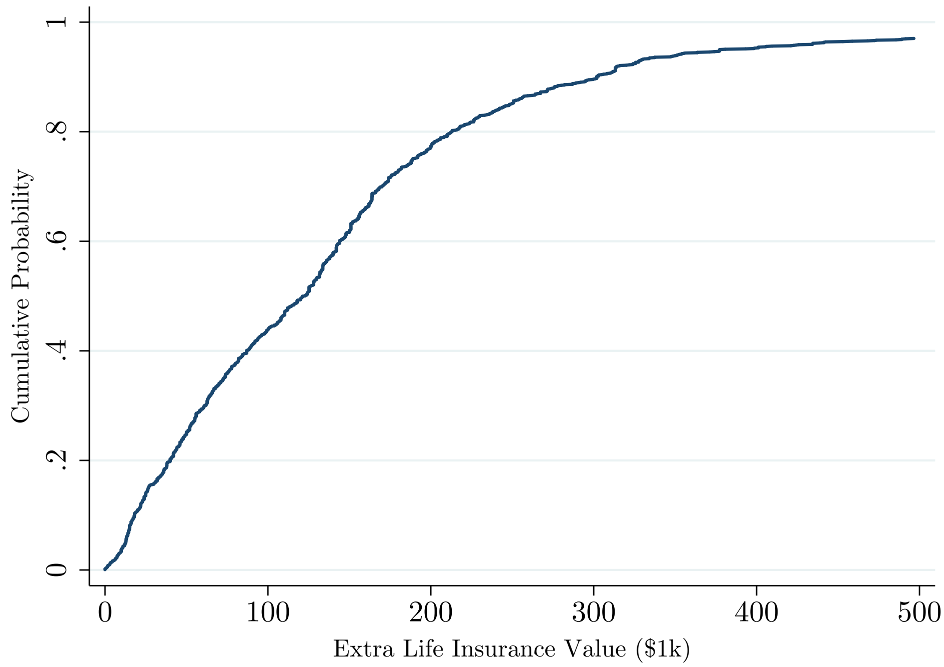

Figure A2. Federal Employees: CDF of Extra Coverage (either supplemental ESLI or Term)