Mind the Gap – Assessing the Size and Determinants of the Life Insurance Gap*

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Abstract

Preparing for the monetary loss associated with premature death of the breadwinner has become more relevant during the COVID-19 pandemic. However, very little is known about how much of the financial vulnerabilities are covered by the life insurance holdings in different population groups. We employ unique individual-level life insurance data of the Finnish population to study the voluntary life insurances, the components of financial loss following from a death of a breadwinner, and the gap in death cover (life insurance gap) calculated as the difference of the two. We find that only about 10% of Finns have a voluntary term life insurance, and that they are concentrated on married people, people of working age and with higher income. The largest insurance gaps are among young individuals, men, high income and highly educated people. We also find that the observed insurance behavior is poorly explained by the net losses following from a death.

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1 Introduction

Preparing for the monetary loss associated with premature death of the breadwinner has become more relevant during the COVID-19 pandemic. The increased mortality risk has caused many individuals to consider the adequacy of their life insurance (Wood et al. 2022). However, assessing the needed life insurance protection is not easy. Households are protected against financial losses due to the death of a family breadwinner by both social insurance and voluntary life insurance policies. The insurance coverage needed to maintain the previous standard of living depends, among other things, on the age and income of the breadwinner, the net wealth of the family, as well as on the number of children living in the household and their ages. For example, in the case of the death of a young breadwinner, the lost future income, as well as the number of dependent children are typically greater than in the case of an older breadwinner.

This paper employs unique individual-level data to study the voluntary life insurances of Finns, the amount of financial loss following from a death of a breadwinner, and the gap in death cover (life insurance gap) calculated as the difference of the two. The life insurance gap indicates how much insurance is needed, in addition to any current policies, to maintain the *standard of living* of the widow and children at the level preceding the breadwinner's death. Earlier study by Bernheim et al. (2003) uses the same type of individual data to study the matching of insurance needs and insurance coverage in the United States. Compared to their use of the HRS survey data, we can also analyse the insurance gap in younger households.

A previous life insurance gap study in Finland (Kari et al. 2007) showed that the average insurance gap in Finland is large. On the other hand, it is known from studies concerning other countries that life insurance purchases and the compensation amounts often do not coincide with the insurance need at the micro level. In this study, we use unique individual and family-level data with information on the family's and the insured person's net income, the protection provided by social security for the widow and children, income taxation and the family's voluntary life insurances. For net wealth, we use age-specific averages from aggregate statistics. A key objective is to examine whether there are differences between population groups in the life insurance gap and both the take-up and the amount of life insurance, for example, by age, gender or family size. The study employs individual-level life insurance data[1], which were combined with background information covering the insured and the entire population of Finland[2]. The period analysed is 2018–2020.

The high quality of our data allows us to measure the life insurance gap including several margins that together determine the size of the gap. We also show the contribution of each of the margins to the gap, which enables to consider also possible different measures, depending on which of the losses following from a breadwinner's death are sought to be covered with the insurance. While the narrowest metric measures how large percentage of the Finns has a voluntary term life insurance, the broadest one tries to account for not only changes in household after-tax income and consumption, but also other factors related to the amount of the insurance gap, such as social insurance compensations and net wealth. Our study thus deepens the knowledge about the components of the insurance gap, albeit the more broadly the gap is defined, the more difficult it becomes to measure precisely.

Our results reveal some clear differences by population groups in the frequency of taking out insurance, in the amount of insurance, in the losses following from a death, and in insurance gap formed through these losses and the insurances that provide protection against them. Based on our results, voluntary term life insurances cover on average only a fraction of the losses following from a death, and the insurances are not typically taken at the early age. Overall, the need for life insurance poorly explains the size of life insurance in the data.

It is worthwhile to relate our findings to the previous literature. The underlying theoretical models build on the idea of forward-looking families smoothening their lifetime consumption with labour supply and saving. Insurances increase welfare of the risk averse individuals and help to make the optimal lifetime plans. However, standard life-cycle modelling,

[1] *The data were provided by Finnish life insurance companies to Statistics Finland for this study.*

[2] *For privacy protection reasons, the researchers used pseudonymised data by means of remote access to Statistics Finland.*

such as Chambers et al. (2011), tends to argue that, compared to the observed behaviour, consumption smoothing would require, on average, larger life insurance policies and insurances should be taken out earlier in the life cycle. Our empirical results, based on individual-level Finnish data, are in line with these observations.

Various explanations can be found for the inconsistency. Hambel et al. (2016) aims to explain the late purchases of insurances by introducing long-term contracts and health risk in the model. Other adverse economic conditions (such as health shock) may result in a lock-in to an unfavourable insurance deal and lower the willingness to have the insurance in the first place. On the other hand, alternative behaviour patterns, such as prospect theory (Gottlieb, 2012) and time inconsistency (Zhang et al., 2021) have also been raised as an explanation for unexpected insurance demand. Coe et al. (2016) investigate other forms of limitations of thinking related to people's choices that may explain insufficient life insurance take-up.

Our findings suggest that the reasons may be informational. The analysis shows that highly educated people tend to be more insured against the potential losses of income, even after controlling for other factors. Moreover, the life insurance premiums tend to be very small at young age because of the low mortality risk, thus arguing against affordability of the insurances as a reason for the late take-up.

Typically, theoretical models predict that the demand for term life insurance will decrease as wealth increases. This is because there are fixed costs associated with insurance, which can be avoided by precautionary saving. However, when Gropper and Kuhnen (2021) studied the coverage of term life insurance policies with US register data, they found that their ownership is strongly positively correlated with wealth. We confirm this pattern in the Finnish case. A person with a higher income is better able to afford the insurance and there is greater loss of income when the insured person dies, which seems to overcome the effect of the fixed costs. The link observed in our study between the number of dependent children and the higher sum insured is also confirmed by other empirical studies.

Interestingly, the propensity for men to protect against the income losses due to death is higher than that of women, even after controlling for differences in other background variables. Differences in the propensity across sexes may reflect differences in life expectancy among other things, despite the fact that Kutlu-Koc and Kalwij (2017) found that especially women, on average, underestimate the length of their lifespans. Correspondingly, however, Luciano et al. (2016a) show that women in Italy have fewer insurance policies even when the effects of other factors are controlled.

The structure of the paper is as follows. The follow-up section briefly reviews the central results in the economic literature related to the insurance market[3]. Section 3 describes the Finnish life insurance market and the death cover provided by the social security system. Section 4 describes the life insurances, the losses following from a death of a person and the life insurance gap. Section 5 studies econometrically the relationship between the persons' characteristics and the life insurance gap. Section 6 draws the conclusions.

2 Life insurance in research literature

This section reviews briefly the relevant literature on life insurance markets and the few key studies that have previously analysed the life insurance gap. We start with the factors that explain the demand for the insurances – a topic that has got a lot of attention. Three types of research papers were found: the ones that use the life-cycle model as the framework explaining the behaviour, the empirical work that challenges some of the predictions of this framework, and the studies that use behavioural economics and imperfect information as a starting point. We also discuss the implications of asymmetric information related to the individual's mortality probability on the supply and prices of life insurances.

[3] *As a justification for the brevity of the description, we use a statement from more distant history: "There is no possibility of illustrating a subject so wide as life insurance in its application to all grades and classes of society, and so various in its forms of procedure, motives, and plans, within the space of a moderate article" (Wright 1886).*

2.1 Factors influencing the demand for life insurance

The basic life-cycle model claims that forward-looking families smoothen their lifetime consumption with labour supply and saving. Insurances increase welfare of the risk averse individuals and help to make the optimal lifetime plans.

Chambers et al. (2011) builds an overlapping generations model to study the family consumption smoothing through life insurance. The model is calibrated to US data, and it includes households that face not only mortality risk but also the risk of loss of wage income. The main result of the model simulations is that consumption smoothing of a couple requires life insurance policies that are approximately twice as large compared to the actual levels shown by insurance statistics. In addition, insurances should be taken out earlier in the life-cycle. The simulations also show that the income differences of a couple are more important for men's greater demand for life insurance than the differences in life expectancy between the spouses.

Wang (2019) builds a corresponding stochastic partial-equilibrium, life-cycle model with lifetime and earned income risk with a considerably more detailed family structure. The model predicts that increased risk aversion, more children, higher incomes, and lower margins of insurance companies will increase the demand for life insurance. Also, the correlation of the couple's wage income shocks influences the take-out. Hambel et al. (2016) aims to explain the late purchases by introducing long-term contracts and health risk in the model. In a young household, the loss of income following from the death of a breadwinner would be large, but the health shock would lower the income and reduce the optimal size of the policy. There are, however, costs in reducing the sum insured or surrendering the policy, and new insurance will be more expensive due to the increased probability of death. Therefore, life insurance is less attractive to the young than to older people, whose income risk is lower and who have a shorter policy period of validity.

Results of statistical studies show some inconsistencies with the predictions of welfare-maximizing life-cycle models. Theoretical models predict that the demand for term life insurance will decrease as wealth increases. This is because there are fixed costs associated with insurance, which can be avoided by precautionary saving. However, when Gropper and Kuhnen (2021) studied the coverage of term life insurance policies with US register data, they found that their ownership is strongly positively correlated with wealth.

Li et al. (2007) studied the demand for life insurance statistically using panel data on OECD countries. According to the results, a country's higher level of education, higher disposable income and number of children are associated with larger average life insurance premiums paid per capita. The result is justified in the study by two factors: A person with a higher income is better able to afford the premiums and there is greater loss of income when the insured person dies. The same need for protection also explains the effect of the number of children increasing insurance premiums. The impact of education on demand can come through several channels. It improves knowledge about insurance needs and insurances and is also connected to foresight and higher incomes.

According to the study, a general decrease in the probabilities of death at working age reduces the need for life insurance, as does the coverage of social security. The competitiveness of the insurance market and the general sophistication of the financial market also increase average insurance premiums according to the study. On the other hand, higher expected inflation and higher real interest rates reduce the demand for insurance[4]. A more recent, non-peer-reviewed study of OECD countries (Tynjälä 2019) supports these results regarding the effects of income, life expectancy and interest rates. In addition, it is observed that larger income differences increase the premium income of life insurance in a country.

[4] *The channel of influence of interest rates is not clear-cut. The study interprets higher returns as enabling the achievement of the savings goal with lower premiums. Alternatively, a high level of interest may be a sign that future consumption is valued less compared to the present and therefore the negative significance of current premiums is emphasised in relation to a possible future loss of income.*

Risk aversion should increase the demand for life insurances[5]. However, Luciano et al. (2016a) shows that women in Italy have fewer insurance policies even when the effects of other factors are controlled. Nam and Sherman (2018) studied single-adult households in the United States and finds that higher risk aversion reduces the demand for term life insurances, but increases cash value life insurance policies. According to the researcher's interpretation, it is difficult to find a rational explanation for the choices, because the income risk is greatest in a single-adult family. Eling et al. (2021) studied the connection between the willingness of people over the age of 50 to take financial risk and long-term insurance in 14 European countries. This study also found a positive link between the desire to take risks and the take up of life insurances. It was stronger for cash value life insurance policies than for term life insurances. According to a study by Hedengren and Stratmann (2016), people with either a high subjective risk of premature death or premature death observed in registers have fewer life insurance policies in the United States.

The surprising results mentioned above have increased the interest in studying alternative[6] behaviour patterns as explanations for insurance demand. One of the premises of *prospect theory* is that losses reduce welfare more than gains of the same amount. People are ready to pay a lot and give up uncertain large gains in order to avoid the realisation of losses. From this point of view, life insurance is interpreted as a risky investment, the return of which is measured by whether the compensations received are at least as large as the premiums paid. Applied to life insurance, the behaviour leads to people having too low life insurance protection at working age and excessive coverage at retirement age (Gottlieb 2012).

According to that theory, underinsurance at a young age is explained by the fact that the compensation from death is unlikely and risky, but the loss in the form of a paid premium is certain. As person gets older, he/she gradually comes to a situation where he/she has been paying insurance premiums for a long time without receiving compensation. To avoid the realisation of the accumulated "loss" from the paid premiums, the sum insured is increased even when the premium is already high.

Another exception to rational behaviour is the inconsistency related to time. It is often modelled using a *hyperbolic discount rate* that decreases over time. In practice, this means that people value current consumption highly relative to near-term future consumption, but at the same time think that they will be less impatient in the future[7]. Zhang et al. (2021) models decision-making in which individuals who are aware of their inconsistent behaviour save a lot, in which case life insurance is not needed to protect inheritances. Individuals unaware of the inconsistency purchase life insurance policies. In Koo's and Lin's (2021) model, hyperbolic discounters own fewer life insurance policies than time-consistent individuals, regardless of preference awareness.

Coe et al. (2016) used surveys to investigate the existence of limitations of thinking related to people's choices that explain insufficient life insurance take-up. According to the results, insurance coverage is generally considered necessary, but people do not want to spend a lot of energy on the purchase decision or its subsequent reevaluation (*status quo bias*). They are usually not able to calculate the amount of death cover needed, and for almost half of the respondents, the need is determined by how much is left over after expenses deemed essential. Those who tried to calculate the need often used as a rule of thumb that the compensations can be used to pay off the mortgage in the event of death (*mental accounting*). The extent of the insurance need can also be underestimated because the compensation is received as a lump sum, even though the loss of income is long-term (*money illusion*). Some respondents determined the insurance amount through

[5] *Risk aversion is often described as a property of the utility function, according to which people value certain future income more than the expected value of risky income of the same amount. On the other hand, risk aversion is connected to many socio-demographic factors. However, according to Outreville's (2014) literature review, previous research has only shown a link between risk aversion and these explanatory variables, not their causal relationship.*

[6] *This refers to people as rational decision-makers who always choose the option that maximises expected utility.*

[7] *Enke and Graeber (2021) show that the complexity of the decision-making environment increases people's short-sightedness. An informed decision to purchase life insurance, which requires foresight, calls for, in addition to evaluating one's current financial situation, anticipation of future income and knowledge of the support provided by social insurance in the event of the death of a family breadwinner.*

the monthly premium by keeping to an easily understandable point of comparison, such as the amount of a coffee shop bill, as the upper limit of the premium (*anchoring*).

Deviating from rational behaviour can also be due to potential policyholders being unable to make informed purchase decisions due to missing information. An example of this is mortality expectations. Kutlu-Koc and Kalwij (2017) found that people have better knowledge of individual probabilities of death than can be inferred from health-related information. On the other hand, the same study shows that especially women, on average, underestimate the length of their lifespans. One possible explanation may be that individuals predict their mortality using the observed life spans of the current old population. As long as mortality decreases in a trend-like manner, life expectancy calculated on the basis of annual mortality significantly underestimates the expected lifespan of the birth cohort (Myrskylä 2010). People's *financial literacy* has also often been linked to insurance take-up. Luciano et al. (2016b) and Lin et al. (2017) show that better financial literacy increases life insurance ownership.

2.2 Supply of life insurances and the life insurance market

The central problem of the life insurance market is that the policyholder knows their own life expectancy better than the insurance company. In the insurance market, this should be reflected in those with a higher risk of premature death having larger insurance policies. In that case, the logical reaction of the insurance companies would be to increase the price of the insurance as the sum insured increases. At the same time, however, it should be possible to prevent the taking out of several smaller insurance policies for the same person. Cawley and Philipson (1999) showed that these predictions of theoretical asymmetric information market models do not hold in the US life insurance market. The sums insured of high-risk individuals are smaller, the prices of insurances decrease as the sums insured increase, and it is possible to take out several life insurance policies.

A study by He (2009) examines potential new policyholders and finds a positive correlation between purchasing insurance and subsequent death when the person's *risk classification* is taken into account. This points specifically to the person having more detailed information about their own condition than the insurance provider. He (2011), in turn, observes adverse selection in that lower-risk individuals surrender their insurance more often than higher-risk individuals.

On the other hand, in a study by Hedengren and Stratmann (2016), an individual's higher risk of premature death reduces the likelihood of purchasing term life insurance in the United States. The authors point to the possibility of positive selection; risk averse individuals both take out insurances and reduce the possibility of harm by their behaviour. It is also possible to direct demand with price discrimination that emphasises risks to create a positive correlation between low risk and owning insurance. According to the results, in the group life insurance market, where the possibilities for price discrimination are low, the correlation contrary to expectations is no longer observed. From this it can be concluded that price discrimination directs low-risk people to buy life insurances more than positive selection.

In addition to pricing, insurance companies can react to asymmetric information by refusing to sell insurances. Hendren (2013) shows that individuals have such subjective information about their own risks that cannot be elicited from demographic or health data. Insurance companies take this into account when making their pricing and refusal decisions based on public information. No market emerges for insuring the most high-risk individuals, because the premiums would become unsustainably high for the policyholder in such a situation. In this way, asymmetric information prevents large groups from entering the long-term care, disability and life insurance market in the US.

Policyholders' knowledge of the insurance market affects prices. Brown and Goolsbee (2002) examine online market premiums observing that the Internet enables easier price comparison and thus reduces search costs. This is found to have intensified competition between insurance companies and lowered prices. Based on their results, insurance prices fell by 8–15% in the 1990s as a result of the Internet.

2.3 Need for life insurances and the life insurance gap

A family's need for life insurances and its relationship with the existing death cover are complicated to assess. Different insurance companies use different methods and online calculators have been developed to help the customers.

Research-based estimates of the gap are represented by Bernheim et al. (1999), which assesses the adequacy of death cover for US couples approaching retirement age. The starting point is a description of the current circumstances using a large family-level sample data. The need is assessed with a financial planning tool based on the life-cycle model (ESPlanner) and the goal is to smooth life-cycle consumption[8]. According to the results, the gap affects women in particular: for more than half, their standard of living would drop when a spouse dies, and 15 percent would see a drop of at least 40 percent. The insurance gap is particularly large for families with only one member who is working.

Bernheim et al. (2003) used the same method and data to study the matching of insurance needs and insurance coverage in the United States. The average sum insured of all insured persons exceeded the insurance need. In addition, more than half of spouses had a larger sum insured than would have been needed to maintain the standard of living after the spouse's death. On the other hand, the study discerned groups with a particularly large insurance gap; low-income people, couples with large income differences, relatively younger households, and non-whites. Just over 14 percent of women would have been left below the poverty line if they were widowed with the death cover of the time of the study. Raising it to the recommended level would have reduced falling below the poverty line by a third. The insurance gap decreased systematically with age.

Harris and Yelowitz (2018) studied the importance of life insurances in reducing the risk of poverty following from the death of a spouse. The study focused on couples in which the spouse died near the end of their working career (between the ages of 55 and 68). The widow's standard of living was monitored for three years after that. According to the data, the majority of insurance compensations were paid to middle- or high-income earners, and the insurance compensations were mostly small (median around $25,000). According to the results, one-time compensations had on average only a minor effect on the risk of poverty. On the other hand, compensation amounts below $10,000 had a significant effect, which illustrates the smallness of the death cover compensation amounts for low-income people, but also their importance to them.

Based on the results of these studies, life insurance coverage in the United States is adequate on average, but there are significant problems in the allocation. Harris and Yelowitz (2018) interpret some of the country's life insurance policies to be more often part of life-cycle financial planning than about protecting the widow from the loss of income following from the death of a spouse.

Naylor et al. (2011) conducted a similar detailed assessment of the life insurance gap of different families in New Zealand, where life insurance coverage is significantly lower than in the United States. The assessment was based on a life-cycle model and extensive statistical data. According to this study as well, the correlation between owning life insurances and the insurance need was weak. In more than half of the families, the death of the higher income spouse would cause a reduction of more than 40 percent in the present value of the family's combined consumption.

Kari et al. (2007) assessed the adequacy of Finns' death cover. The life insurance coverage gap was calculated for three household types and four age groups. The goal of cover was set at the standard of living that the family members had before the death of a breadwinner. According to the results, the average gross insurance gap (of a typical household) calculated using income, net wealth and social security was around €140,000 in 2006. When voluntary insurances were taken into account, the average of which was around €12,000 per household, the remaining net average gap was €126,000 per household.

[8] *The article states that the model does not enable the evaluation of optimal life insurance because, for example, the risk aversion that affects varies from individual to individual. The model also does not take into account the possibility of a new marriage.*

Additional information about the need for supplementary insurances can also be obtained by looking at the widow's income before and after the death of a spouse. Rantala (2013) studied the livelihood of widowed people in Finland in 2005. The majority of them were retired women. Only 12 percent were between the ages of 18 and 55. In two-thirds of cases, the change in family situation was from a two-person household to a one-person household. After being widowed, the total income of the household dropped on average by approximately 30–40 percent. The decrease was greater for working widows when measured in euros, but relatively greater for pensioners. When taking into account the reduction in the size of the household and the consequent reduction in the scale benefits of living together, the livelihood of retired widows decreases by about a tenth, but the livelihood of a working widow remains almost unchanged, except for the drop in the year of death. In the case of widows of working age, this is explained not only by the survivors' pension, but also by the increase in the widow's average earned income. The metric used does not take into account the impact of net wealth.

3 Death cover in Finland

3.1 Social insurance compensations in Finland

When a breadwinner dies in Finland, the social security system provides survivors' pensions for the widow and orphans under certain conditions. There are several statutory schemes that may pay survivors' pensions: the earnings-related pension scheme, the national pension scheme and accident insurances. In addition, a large majority of the employees are insured by group life insurance taken out by employers on the basis of collective agreements.[9] The main rules for the entitlements and paid amounts are as follows.

In the earnings-related pension scheme, the entitlement for widow's pensions is clear, if the survivor has under-aged children with the deceased, but otherwise there are several conditions related to age of the widow, the age of the spouses, when they married, and the period of time lived together. While for widow's born before 1975 the pension is for a lifetime, for widows born in 1975 and later it is paid for 10 years at the most, but at least until the youngest child turns 18. Also, a common-law spouse is entitled to the surviving spouse's pension, when the couple has common under-aged children. The children have entitlement to orphans' pensions until they turn 20.

The basis of the survivors' pension is in this pension scheme the deceased person's earnings-related pension, or if not retired, computational disability pension. In addition, the widow's pension, or a computational disability pension, if the widow is not retired, influence the paid amount. The widow and the orphans share the survivor's pension so that the number of under-aged children affects both the widow's and the individual orphan's pensions. The pensions are taxable, and the wage income of the widow influences the income tax rate applied. If the survivors' pensions are based on statutory accident insurance, they will lower the pensions paid from the earnings-related pension scheme.

In the national pension scheme, survivors' pensions are paid to survivors permanently living in Finland, but since the pensions are small and income tested, there are less than 5000 widows that draw these pensions and the average monthly pension is less than 200 euros. The group life insurance pays an age-dependent lump sum to the widow and a fixed sum to the orphans.

The complicated rules for the entitlements and the paid amounts, the progressive and wage-dependent taxation of survivors' pensions and the interaction of the pensions with other means-tested social security exacerbates greatly the evaluation of the net compensation paid after the breadwinner dies.

[9] *The obligation to take out insurance applies to all those employers with a collective agreement binding on them or a general national collective agreement in force in their field containing provisions regarding group life insurance (TVRH 2020).*

3.2 The life insurance market in Finland

There are many products developed for different purposes available in the Finnish life insurance market. Their classification and content of concepts varies somewhat depending on the source. Insurances where the insured risk is the death of a person are usually called term life insurance policies. However, coverage in case of disability or illness can also be attached to these policies, as is typical for so-called extensive loan protection insurance that is often attached to a mortgage. Companies also take out voluntary life insurances for their personnel, which may include other insurance coverage. Term life insurances do not usually involve saving.

The insurance premium for term life insurances can increase with age, which makes it possible to keep the compensation unchanged. Correspondingly, the insurance premium can be fixed if the insurance compensation decreases with age. The insurance compensations are paid on a one-time basis after the death of the insured person.

Compensations from private life insurances do not reduce the widow's or orphan's pensions provided by social security, but they are subject to inheritance tax for next of kin and estates[10], and capital income tax for other beneficiaries. An exception from liability to taxation is the part of loan protection insurance compensation that goes directly to the repayment of a mortgage.

Term life insurance policies are sometimes purchased as joint cover insurances, which are cheaper in terms of premiums, where the compensation is paid to the widow of the spouse who dies first and the insurance terminates after that. Joint cover can also consist of two life insurance policies, in which case the beneficiaries are the children after the death of both parents. Many trade unions and organisations have signed agreements with insurance companies for self-funded group insurances offered to members. Their price is typically significantly cheaper than in policies sold individually due to savings in marketing and administrative costs and a reduction in adverse selection. In addition, companies can take out voluntary life insurances for their employees. Almost all employees are insured with the employer's group life insurance linked to collective agreements, the compensation of which is, however, quite small.

Endowment insurances are fixed-term savings policies where the capital is in principle transferred to the insurance company upon the death of the insured person during the insurance period. In practice, however, life insurance is attached to the policies, whereby the saved amount is transferred to the beneficiaries named in the policy in the event of death. The insured person can influence the investment portfolio and change it without having to pay tax on the profitable investments before withdrawing the savings. Endowment insurance policies are mainly marketed as savings and investment items. In voluntary pension insurance policies, the assets are usually protected in a similar way by life insurance in case of premature death.

Life insurances are thus taken out not only to directly compensate for the loss of income following from the death of a family breadwinner, but also to secure the repayment of a mortgage and to ensure the return of the amount saved in the endowment insurance and pension insurance upon the death of the saver. The sale of new voluntary individual pension insurances has practically stopped due to the changes related to their taxation and withdrawal age and changes in the taxation of competing products, but there are still many old policies left.

[10] *Insurance compensation payable on death was exempt from inheritance tax for the next of kin up to €35,000 until 2017. Liability to taxation began to apply in practice from the start of 2018 due to a transition period.*

Table 1. *Premium income of life insurance companies from domestic direct insurance, EUR million*

	2017	2018	2019	2020
Individual risk insurances	137	178	183	174
Other group life insurances	178	132	141	152
Employees' group life insurance	39	40	41	41
Endowment insurance	2,052	1,549	2,065	1,257
Capital redemption policies	1,474	1,832	2,915	1,797
Pension insurances	591	575	622	566
Total	4,472	4,305	5,967	3,988

Source: Financial Supervisory Authority

Table 1 depicts the annual premium income of life insurance companies from different products. Individual risk insurances include term life insurance policies and loan protection insurance. Their share of premium income is small compared to endowment insurances. Life insurance companies also have voluntary pension insurances and capital redemption policies in their product range. In 2019, the premium income of endowment insurances and capital redemption policies grew exceptionally large, because these investment policies were liquidated in anticipation of the tightening of taxation, and new ones were taken out to replace them.

4 The life insurance gap in Finland

The life insurance gap arises as the difference between the loss following from a death and the cover against it provided by the insurances. In this section, we examine the determinants of life insurance gap of Finnish persons and the average size of the gap using individual-level data. We begin the examinations by describing the data in Section 4.1. Thereafter, we examine the life insurance take-up and the sums insured of Finnish persons in Section 4.2. Section 4.3 focuses on the amounts of losses following from a death. In section 4.4 we study the contribution of social security on the life insurance gap. Section 4.5 examines the insurance gap, which indicates how much the sums insured should be changed to maintain the *standard of living* of the widow and children of the remaining household at the level preceding the breadwinner's death.

4.1 Data

The data employed in the study consists of information from life insurance companies' customer registers for the years 2018–2020, which has been combined with Statistics Finland's FOLK register data at individual level.[11] From the information in the FOLK data, the study employs both basic personal information on persons living permanently in Finland and information related to their households.

Of the products of life insurance companies, the analysis includes the voluntary term life insurance (also known as pure life insurance) policies taken out by households.[12] Insurances taken out to protect the savings amounts of endowment

[11] *The data employed covers approximately 70 percent of the term life insurance policies offered by insurance companies operating in Finland. We do not have access to product-specific market shares.*

[12] *Voluntary group life insurances are not taken into account in the gap calculation due to their special nature. They may be large at individual level, but they can be estimated to have only a minor effect on the average insurance gap. Also, the mandatory group life insurances are on average small (see Table 1).*

insurances and pension insurances have been excluded from the insurance gap calculations, because they are interpreted more as part of investment activities.[13]

Regarding the sums insured in 2020 the individual risk insurances cover slightly more than half (€36.1 billion) of the total amount of the sums insured in the data (€67.3 billion).[14] In the calculations below, we focus on individual life insurances.

From Statistics Finland's information, we employ information from the FOLK basic data module on a person's age, gender, marital status, income and education. From the FOLK family module, in turn, we employ information on the size and location (place of residence) of a household. Table 2 lists the variables used in the study. The data contains a total of 16,576,444 observations from years 2018–2020.[15]

Table 2: *Variables used in the analyses*

Source of information	Variable
Insurance companies	Death benefit of term life insurances
Statistics Finland's FOLK data	Age
	Gender
	Marital status
	Income
	Education
	Size of household
	Place of residence

4.2 The take-up and the sums insured

In this subsection, we examine the share of people in the data that have acquired voluntary term life insurance (hereafter also life insurance). We also look at how the coverages of life insurance differs between population groups. The data shows that during the analysis period of years 2018–2020, on average 8.02% had a term life insurance. There is not much difference between the years.[16]

We first study how a person's background factors (age, gender, marital status, income, education) and household factors (size of household, place of residence) relate to life insurance. The first column of Table 3 shows that take-out of life insurances is largely concentrated in the working age population and that young people and pensioners have fewer policies.[17] It also shows that men have slightly more often life insurances than women, although no major difference between the sexes is observed in terms of life insurance take-up. Among marital statuses, taking out insurances is most common among married people, next most common among divorced people, and least common among unmarried people and widows. Life insurance take-up is found to be very different with respect to income. People with higher incomes (have higher than

[13] *It is well known fact that the motive for buying an endowment policy is tax planning and portfolio considerations rather than hedging against a mortality risk (Heo et al. 2013). Correspondingly, Heo et al. (2021) shows that the demand for term life insurances is explained by different characteristics of the households than the demand for endowment policies.*

[14] *The total amount of the sums insured arises as a sum of individual risk insurance, other group life insurances, endowment insurance and pension insurance.*

[15] *In processing the data, we have replaced both missing and negative insurance information with zeroes, i.e. we have interpreted that there is no insurance at all in these respects.*

[16] *In 2018–2020, the share of people with life insurance was 7.84%, 8.11% and 8.12%, respectively.*

[17] *Note that we do not have observations from all the insurance companies. Thus, if the customers of missing companies would behave similarly (conditional on their characteristics) than those we observe in the data, the take-ups and sums insured should be multiplied by a single constant (which is 1/(1-missing market share)).*

average taxable income in government income taxation) have life insurance more than twice as often as people with lower incomes: among people above the average, 12.6% have life insurance, while only 5.2% of people below the average have it. Some differences are also observed according to education. Especially those with a low level of education (unknown or upper secondary level of education) have fewer life insurance policies than others. According to the size of household, life insurance is most common in households of 3–5 people. The place of residence in turn does not seem to make a significant difference in life insurance coverage between those living in an urban area and those living in a rural area.

Next, we consider the amount of life insurances in the data. The second column of Table 3 shows the sums insured with respect to the same characteristics as above for those people who have life insurance. The table shows that the largest life insurances are also among working age, married people with higher education. Contrary to the take-up results, the largest average magnitudes of the life insurances are among the largest households. The third column of Table 3 shows the corresponding numbers for all the observations, including people who do not have a life insurance. The results show highly similar pattern compared to the take-up results.

Table 3. *Term life insurances and background factors*

		Take-up of life insurance (%)	**Sums insured (€; positive sum)**	**Sums insured (€; all)**
Age group	0-10 years	0,3	5657	14
	11-20 years	1,1	8256	88
	21-30 years	6,6	71366	4686
	31-40 years	15,5	98872	15355
	41-50 years	18,5	87478	16168
	51-60 years	14,7	57219	8437
	61-70 years	6,3	30381	1903
	71-80 years	0,9	20809	185
	81-90 years	0,5	13667	66
	90+ years	0,2	2603	4
Gender	Man	8,3	77195	6373
	Woman	7,8	68972	5377
Marital status	Unmarried	4,3	61844	2656
	Married	14,0	79808	11194
	Divorced	7,9	65304	5129
	Widow	2,0	42517	837
Taxable income	Above average	12,6	72270	9081
	Below average	5,2	74440	3904
Degree	Upper secondary education	9,4	65482	6144
	Specialist vocational qualification	18,9	76109	14354
	Lowest level tetriary education	12,3	56292	6943
	Lower tetriary level	14,6	80568	11773
	Higher tetriary level	16,0	85805	13757
	Doctorate level	13,2	82866	10948
	Unknown	5,5	75550	4133
Size of household	1 person	4,3	46459	1990
	2 persons	8,0	54827	4373
	3 persons	10,5	76965	8108
	4 persons	11,5	94004	10836
	5 persons	9,5	99605	9484
	6 persons	7,2	101377	7338
	7 persons	5,9	103856	6094
	8 persons	5,3	110198	5821
	9 persons	4,5	111324	4978
Area of residence	City	8,1	74663	6021
	Countryside	8,2	69237	5647
	Average	8,02	73150	5868
	Observations	16,576,444	1,329,834	16,576,444

In summary, the take-up of life insurance is the largest among people of working age, people with higher incomes and married people, as well as those who live in households of 3–5 people. Of all the observations 8% has a life insurance. The largest average magnitudes of life insurances, conditional on having one, are among working age people, married individuals and large households. On average the amount of life insurance is €5,868 in the data. For those who have a life insurance, it is on average €73,150. For those persons having income, other members in their household, all family members identified and at most two breadwinners in the household, the average life insurance is €11,847 (see also the right column of Table 4).[18]

4.3 Losses following from a death

While the take-out of voluntary life insurances and sums insured, one component that limits the insurance gap, was examined above, this section describes another component of the insurance gap, the financial losses following from a death. The financial losses arise as a sum from several different margins: while the overall incomes of the household decrease after the death of a breadwinner, also the amount of consumption decreases, and the net wealth is reallocated within the household. In addition, social security and progressive income taxation limit the net losses. All these margins affect the standard of living of the surviving family members. Next, we describe the construction of each of these margins separately. After considering the lost after-tax income following from a death (Section 4.3.1), we focus on the reduced consumption (Section 4.3.2), on net wealth reallocation within a household (Section 4.3.3) and finally on the changes in social security benefits (Section 4.4). We start by estimating how much the after-tax income of a household is reduced due to the death of a breadwinner.

4.3.1 Lost after-tax expected income

The current value of the lost income following from a death of the breadwinner depends on several factors, in particular, on the income profile of the remaining life-cycle of the deceased person, the taxation of income and the discount rate. Regarding the income profile, we account for in the calculations that income depends, in addition to age, strongly on level of education. We make use of the wage profiles reported in previous research and they are depicted in Figure A1 in the Appendix.[19] With regard to tax rates, we use the 2020 tax rates depicted in Figure A2 in the Appendix.

In more detail, let us denote the current year by $t_0 = 0$ and the current income of a person by I_0. For the next year (year $t=1$) a person has income I_1 , which is calculated based on the wage profiles depicted in Figure A1. For each person his/her incomes are assumed to change according to these wage profiles. The shapes of the profiles depend both on the age and the education level (basic, upper secondary, tertiary) of a person. The net-of-tax incomes are then constructed by using year 2020 tax rates (shown in Figure A2), and they are $(1 - \tau_1(I_1))*I_1$. Due to the progressivity of the income taxation, the tax rate is a function of a person's incomes $(\tau_1 = \tau_1(I_1))$. The net-of-tax incomes for year 1 are then discounted by $\rho^1 = \rho$.[20]

For year 2 we use the same procedure than for year 1 and arrive to discounted net-of-tax incomes of $\rho^2(1 - \tau_2(I_2))*I_2$. For the other years $t \in \{3,...,t_U\}$, discounted net-of-tax incomes are $\rho^t(1 - \tau_t(I_t))$. Here t_U corresponds to the year when a person is 69 years old. The person is assumed to retire at the age of 70 years. In the calculation for the financial loss of death we add up all the future discounted net-of-tax incomes of a person, which are the following:

[18] *We use the term "breadwinner" for each person in the household that earns income and is one of at most two parents of the household. We study each of the breadwinners in the household separately and study how the death of one breadwinner in the household would affect different margins.*

[19] *A more detailed description of the wage profiles in question can be found in studies by Määttänen (2013) and Valkonen and Lassila (2021). The wages have been normalised so that the income of a person with a basic level of education is 1 in the age range 30–34 years.*

[20] *We use the value 0.98 as the discount factor. The factor accounts for interest and the general increase in the estimated income level.*

$$(1) \qquad \sum_{t=1}^{t=t_U} \rho^t \left(1 - \tau_t(I_t)\right) * I_t$$

Here t stands for the year, I_t the incomes of a person of that year, τ_t for his/her tax rate, ρ for the discount rate, and t_U the year when s/he turns 69 years.

Of the 16,576,444 observations in the data, 10,452,560 (63.1%) concern persons aged 20–69. Of these, lost discounted after-tax income arises for 6,658,426 (63.7%). For them the average discounted after-tax income is €424,697 and the distribution is illustrated in Figure A3.[21] The figure shows, for example, that losses of less than €100,000 account for a little more than 15% of the observations, i.e., about one million. For those persons having income, other members in their household, all family members identified and at most two breadwinners in the household, the average discounted loss of income is €447,270 (see also Table 4).

4.3.2 Change in household consumption

In addition to the losses of income, a person's death reduces the overall consumption of the remaining household. The consumption reduction we focus on is considered to stand for the "mechanical" decrease by which we mean the effect that relates for instance to the fact that there remains one mouth less to feed. The "behavioural" effects, which correspond to changes in the behaviour following from a death of a person, like a change in workforce participation, or remarriage, are not accounted for in the calculations. We approximate the change in the consumption using three pieces of information. The starting point is the household-level future income (I), which accounts also for the future income of a spouse.[22] It is calculated by summing up the future income of the whole household, especially the future income of both spouses, already calculated above. A fraction of these future income of the household are then supposed to be consumed (share of consumption of household income $c = 0{,}9$). From the household-level consumption each household member consumes his/her share (s). This share is assumed to stay the same over the years and is approximated by an equivalence scale, often used in the assessment of household consumption, and which aims to account for that households of different sizes and structures have different amounts of consumption. For instance, the consumption of a large family with children is different from that of a one-person household. In a larger household, the consumption share of each member is smaller, in addition to which the contents of these consumption baskets can differ considerably.

In our chosen (Oxford) scale[23], the first adult in the household is assigned a weight of 1, the other adults a weight of 0.7 and the children each a weight of 0.5.[24] The different weights aim to account for that part of household consumption that is such that all members derive utility from it (common goods), while part of it takes place at the individual level. Adding up the weights of everyone living in the household results in a measure describing the household's consumption. For example, in a household of two adults and one child, the measure is given the value 2.2 (=1+0.7+0.5). In our calculations, the change in consumption is based on the change in this measure, when accounting for the departure of a deceased person from the household. For example, the measure of a household consisting of two adults changes from 1.7 to 1.0 as

[21] *The average of discounted after-tax lost income for all the observations is €170,592.*

[22] *This accounts for that a deceased person would have also consumed a part of his/her spouse's and children's income.*

[23] *See, for example, Martin (2017).*

[24] *We acknowledge that a 1-year-old child is likely to differ in the consumption share of a household from that of a 17-year-old child. However, we focus in the calculations on how the number of children is related to the life insurance gap on average. Moreover, we do not have data about how much do the consumption shares differ. Regarding the calculations, we implicitly assume that the distribution of different household decompositions stays the same in each year.*

a result of the death of one member of the household, i.e. consumption is considered to decrease by 41% (= (1.7-1.0)/1.7) in this case. We limit the analysis to cases where one member of the household dies.

Figure A4 illustrates the relative changes in consumption in case one member of the household dies. The largest share of relative changes in the figure is at -0.41, which corresponds to the change in the consumption of a two-adult household when one person dies. The value -1 corresponds to the death of the only person in a one-person household, while 0.66 (=(1.5-0.5)/1.5) corresponds to a situation where the adult dies in a household of one adult and one child. The average reduction in household consumption in the figure is 48%. This average includes also one-person households, which account for more than a one fifth of all households (see Figure A4). Without one-person households the average reduction in household consumption is 32%.

In deriving the reduction of consumption, the future discounted after-tax income of the *household* is first calculated. This includes the income of both spouses. Of this income 90% is assumed to be consumed (marginal propensity to consume 0.9). After a death a smaller part of the household's discounted future income is consumed, compared to what would have been consumed without the death, because a share (*s*) of the household consumption does not occur after a death.[25] The consumption reduction is calculated as *scI*, where *s* stands for the share of a household consumption of a deceased person, *c* is the marginal propensity to consume, and *I* is the household-level discounted net-of-tax future income stream. Taking into account the household future income, the marginal propensity to consume, and the consumption shares within the household, we find that the household consumption is reduced by €106,148 on average. The distribution of reductions in consumption is given in monetary terms in Figure A5. For those persons having income, other members in their household, all family members identified and at most two breadwinners in the household, the average consumption reduction is €270,994 (see Table 4).[26]

4.3.3 Contribution of household net wealth

The wealth of a household reduces the need for life insurance because it supports maintaining the level of consumption, or, more precisely, the consumption possibilities, after the death of a breadwinner. Wealth typically increases with age and as life conditions change. Students and those who have just started their working career have little wealth. One's own dwelling is often purchased almost entirely by loan, in which case net wealth is still low and it is mainly increased through loan repayments. A dwelling is the main form of wealth for all but those with the very highest incomes. Families with children have a larger portion of their wealth tied up in a dwelling than those without children.

In a situation where a breadwinner dies at the time when the family with children needs a large dwelling and a sizeable mortgage, the utility from life insurance is great. The insurance is also quite cheap because the probabilities of death are low for young adults. The situation justifies a loan protection insurance type of life insurance, the compensations from which can be used to pay off the mortgage. Elimination of the need to save for loan instalments significantly increases a

[25] *In the absence of death 90 % of the household future income would have been consumed. The average reduction in household consumption is 48 %, which means a reduction of 43.2 % (=0.9*0.48) of the household future income in case of a death of a breadwinner. Compared to the future income of one spouse this percentage is typically much higher.*

[26] *Various sources give different view on the relevant saving rates. For example, National Accounts show that the savings of the aggregate household sector have been close to zero in the recent years. On the other hand, the implicit saving rate for the working age population deduced from the Statistics on households' assets are in line with the MPC used in our study. Even lower numbers can be found from statistical studies form other countries, see e.g., Carroll et al. (2017). As the robustness checks we have considered the question of how different marginal propensities to consume change the results. For the baseline case* $c=0.9$ *the average consumption reduction is €270,994, it corresponds to 60.6 % of the income decrease and €65,193 average life insurance gap (see section 4.5). For* $c=0.85$, $c=0.95$ *and* 1 *the consumption reductions (and percentages of the income decrease) are €255,939 (57.2 %), €286,049 (64.0 %) and €301,104 (67.3 %) respectively. The corresponding life insurance gaps are €80,248, €50,138 and €35,083. The chosen alternatives for the marginal propensity to consume reflect the fact that savings of the household sector have been close to zero for a long time. Still, the savings are higher at certain ages and correlated more generally with age. Yet, trying to account for this correlation might induce double-calculation, because we account for the wealth separately (see section 4.3.3).*

family's disposable income for consumption, and insurance thus acts as a liquidity safeguard. On the other hand, when the children move out in due course, the widow will be left with considerable housing wealth.

Finnish middle- and high-income households typically save throughout their life-cycle, which is why net wealth is on average at its highest and the life insurance gap at its lowest towards the end of the life-cycle. The medians of assets, liabilities and net wealth of different households according to the age of the reference person are shown in Figure A6 in the Appendix.

We employ the net wealths[27] (in Figure A6) together with the changes in consumption (in Figure A4) to estimate how much of the household's net wealth is transferred from the deceased person to the consumption possibilities of the surviving members. This part of net-wealth would have been available for the consumption of the deceased person in the absence of death. We use age group averages in our estimates, and the age of the household's reference person is considered as the age of the oldest member of the household. Using average values ignores information related to the distribution of net wealth, including particularly high net wealth as well as low and, for young households, more often negative net wealth.

The distribution of unconsumed net wealth is illustrated in Figure A7. The figure shows that slightly more than 15% of the observations derived from the age-group specific data, have no unconsumed net wealth, which relates to these households not having accumulated any net wealth. On average, the net wealth left unconsumed due a person's death is €48,004. For those persons having income, other members in their household, all family members identified and at most two breadwinners in the household, the average contribution of net wealth is €43,560 (see Table 4).

4.4 Social security responses to a death (Survivors' pensions)

Survivors' pensions are granted in accordance with both laws concerning employee pensions and the National Pensions Act. In pensions according to both, family cover consists of widow's pension and orphan's pension (for example, the legal provisions under the Employees Pensions Act are TyEL: Sections 54–62 and 84–91, and for the National Pensions Act KEL: Sections 26–50). Based on data from 2018, survivors' pensions granted based on laws concerning employee pensions amounted to €1,713 million and survivors' pensions based on national pension to €27 million (HE 66/2021 vp).[28] The share of national pensions is therefore only 1.5% of all survivors' pensions. For this reason, in the calculations, we focus on accounting survivors' pensions to the extent that they are formed through the employee pension system.

In the calculations related to survivors' pensions, we use several types of information, which together determine the amounts of survivors' pensions. The basis for survivors' pensions in the calculations is the person's income information.[29] With regard to the household, we employ information on the number of adults and children, whether the spouses have children together, and the age of the youngest person, which determine, among other things, the division between widow's pension and orphan's pension and, in part, the length of the widow's pension. With regard to the spouse, information about their age, year of birth, gender and income is used, which in part determines, among other things, the right to a widow's pension, the duration of the widow's pension (lifetime vs. 10 years, except if the widow has a child under the age

[27] *In the calculations, it is assumed that a household's net wealth depends on the age of the oldest member of the household as follows: net wealth is €0 for those aged under 25, €11,982 for those aged 25–34, €89,678 for those aged 35–44, €156,428 for those aged 45–54, €160,908 for those aged 55–64, €173,532 for those aged 65–74, and €160,791 for those aged 75+.*

[28] *At that time, widow's pensions granted in accordance with laws concerning employee pensions amounted to €1,650 million and orphan's pensions to €63 million. Widow's and orphan's pensions granted based on national pension amounted to €11 million and €16 million, respectively.*

[29] *We assume that a person's pension is half of his/her income taxable in government income taxation. This corresponds roughly to current average ratio of pensions to wages in Finland.*

of 18 after 10 years) and the amount of the deduction from the full widow's pension.[30] With regard to children, their age is taken into account, which determines the duration of the orphan's pension. The calculations also account for the compensation in the amount of the widow's pension included in the orphan's pension when there is no widow. For spouses born in or before 1974, the duration of the widow's pension is defined by means of the age and gender dependent life expectancies shown in Figure A8 in the Appendix. The expectancy is higher for women.

Figure A9 shows the discounted survivors' pensions following from a death of a person. The left graph of the figure shows that for the most of observations survivors' pensions are zero, because of having too large income or living in a single person household. The right graph (no zeros included) shows that the higher the survivors' pension the fewer observations we have. The tail of the distribution goes close to zero at €400,000. For those persons having income, other members in their household, all family members identified and at most two breadwinners in the household, the average survivors' pension is €55,676 (see Table 4).

4.5 Life insurance gap

This section examines the formation of the life insurance gap from its various components described above. We focus on looking at the difference of the losses following from a death and the protection against it for persons with income and who live in households of at least two people. The life insurance gap corresponds to the additional amount of life insurance that would retain the net income of the remaining household at the level preceding the death of the breadwinner.[31] Table 4 compiles the average discounted losses of income, reductions in consumption, unconsumed household net wealth, survivors' pensions, amounts of life insurances and the life insurance gaps formed through these figures. The table shows the outcomes for three groups. The first column stands for those people that have positive income and live in a household of at least 2 members. The second column in the table considers people that have positive income and live in a household with exactly two adults (and possibly also children). The third column considers people with positive income living in a household that has at least two members, but at most two adults. The table shows that the insurance gap of persons with income to lose and who do not live in one-person households is on average in the order of €65,000 to €70,000.

Table 4: *Discounted losses of income, reductions in consumption, unconsumed wealth, term life insurances and the life insurance gap for different groups*

Observations	**2+ person households 4,685,584**	**2-adult households 4,115,562**	**Up to 2 adults in a household 4,524,544**
Loss of income	446,605	451,185	447,270
Reduction in consumption	267,504	270,297	270,994
Unconsumed wealth	42,885	40,696	43,560
Survivors' pension	55,477	57,592	55,676
Life insurance	11,764	12,301	11,847
Life insurance gap	**68,975**	**70,299**	**65,193**

Note: All samples in the table are restricted to people who have positive income.

[30] *We limit the examination to persons whose households have no more than two adults, because otherwise it is not possible to deduce the spouse's information very precisely with the available data.*

[31] *Calculation of optimal life insurance holdings would require building a stochastic life cycle model with family structure specific preferences (Hong and Rios-Rull 2012) and income and mortality uncertainties (Chambers et al. 2011). More complications would arise, if the model is designed to consider the differences in risk aversion (Outreville 2014), cognitive abilities (Li et al. 2022) and cognitive biases (Coe et al. 2016).*

Figure 1 illustrates how the insurance gap is formed as the difference between the losses following from a death and the protection against it, for persons with income and who live in households of at least two people, but no more than two adults (right-hand column of Table 4). The figure shows that of the loss of income following from a death (€447,270), the majority (€270,994; 60.6%) is compensated by the change in consumption and the still unconsumed wealth (€43,560). Survivors' pensions and life insurance cover some, but not all, of the remaining gap.[32]

Figure 1. *Formation of the insurance gap from its components*

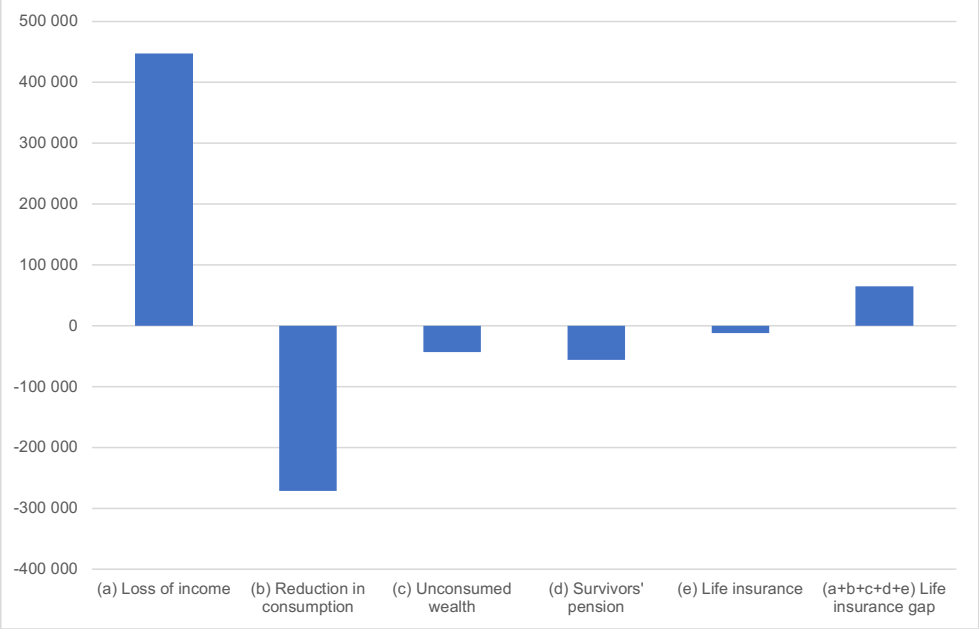

Table 5 illustrates the extent to which survivors' pension insurances and life insurances cover the losses following from a death. According to the table, survivors' pensions cover on average about 40%[33] and life insurances about 10%[34] of the losses following from a person's death, when changes in income, consumption and accumulated net wealth on the future consumption of the surviving household are taken into account and looking at persons with income to lose and who live in households of at least two people. After survivors' pensions and life insurances, the remaining insurance gap is approximately €65,000 to €70,000.

[32] *For two adults and one child the change in the consumption would be 32 % (= (1.5-2.2)/2.2) of the household future income. With both spouses earning the same amount this corresponds to 64 % of the future income of one of the adults. This is quite similar with 60.6 % reported above. This would also be similar with the household with a single adult income earner and one child, for which it would be 66.7 % (= (0.5-1.5)/1.5). The data shows that for households with single adult and children, the future income loss is on average €407,879 and the consumption reduction €278,010. The consumption decrease is thus 68.2 %. It exceeds 66.7 % as some children are also earning income for the household.*

[33] *With regard to survivors' pensions, we have only taken into account survivors' pensions granted through employee pension systems. These correspond to approximately 98.5% of all survivors' pensions (HE 66/2021 vp). Also taking into account survivors' pensions granted through the national pension system (which correspond to 1.5% of all survivors' pensions), their average amounts change by less than €1,000. In terms of the insurance gap, these therefore change the results only marginally. It is worth noting that survivors' pensions granted through the national pension system are targeted at low-income persons.*

[34] *We do not have information from all insurance companies and our information on term life insurances covers approximately 70% of all term life insurances in Finland. Taking into account the missing approximately 30% results in an estimate of €16,924 (= 11,847/0.7) for the average life insurance, which is approximately €5,000 more than the life insurances shown in the data and corresponds to an insurance gap of €60,000 to €65,000, which is of the same magnitude as the results illustrated in Table 4. Therefore, the life insurance information missing from the data does not seem to affect our results regarding the magnitude of the insurance gap. Moreover, to close the life insurance gap the customers of the remaining 30 % of companies should have life insurances of about 1 200 % of those in our data.*

Table 5: *Coverages of survivors' pensions and term life insurances in different groups*

	2+ person households		2-adult households		Up to 2 adults in a household	
Observations	4 685 584		4 115 562		4 524 544	
Loss of income	446 605		451 185		447 270	
Reduction in consumption	267 504		270 297		270 994	
Unconsumed wealth	42 885		40 696		43 560	
Net losses without survivors' pensions and life insurance	136 216		140 192		132 716	
of which survivors' pensions cover	55 477	41 %	57 592	41 %	55 676	42 %
of which life insurances cover	11 764	9 %	12 301	9 %	11 847	9 %
Insurance gap without life insurance	80 739		82 600		77 040	
Insurance gap after life insurance	68 975		70 299		65 193	

Note: All samples in the table are restricted to people who have positive income.

In addition to the items mentioned above and included in the calculations, a breadwinner brings their own contribution to homework. Taking that into account would produce the broadest possible metric of the change in a household's total resources upon the death of a breadwinner. The value of household production describes the monetary value of goods and services produced by households for their own use. According to the data from Statistics Finland, in 2020, it was on average somewhat more than €50,000 per household. However, when conducting this study, there was no information available on the basis of which the value of domestic work could have been allocated to different households according to their characteristics. In addition, the death of a breadwinner reduces, in part, the need for domestic work, which in any case would have significantly weakened the relevance of the calculation.

5 Analysis

5.1 The components of the life insurance gap

While section 4 described the losses from the death of a breadwinner, the life insurance to encounter these losses and the life insurance gap, this section studies how different individual characteristics are related to the magnitude of the life insurance gap and its components. Using a regression model allows us to study these correlations jointly, instead of studying each of them separately. Our regression model is the following:

$$y_i = \alpha + \beta_1 AgeGr_i + \beta_2 Gender_i + \beta_3 MaritalSt_i + \beta_4 Income_i + \beta_5 Educ_i + \beta_6 HHSize_i + \beta_7 Area_i + \varepsilon_i \quad (2)$$

In equation 2 the outcome variable y_i (lost income, change in consumption, net wealth contribution, survivors' pensions, life insurance or life insurance gap) is explained by the age group of a person, his/her gender, marital status, income level, education, household size and the area of residence.

Table 6 shows the regression results from our regression model for seven outcome variables: the magnitude of lost incomes, the change in household consumption, the net wealth implications, the survivors' pensions, the magnitude of life insurance, the life insurance gap, and the take-up of life insurance. The results show how the personal and family characteristics relate to these outcomes. The regressions focus on those persons who have incomes, other members in their household, all family members identified and at most two breadwinners in the household (the same than those in the right-hand size columns of Tables 4 and 5).

The first column of Table 6 shows the results for the discounted income losses following from the death of a breadwinner of the household. It shows that while all the other characteristics being the same, the losses of income following from a death are on average the highest for people aged 21–40. The result arises as young adults have more of their working careers left than older people. In terms of gender, the loss of income is greater for men than for women. Conditional on other characteristics being the same the widows seem to have slightly higher incomes to lose compared to people with other marital statuses. Regarding this result it is worth noting that the age and being a widow are highly correlated, which makes it less straightforward to interpret the regression coefficients, and the result for the widows is likely to arise due to this correlation. For people with higher incomes, the loss of income following from a death is higher than for people with lower incomes. Regarding the education the loss of income for the highly educated (higher tertiary level or doctorate level education) is on average hundreds of thousands of euros higher than for those with the lowest level of education (unknown). Regarding the size of household, the loss of income is slightly higher in households of 3–5 people than in other households. The location of the household does not seem to have much of a bearing on the amount of the loss of income.

The second column of Table 6 focuses on how consumption following a death decreases differently according to the characteristics of a person and their household.[35] The results show that the largest reductions in the consumption occur mostly among the same people that have the highest income losses: younger people, people with higher incomes and highly educated people. Column 3 of Table 6 depicts the results for the net wealth contribution to the consumption possibilities. It shows that the households of young people receive less support for the consumption possibilities from their net wealth as they have not accumulated wealth as much as the older people. Another result from this regression is that larger households do not receive as much help for the losses via net wealth than people living in two-person household.

[35] *Note that a positive number in the table means a reduction in consumption compared to the reference category.*

Table 6. *Regression results for the determinants of losses following a death, the magnitude of life insurance the life insurance gap, and the take-up of term life insurance*

		Income Loss	Consumption Change	Net Wealth Contribution	Survivors' Pensions	Life insurance	Life insurance gap, up to 2 adults in a household	Life insurance (0/1)
Age group (vs -20 years)	21-30 years	+96 650	-8 169	-20 354	+21 929	+2 725	+83 181	0.035
		(760)	(485)	(70)	(290)	(168)	(554)	(0.001)
	31-40 years	+48 027	+61 096	-5 022	+48 075	+7 986	+58 085	0.080
		(769)	(490)	(71)	(293)	(170)	(561)	(0.002)
	41-50 years	-59 233	+114 830	+15 999	+28 068	+6 719	+4 813	0.093
		(778)	(496)	(72)	(296)	(172)	(567)	(0.002)
	51-60 years	-253 878	+187 845	+27 347	-2 375	+535	-91 540	0.071
		(784)	(500)	(73)	(299)	(173)	(572)	(0.002)
	61-70 years	-442 680	+326 528	+31 061	-847	-4 686	-141 680	0.0001
		(800)	(510)	(74)	(305)	(177)	(583)	(0.002)
Gender (vs woman)	Man	+88 878	-17 150	-982	+27 483	+2 397	+42 829	0.013
		(173)	(110)	(16)	(66)	(38)	(126)	(0.0003)
Marital status (vs unmarried)	Married	+9 929	+13 367	-6 021	+16 625	+6 238	+6 453	0.053
		(228)	(145)	(21)	(87)	(50)	(166)	(0.0004)
	Divorced	+3 468	+10 791	+5 247	+7 701	+2 461	-1 149	0.009
		(349)	(223)	(32)	(133)	(77)	(254)	(0.0006)
	Widow	+17 605	-33 792	+13 396	+15 939	+5 611	-51 134	0.033
		(1 099)	(701)	(102)	(419)	(243)	(802)	(0.002)
Taxable income (vs below average)	Above average	+318 893	-128 653	-4 541	+37 045	+6 779	+150 957	0.084
		(233)	(149)	(22)	(89)	(51)	(170)	(0.0005)
Degree (vs unknown)	Upper secondary education	+15 293	-15 288)	-561	+507	+2 213	-2 155	0.034
		(277)	(176)	(26)	(105)	(61)	(202)	(0.0005)
	Specialist vocational qualification	+56 711	-35 419	-982	+8 420	+5 692	+8 162	0.068
		(750)	(478)	(69)	(286)	(166)	(546)	(0.001)
	Lowest level tertiary education	+43 459	-31 283	+369	+4 499	+3 886	+3 423	0.059
		(370)	(236)	(34)	(141)	(82)	(269)	(0.0007)
	Lower tertiary education	+77 236	-50 301	-2 816	+15 920	+5 554	+8 278	0.060
		(334)	(213)	(31)	(128)	(74)	(244)	(0.0007)
	Higher tertiary level	+207 210	-102 818	-1 845	+39 069	+6 940	+60 228	0.061
		(347)	(221)	(32)	(132)	(77)	(253)	(0.0007)
	Doctorate level education	+234 856	-106 990	-700	+47 003	+4 468	+77 096	0.033
		(770)	(491)	(71)	(294)	(170)	(562)	(0.002)
Size of household (vs 2 persons)	3-5 persons	+10 488	+61 495	-12 211	+83 811	+5 696	-5 313	0.044
		(197)	(126)	(18)	(75)	(44)	(144)	(0.0004)
	6-9 persons	-1 862	+158 669	-23 749	+68 216	+8 397	+103 943	0.048
		(542)	(346)	(50)	(207)	(120)	(395)	(0.001)
Area of residence (vs countryside)	City	+17 927	-16 929	-11 668	+5 871	-554	-2 398	-0.010
		(193)	(123)	(276)	(74)	(43)	(141)	(0.0004)
	Constant	+182 059	-287 720	+49 390	-73 645	-7 799	-73 606	-0.067
		(786)	(501)	(73)	(300)	(174)	(573)	(0.002)
	Observations	4,524,544	4,524,544	4,524,544	4,524,544	4,524,544	4,524,544	4,524,544

The fourth column in the table shows that the discounted survivors' pensions are on average larger for young people with the same other characteristics. They are also larger (conditional on all the other characteristics being the same) for men, people with higher income, higher education level and for the larger households.

Regarding the life insurances the fifth column of Table 6 shows that they are the largest for people aged 31-50, men, higher income people and for those living in larger households. The sixth column of the table shows the results for the life insurance gap arising as the difference between the losses following from a death and the life insurance designed to counteract the loss. The results show that while keeping the other characteristics constant, the life insurance gaps are the highest for young people, men, people with higher level of income and people living in very large households.

The last column of the table shows how the take-up of life insurance relates to the personal and family characteristics. The results show qualitatively very similar results than those for the magnitude of the life insurance: conditional on other characteristics being the same, the take-up is largest among people aged 31-50, men, higher income people and for those living in larger households.

Regarding the results shown in Table 6, it is worth noting that several variables are correlated with each other. For example, income and gender, income and age, and income and level of education interact with each other. For this reason, a change in one factor may also change other factors at the same time. This complicates the straightforward interpretation of the coefficients, which examine how a change in one variable affects the outcome variable when other factors remain constant.

To illustrate the life insurance and the life insurance gap with respect to person's and his/her characteristics we provide graphs on group means for both measures in Figures A10 and A11 in the Appendix. The groups are the same as those in Table 6. The figures correspond to columns five and six of the regressions in the table (life insurance and life insurance gap). Regarding the life insurances both the regression and the group means show that the life insurance is on average largest for people of ages 31-50 years, men, income above average, education level high and living in 3-9 person households. Regarding the life insurance gap, the regression results and the group means both show that the life insurance gap is largest for people between ages 21-40 years, men, income above average, education level high, and living in 6-9 person households.

The results also show that for some groups both the life insurance and the life insurance gap are larger than for other groups. This is the case, for instance, for people with income level higher than the average, and for those with education level higher than upper secondary education. In these cases, people have taken larger life insurances than others, but given their characteristics, they should have taken even larger life insurances to cover the need for life insurance to maintain the standard of living after the death of a breadwinner of the household.

5.2 The monetary loss from a death and the demand for life insurance

Next, we study how the monetary loss from a death and the life insurance demand are related. A high monetary (net) loss from a death provides higher incentives to shelter from the undesired outcome by buying more life insurance. We use a statistical model to analyze which factors correspond with the propensity to shelter from the economic risks of death with life insurance. The analysis can provide us important information regarding the overall propensity as well as the underlying factors behind the life insurance gap.

To study the issue empirically, we first employ a model that quantifies the average response of the life insurance coverage to the loss from the death:

$$LifeInsurance_i = \alpha + \beta_1 LossFromDeath_i + \beta_2 Z_i + \varepsilon_i \quad (3)$$

Here variable $LifeInsurance_i$ stands for the amount of the life insurance, $LossFormDeath_i$ stands for the (net) loss from the death and is constructed from four components described above for instance in Table 4: the loss of income, the consumption reduction, net wealth contribution and survivors' pensions. Variable Z_i stands for control variables, which

include age group, gender, marital status, taxable income, degree, the size of household and the area of residence. The parameter of interest is β_1, which describes how the life insurance is related to net loss from the death.

We also consider whether there are differences in the response with respect to person's characteristics. We run separate regressions, where the control variables are the same as above, but for each characteristic we exclude the corresponding characteristic from the control variables (see Table 7 below).

$$LifeInsurance_i = \alpha + \beta_1 LossFromDeath_i * Characteristic_i + \beta_2 Z_i + \varepsilon_i \quad (4)$$

Table 7 shows the regression results of the two models. First, we study the overall propensity for people who have income, other members in their household, all the family members are identified and there are at most two breadwinners in the household ("All" in Table 7). We find that the propensity is low, 0.015: A €1000 higher net loss from the death is associated with merely €15 higher life insurance coverage.

However, the propensity is heterogeneous across different population groups. Regarding different age groups, we see that the largest response to net losses is among adults, between the ages of 41 to 50, even after controlling for other factors. They increase life insurance coverage by €24 euro in response to additional €1000 net loss from the death. People aged 61 to 70 have the lowest propensity among the age groups. The differences may, at least partly, reflect differences in the supply of insurances: restrictions of access and their higher prices.

Interestingly, the propensity for men (0.021) is about three times as much as that of women (0.008), even after controlling for differences in other background variables. Differences in the propensity across sexes may reflect differences in life expectancy among other things, despite the fact that Kutlu-Koc and Kalwij (2017) found that especially women, on average, underestimate the length of their lifespans. Correspondingly, however, Luciano et al. (2016a) show that women in Italy have fewer insurance policies even when the effects of other factors are controlled.

People with low income do not seem to respond to the incentive positively. This is consistent with, for example Gropper and Kuhnen (2021), who studied the coverage of term life insurance policies with US register data. They found that the ownership is strongly positively correlated with wealth.

Table 7. *Life insurance responses to the net loss from death*

Life insurance										
		Age group					**Gender**		**Income level**	
	All	**21-30 years**	**31-40 years**	**41-50 years**	**51-60 years**	**61-70 years**	**Men**	**Women**	**High income**	**Low income**
Net losses	0.015	0.013	0.016	0.024	0.014	0.007	0.021	0.008	0.017	-0.006
	(0.0001)	(0.0002)	(0.0004)	(0.0004)	(0.0003)	(0.0003)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Control variables										
Age group	YES	NO	NO	NO	NO	NO	YES	YES	YES	YES
Gender	YES	YES	YES	YES	YES	YES	NO	NO	YES	YES
Marital status	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Taxable income	YES	YES	YES	YES	YES	YES	YES	YES	NO	NO
Degree	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Size of household	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Area of residence	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Observations	4,524,544	726,061	1,003,717	983,841	997,552	750,690	2,167,042	2,357,502	3,667,445	857,099
	Degree							**Household size**		
	Unknown	**Upper secondary education**	**Specialist vocational qualification**	**Lowest level tertiary education**	**Lower tertiary education**	**Higher tertiary level**	**Doctorate level education**	**2 persons**	**3-5 persons**	**6-9 persons**
Net losses	0.014	0.012	0.026	0.017	0.013	0.019	0.023	0.008	0.018	0.028
	(0.0003)	(0.0002)	(0.0016)	(0.0005)	(0.0004)	(0.0004)	(0.0012)	(0.0002)	(0.0003)	(0.0011)
Control variables										
Age group	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Gender	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Marital status	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Taxable income	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Degree	NO	NO	NO	NO	NO	NO	NO	YES	YES	YES
Size of household	YES	YES	YES	YES	YES	YES	YES	NO	NO	NO
Area of residence	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Observations	563,136	2,022,722	65,241	469,957	719,266	622,461	61,761	2,231,484	2,163,719	125,677

The higher propensity is at least partly explained with education: The higher educated people respond more strongly than others (0.019 for higher tertiary level and 0.023 for doctorate level education). Regarding the household size the results reveal that the people living in very large households respond with life insurance to the loss from death more heavily than other people (0.028). Notably, Li et al. (2007) who studied the demand for life insurance statistically using panel data on OECD countries, also found that higher level of education, higher disposable income and number of children are associated with larger average life insurance premiums paid per capita at a country level.

6 Conclusions

Using individual-level data, we have examined the prevalence of voluntary term life insurances in different groups, the amounts of life insurances and the (net) losses following from the death of a breadwinner, as well as the difference of these losses and death cover, the insurance gap. The examinations are based on Finnish insurance companies' life insurance information and Statistics Finland's personal and household information from 2018–2020.

Based on the results, some clear differences between population groups are observed. The probabilities and amounts of life insurance vary depending on a person's characteristics. People of working age, people with higher incomes and married people, as well as those who live in households of 3–5 people, have life insurances more often than other people. Between 2018 and 2020, an average of 8% of individuals have had a life insurance in the data. For all observations in the data, the average amount of life insurance is €5,868, and for those who have a life insurance, the average is €73,150. The data covers approximately 70 percent of term life insurances in Finland.

A central monetary loss following from a death for a household is the person's lost future income. For persons who have income and who live in households of at least two people, the loss of earned income at present value is on average around €450,000 in the data. In addition to the income change, also the total consumption of the household changes, decreasing by an average of around €270,000 in the data, which compensates for the majority of the loss of income. In addition, a greater share of the wealth accumulated in the household is left for the surviving household to use. Taking this into account compensates for loss of income by around €45,000. Without survivors' pensions and life insurances, the life insurance gap would be approximately €130,000 to €140,000.

Statutory survivors' pensions compensate for the loss by around €55,000, which corresponds to about 40% of the loss. Life insurances, on the other hand, only compensate for a little over €10,000, which corresponds to less than 10%. The remaining insurance gap is on average around €65,000 to €70,000 in the data. An additional insurance of this amount would maintain the consumption possibilities of the surviving household at the current level. However, currently the amounts of life insurances are on average about one sixth of what they should be to maintain the current standard of living of a household. The amount of the insurance gap we observed is about half of the result of a previous study based on Finnish data (Kari et al. 2007).[36] The difference is explained, in part, by us having individual-level data at our disposal, enabling finer and more precise examinations than before.

Clear differences are also observed in the insurance gap in relation to population groups. The life insurance gap is found to be the largest among young people, men, people with higher incomes and those with a higher level of education. Insurance gap also arises mostly due to those people having no voluntary term life insurance at all.

We also studied how the life insurance responses to net loss from death. We found quite small response: on average a €1000 higher net loss from the death is associated with a €15 higher life insurance. However, some clear differences in the response occur: people of 41-50 years of age respond to net losses more than other people, the response of men is

[36] *They reported an insurance gap of €126,000 on average, and €230,000 for households with young breadwinners. In their results, private life insurance covered an average of about 4% of the need for protection. Compared to their results, our results are based on individual-level data, which reduces the possibility that unobserved factors would affect them.*

about three times that of women, highly educated people respond more strongly than others, and people living in very large households respond with life insurance to the loss from death more heavily than other people.

Overall, our findings are consistent with previous literature regarding the existence and qualities of the life insurance gap. From the policy perspective, they hint towards the reasons of the gap being, at least partly, informational. The analysis shows that highly educated people tend to be more insured against the potential losses of income, even after controlling for other factors. Moreover, the cost of life insurance tends to be low at young age, thus suggesting that the low and late take-up of the insurances may not be a result of informed economic decision making. Thus, there might be room for further education with respect to the size of economic losses as a result of death as well as the options of self-insuring the risks of such an event, especially in those households where the risks are high and concentrated.

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Appendix/Online Appendix

The wage profiles in Figure A1 are used when evaluating a person's future wage income from now until they retire. With the profile information, an estimate is made of a person's income for the next year, the year after that, and so on until the last year before retirement.[37] By taking into account taxation (in Figure A2) and discounting over the years, an estimate can be made of the after-tax expected (net) income lost due to a death in current value.

Figure A1. *Wage profiles*

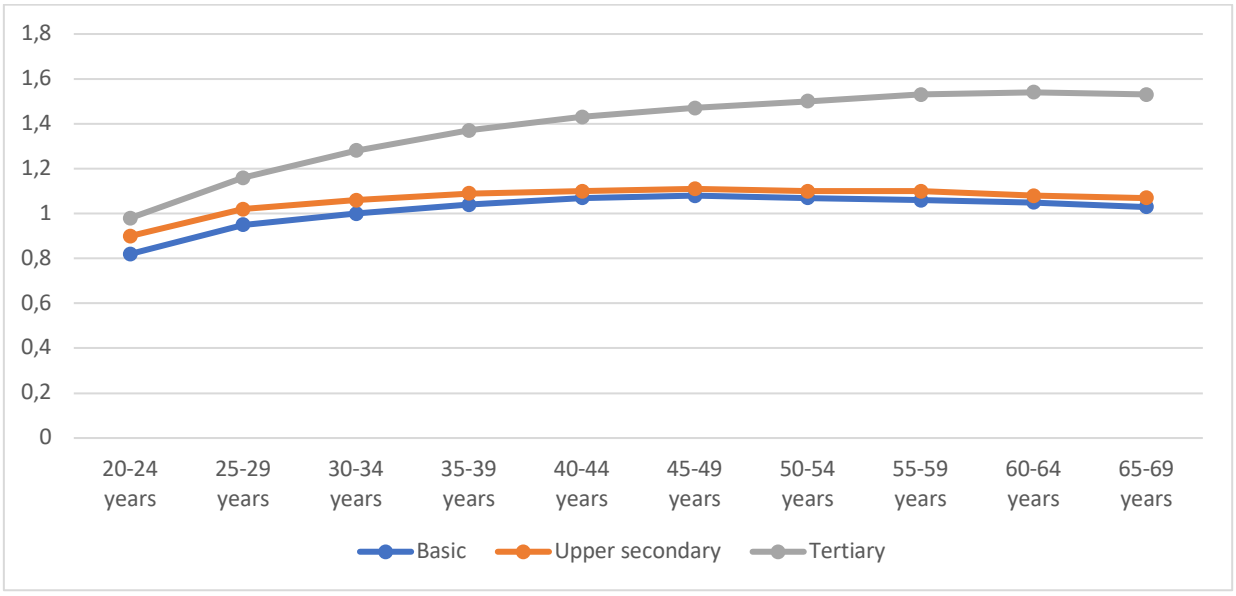
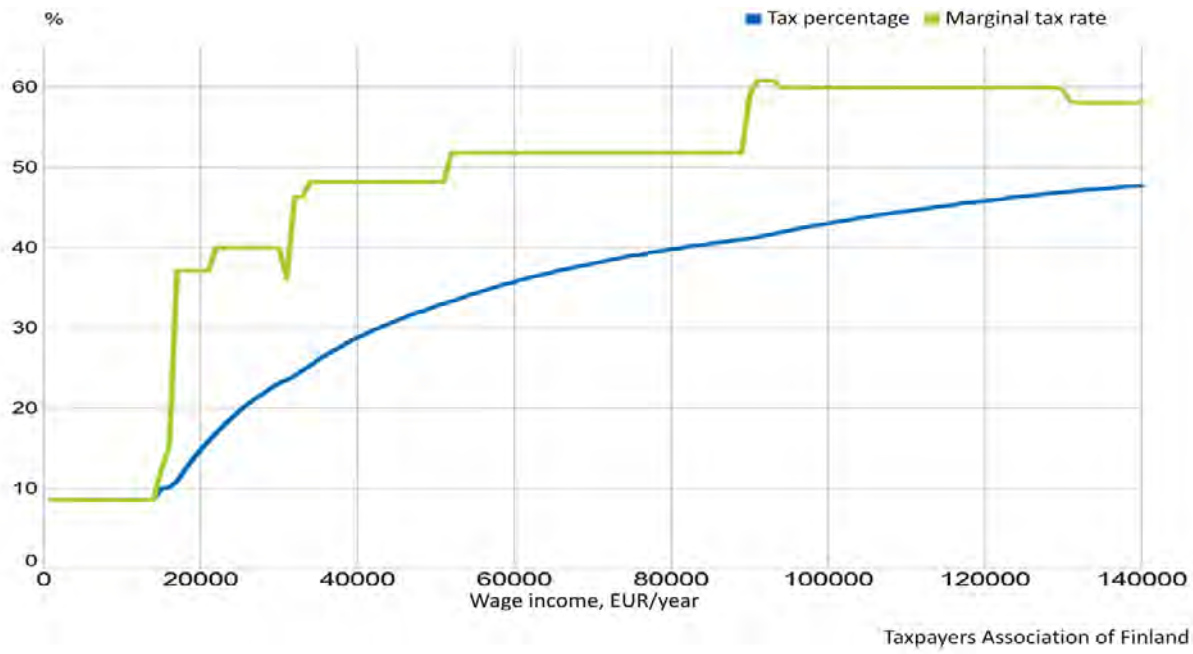


Figure A2. *Tax rates for wage earners in 2020. Source: Taxpayers Association of Finland*



[37] *Since the level of education typically changes for young people, we apply the education-dependent profiles described above to people aged 30 and over. For those aged 20–29, we use an average wage profile formed with the help of the profiles in the figure.*

Figure A3. *The lost future current value after-tax income following from a death (shares and frequencies)*

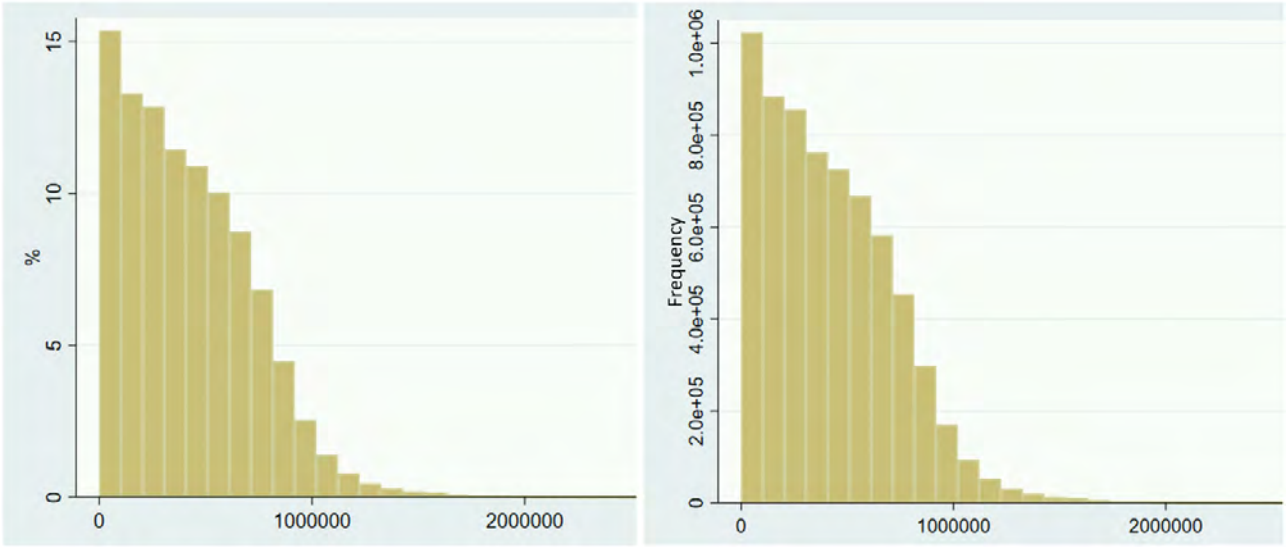
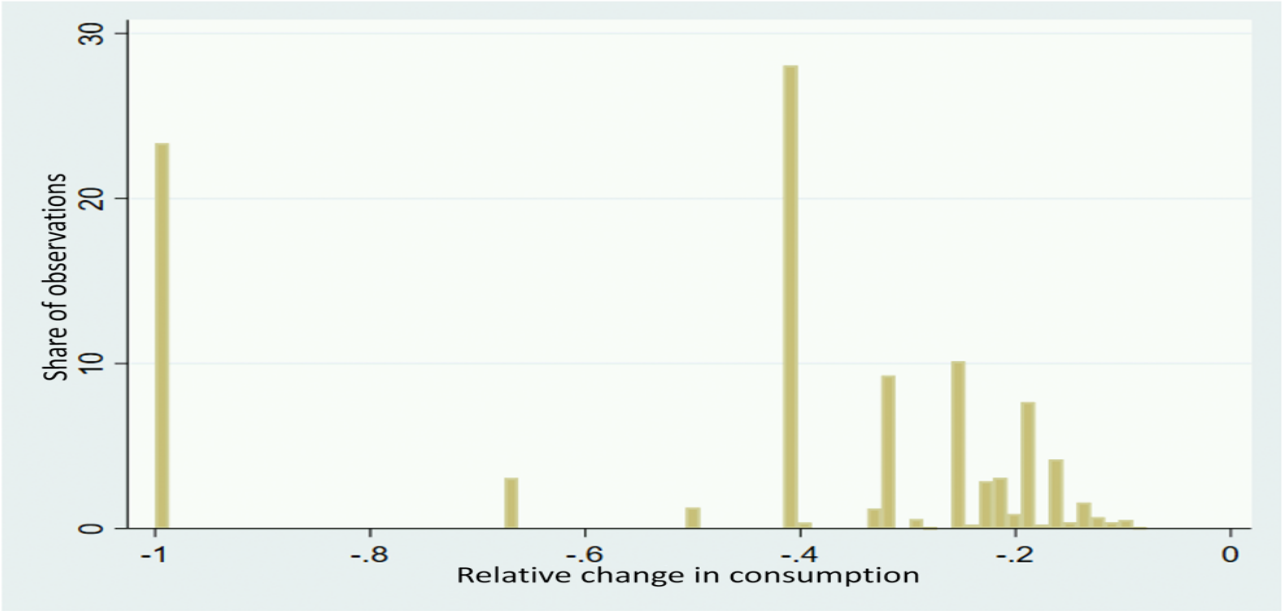


Figure A4. *Distribution of relative changes in household consumption upon the death of one person*



The left-hand graphs of Figure A5 illustrate the distribution of reductions in consumption. For comparison, the figures on the right depict the distribution of lost income accordingly. The figures at the top depict all observations, the bottom ones only those for which the observations are positive. As a combined effect of lost income and reduced consumption, the consumption possibilities of a household would decrease due to a death by an average of €64,444 (= €170,592 - €106,148; without zeroes: €193,640 = €424,697 - €231,057). This means that, for all observations, an average of 62% of the reduction in income following from a death is compensated through a reduction in consumption (54% without zeroes).

Figure A5. *Distributions of reductions in consumption and lost income. Source: Statistics Finland*

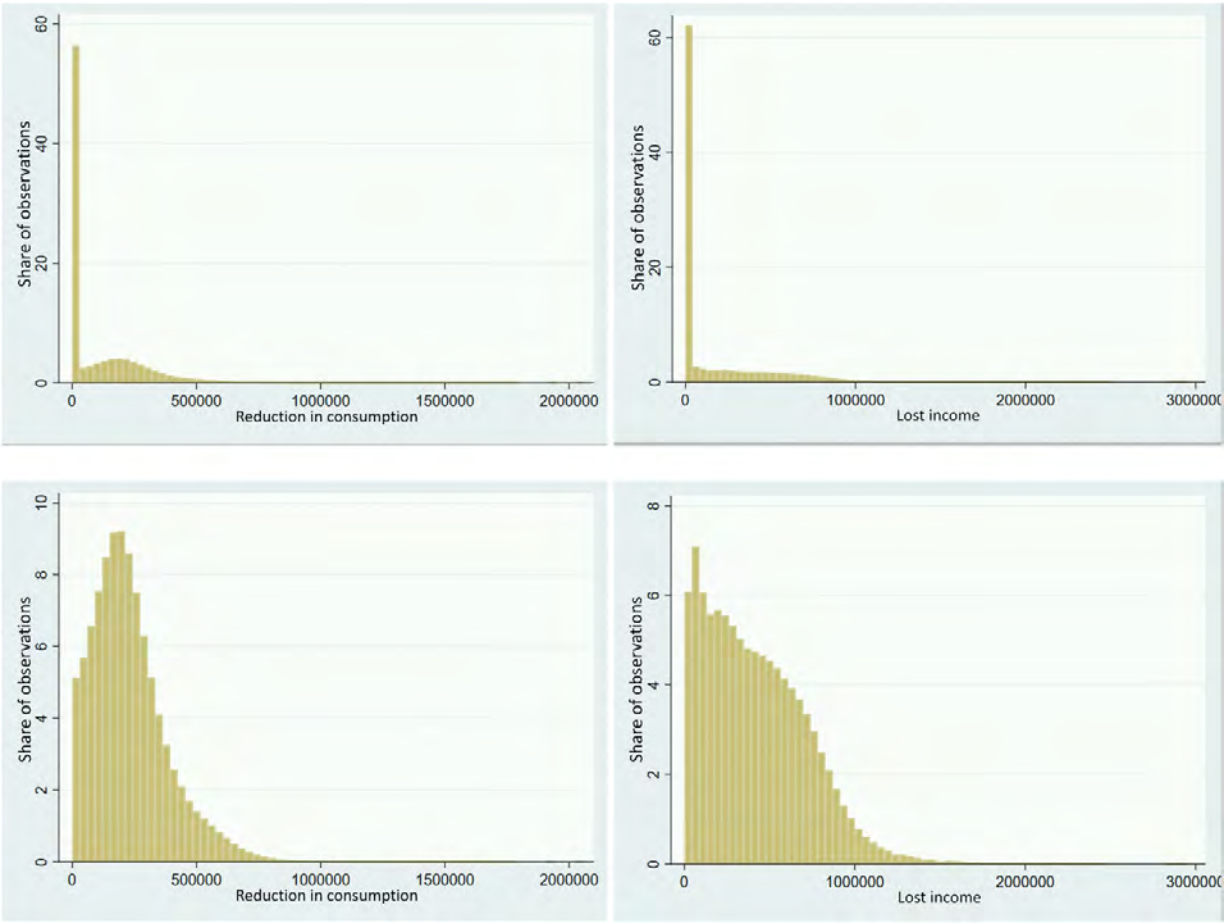


Figure A6. *Assets, liabilities and net wealth, median 2019*

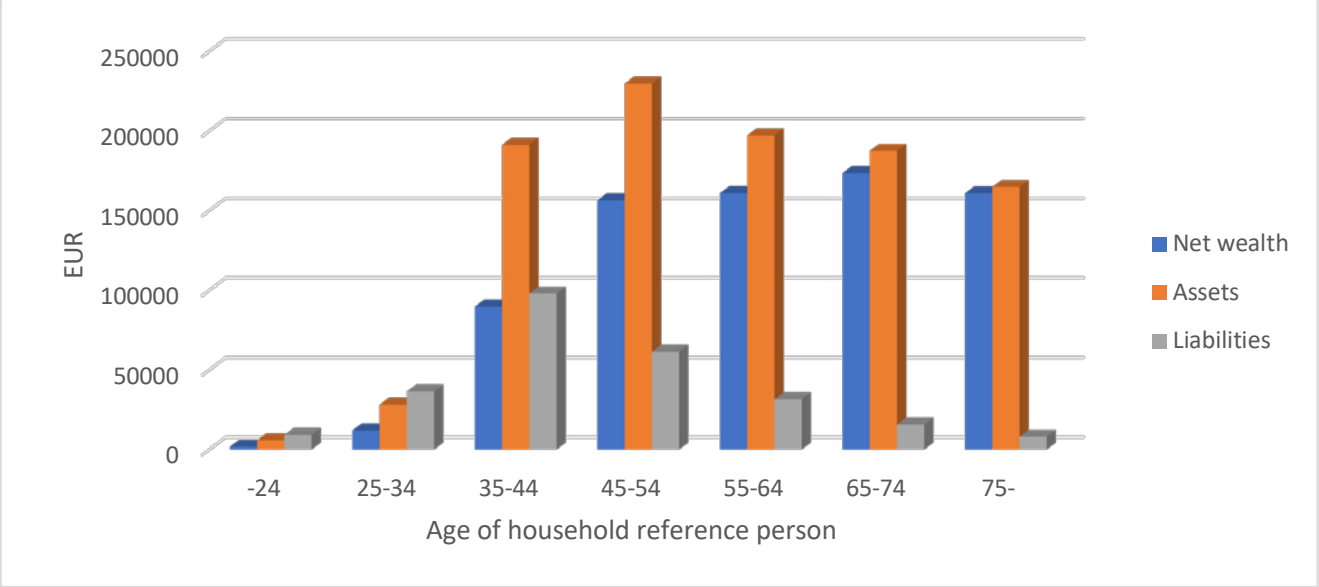


Figure A6 shows the medians of assets, liabilities and net wealth of different households according to the age of the reference person. They are based on Statistics Finland's wealth survey from 2019. When interpreting the figure, it should be noted that the wealth of older age groups originates from a time when incomes were lower than today. This explains, at least in part, the fact that, in the figure, gross wealth appears to decrease after middle age and net wealth is lower for the oldest people, even though the median wealth of households in that cohort has increased throughout the life-cycle. In the youngest age groups, the median net wealth is positive even though the median liability is greater than the median wealth. This is due to the properties of the distributions.

Figure A7. *Unconsumed net wealth (€)*

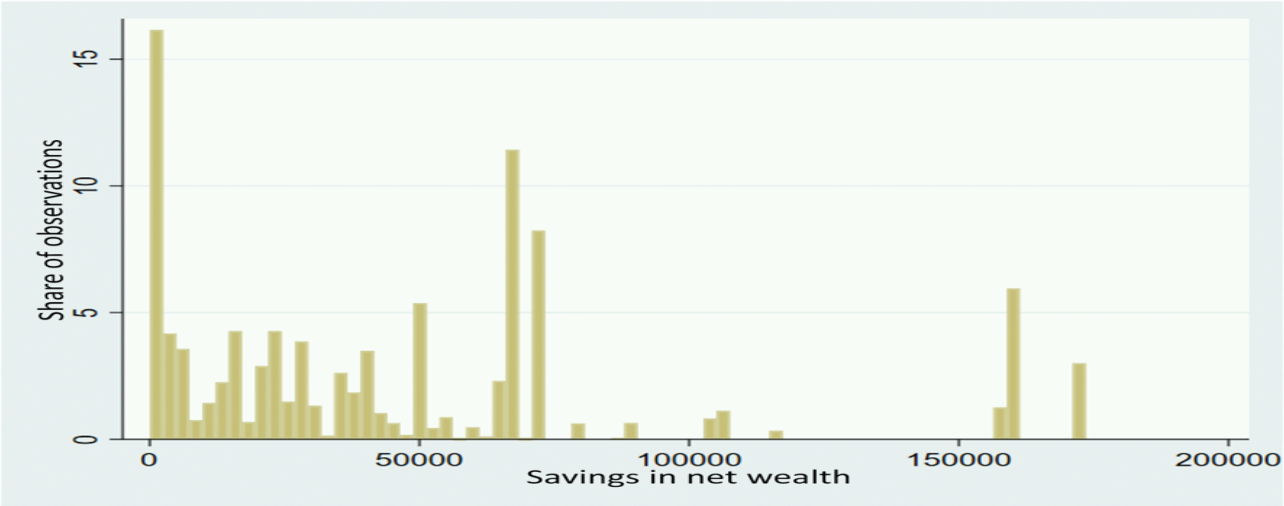
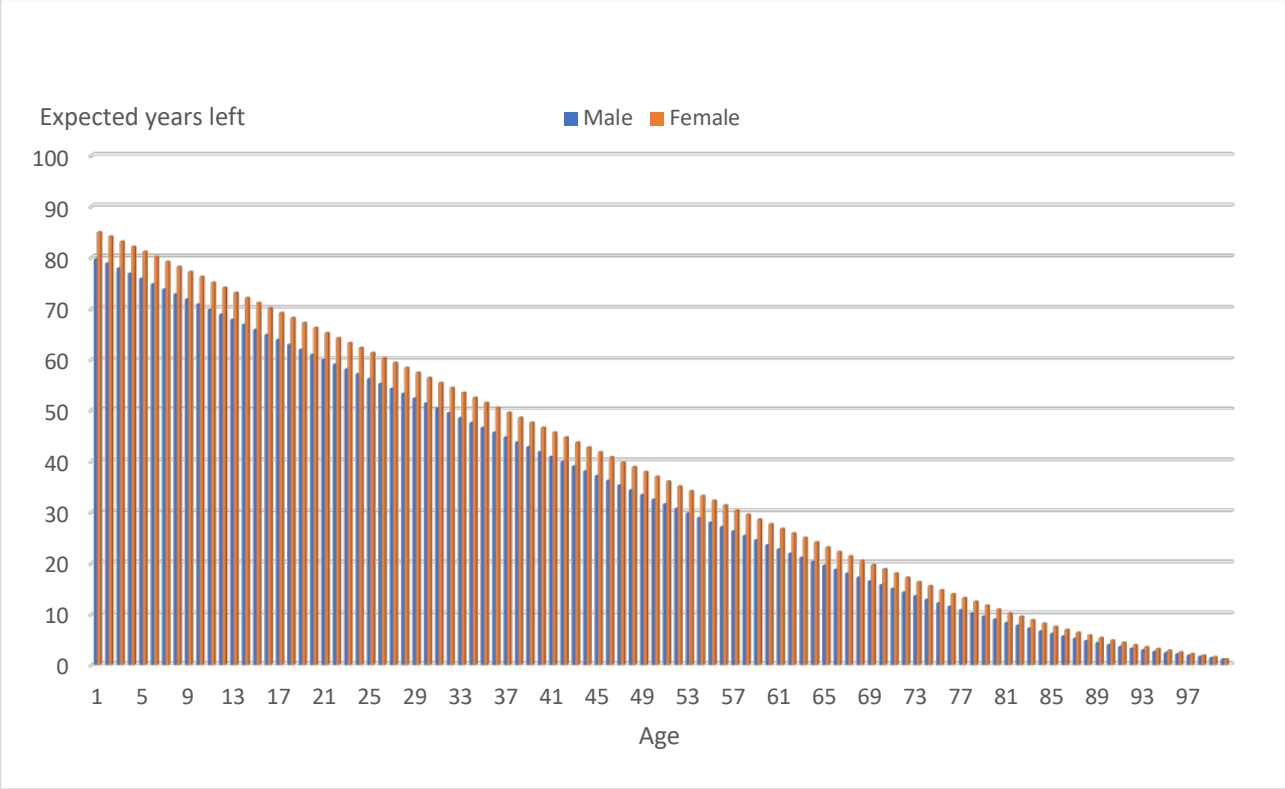
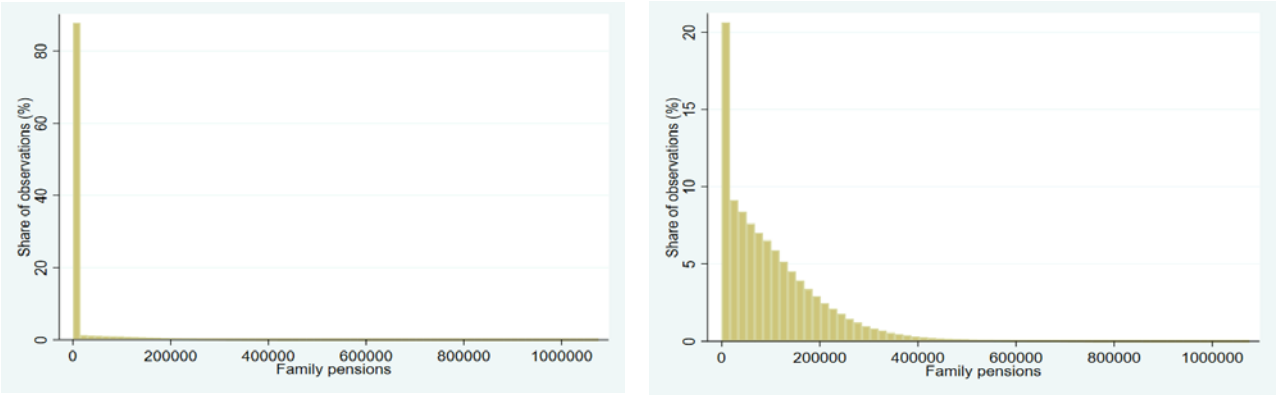


Figure A8. *Life expectancy of people of different ages by gender in 2021. Source: Population projection 2021, Statistics Finland*[38]



For spouses born in or before 1974, the duration of the widow's pension is defined by means of the age and gender dependent life expectancies shown in Figure A8. The expectancy is higher for women (red bars).

Figure A9. *The discounted survivors' pensions following from a death in current value (right without zeroes)*



[38] *https://pxnet2.stat.fi/PXWeb/pxweb/fi/StatFin/StatFin__vrm__vaenn/statfin_vaenn_pxt_139l.px/*

Figure A10. *The life insurance and the background characteristics*

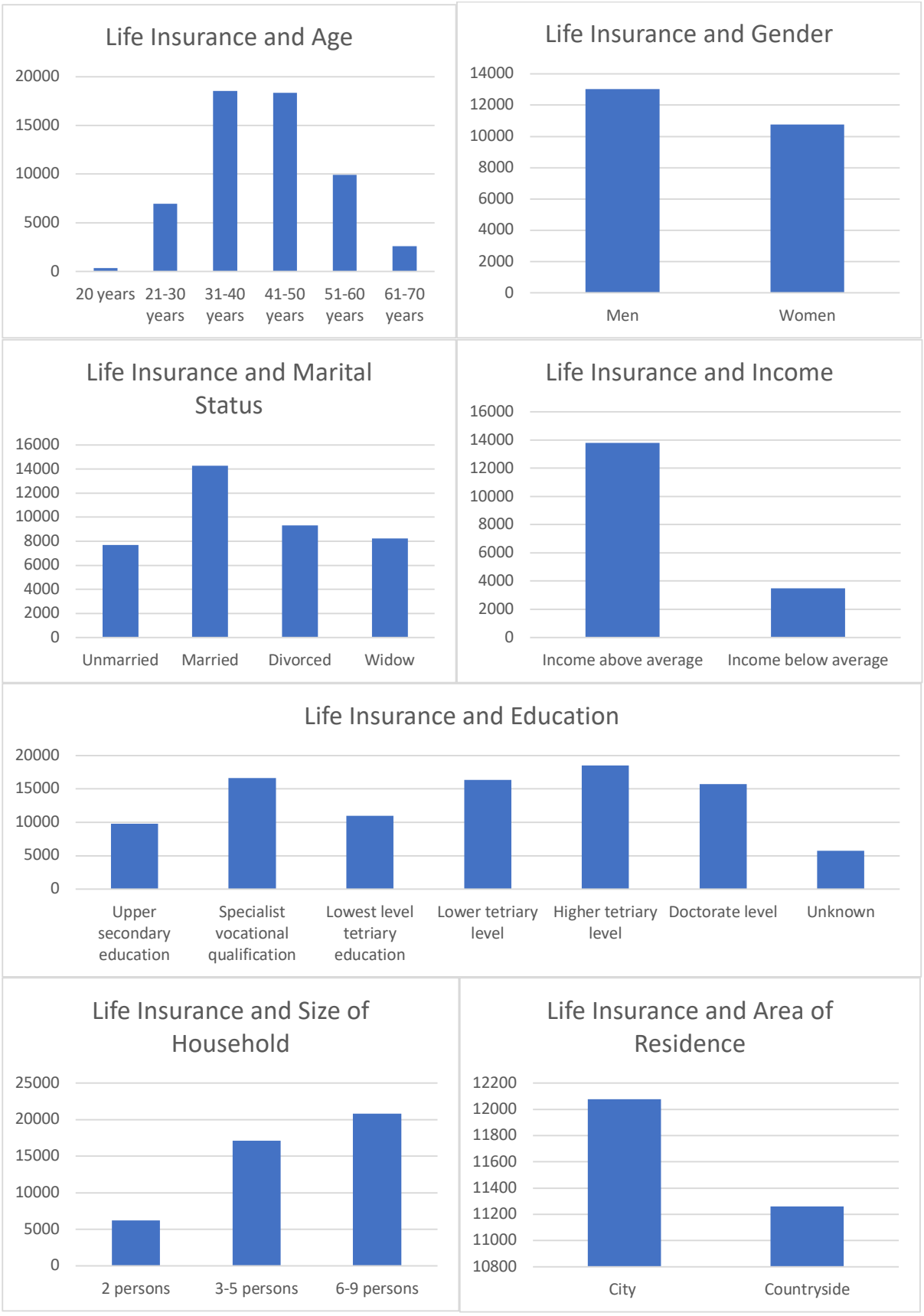


Figure A11. *The life insurance gap and the background characteristics*