International Center for Insurance Regulation
Goethe University Frankfurt

House of Finance
Sustainable Architecture for Finance in Europe

ICIR Working Paper Series No. 24/2016

Edited by Helmut Gründl and Manfred Wandt

Life Insurance and Demographic Change: An Empirical Analysis of Surrender Decisions Based on Panel Data

Irina Gemmo*, Martin Götz†

This version: December 2016

Abstract

Households buy life insurance as part of their liquidity management. The option to surrender such a policy can serve as a buffer when a household faces a liquidity need. In this study, we investigate empirically which individual and household specific sociodemographic factors influence the surrender behavior of life insurance policyholders. Based on the Socio-Economic Panel (SOEP), an ongoing wide-ranging representative longitudinal study of around 11,000 private households in Germany, we construct a proxy to identify life insurance surrender in the data. We use this proxy to conduct fixed effect regressions and support the results with survival analyses. We find that life events that possibly impose a liquidity shock to the household, such as birth of a child and divorce increase the likelihood to surrender an existing life insurance policy for an average household in the panel. The acquisition of a dwelling and unemployment are further aspects that can foster life insurance surrender. Our results are robust with respect to different models and hold conditioning on region specific trends; they vary however for different age groups. Our analyses contribute to the existing literature supporting the emergency fund hypothesis. The findings obtained in this study can help life insurers and regulators to detect and understand industry specific challenges of the demographic change.

Keywords: Demographic Change, Life Insurance, Surrender

*Corresponding author, telephone: +49 69 798 33694, e-mail: gemmo@finance.uni-frankfurt.de

†Irina Gemmo is with the International Center for Insurance Regulation at Goethe University Frankfurt, House of Finance, PF 39, Theodor-W.-Adorno-Platz 3, D-60629 Frankfurt am Main, Germany. Martin Götz is with the Research Center Sustainable Architecture for Finance in Europe (SAFE) at Goethe University Frankfurt, House of Finance. Both authors gratefully acknowledge research funding from the SAFE Center of Excellence, funded by the State of Hessen initiative for research LOEWE.

‡The authors are grateful for helpful comments and suggestions by participants of the Annual Congress of the German Insurance Science Association, Vienna, Austria and the 2016 Annual Meeting of the American Risk and Insurance Association (ARIA), Cambridge, MA, USA. Any errors are our own.

1 Introduction

The risks that can arise from life insurance policy surrenders[1] are of high importance for the stability of the insurance industry and therefore also affect insurance regulation.[2] Kuo et al. (2003) categorize the effects surrender can have on an insurer into three groups: (1) As surrender stops the insurer's premium inflow, it might not earn enough premiums to cover the initial expenses it had before issuing the policy, such as costs of acquiring new business and underwriting. (2) As impaired policyholders with a life expectancy below average do not tend to surrender their life insurance policies, this kind of adverse selection can cause the pool of insured to contain a higher fraction of "bad risks" when the surrender rate is high compared to a case without policy surrender. (3) As most life insurance policies ensure the policyholder a cash surrender value (CSV)[3], a high rate of policy surrenders can cause liquidity problems to the insurer. If the insurer's asset allocation was determined without accounting for the surrender rate or by using an incorrectly estimated surrender rate, the insurer might not be able to liquidate a sufficient amount of assets to meet its obligations. Therefore, it is of high importance for an insurer to have a realistic assessment of the surrender rate and its fluctuation over time.

Empirical research on the topic investigates which factors influence the surrender behavior of life insurance policyholders. Most articles either look at the economic environment, such as economic growth, interest rate environment and unemployment rate[4] (e.g. Outreville (1990), Kagraoka (2005), Kim (2005), Kiesenbauer (2012), and Russell et al. (2013)), or they look at insurance policy characteristics (e.g. Renshaw and Haberman (1986), Cerchiara et al. (2008), Milhaud et al. (2011), Eling and Kiesenbauer (2014), Moenig and Zhu (2014) and MacKay et al. (2015)). Only

[1] The terms *lapse* and *surrender* both describe the termination of an insurance policy before maturity. However, they differ as lapse refers to termination without any payout to the policyholder, while surrender usually indicates that a surrender value is paid (See e.g. Kuo et al. (2003) or Gatzert et al. (2009)). Throughout this paper the term *surrender* is used referring to both surrender and lapse situations.

[2] See Eling and Kochanski (2013).

[3] See Fang and Kung (2012).

[4] Initially, only two economic explanatory variables had been studied in this area: The impact of interest rates on surrender, referred to as the interest rate hypothesis, and the impact of unemployment on surrender, referred to as the emergency fund hypothesis. The latter explains that in times of personal financial crises life insurance is turned into cash values. Later on, this work has been extended by taking into account additional economic drivers of policy surrender.

in the recent years, individual or household characteristics have been studied on a micro-level in this context (e.g. Fang and Kung (2012), Fier and Liebenberg (2013), Belaygorod et al. (2014), Mulholland and Finke (2014), Nolte and Schneider (2015) and Sirak (2015)).[5]

Extracting the drivers of life insurance surrender can help predicting future surrender rates. Regarding surrender behavior that is related to certain insurance policy features, a part of the academic literature looks at how life insurance companies can lower their surrender rate by designing the policies accordingly (e.g. Moenig and Zhu (2014) and MacKay et al. (2015)). However, insurance companies have little or no influence on surrender rates that are driven by economic factors and individual characteristics. Since premature contract termination can be beneficial for households in times of liquidity needs, life insurance surrender can be part of households' liquidity risk management. Liebenberg et al. (2012) use data from the $1983 - 1989$ *SCF panel study* to examine amongst other variables the impact of education levels, marital status, number of children and financial vulnerability on the demand for life insurance policies. They find a significant relationship between individual life events, such as new parenthood, and demand for life insurance, as well as a higher likelihood to surrender for households in which either spouse has become unemployed. When regarding economic and individual characteristics related to surrender decisions, one has to take into account that these factors may collectively change over time.

As reported by The World Bank (2015), life expectancy at birth has increased from 70.6 years in 1970 to more than 80 in 2013. Due to this increase in lifetime, the number of people over the age of 80 will double to 9 million in Germany by 2060 (German Federal Statistical Office, Statistisches Bundesamt (2015)). An additional reason for the ageing society is the decreasing number of children. The *World Development Indicators* provided by *The World Bank* state that the fertility rate in Germany has dropped from 2.51 to 1.38 children between 1963 to 2013. While the population is ageing, there are other demographic factors that might display a liquidity shock to a consumer and that have exhibited a trend over the last decades: According to the *Eurostat database divorce indicators*[6], the divorce rate in Germany has increased from 1.0 divorce per 1000 inhabitants in 1960 to 2.1 divorces per 1000 inhabitants in 2013. Andrews and Sánchez (2011) analyze the demographic influence on the evolution of home ownership. They find that the probability of home ownership

[5] See Eling and Kochanski (2013) for a more detailed and more extensive overview on the empirical and theoretical research that has been done in the area of life insurance surrender.

[6] The data was withdrawn from Eurostat (Online data code: demo_ndivind), accessed 04.03.16

in OECD countries significantly increases in the $25-44$ age bracket, and it peaks between the age of 55 and 64. Furthermore, Andrews and Sánchez (2011) show that home ownership rates in OECD countries have generally increased since the 1990s. They conclude that ageing populations affect aggregate home ownership rates, since home ownership rates are higher for older people and that the increase in home ownership rates is partly reflecting demographic trends, in particular the population ageing.

This article aims to investigate empirically which individual and household specific sociodemographic factors influence the surrender behavior of life insurance policyholders and to address the question in which way demographic or societal changes affect life insurance surrender rates through the found characteristics.

The remainder of this paper is organized as follows. In Section 2, we describe our data and explain the process of constructing our sample and defining proxies for life insurance surrender. In Section 3, we present the estimations of the main regression models and discuss the results. Section 4 provides further regressions that focus on households' differential exposure to liquidity shocks. Robustness checks with respect to the model are conducted in Section 5. We conclude the analysis in Section 6. The Appendix contains additional technical descriptions and results, as well as some further robustness tests.

2 Data Source, Variable Definition and Sample Construction

2.1 Data Source

Our data source is the German Socio-Economic Panel (SOEP). The SOEP is an ongoing representative longitudinal study of private households, administered by the *German Institute for Economic Research, DIW Berlin*. The panel started in 1984 and is based on survey information from about 11,000 households or 30,000 individuals. The data provide a high level of detail and cover topics such as household composition, wealth, employment, income, health, consumption and satisfaction indicators. Moreover, by design the SOEP follows households over time and hence earlier work has analyzed it to study long-term social and societal trends (e.g. Fuchs-Schündeln and Schündeln (2005)). For our analysis we use information from the years 1984 to 2013.

2.2 Variable Definitions

2.2.1 Life Insurance Surrender

The SOEP does not explicitly ask whether a household surrendered an existing life insurance contract. Thus, we need to approximate whether a household has surrendered a life insurance policy in a given year. Because the SOEP follows households over time, it is possible to identify whether a households' portfolio of life insurance policies has changed. In particular, households are asked, whether they owned a life insurance policy in the previous year.[7] Exploiting changes in the investment portfolios of households we thus define life insurance surrender as a dummy variable taking on the value of one in year t if a households does not have a life insurance policy in year t, but owned a life insurance policy in year $t-1$, and zero otherwise. Hence, the surrender is based on changes in the holding of a life insurance policy in a household's investment portfolio. This approach is similar to Nolte and Schneider (2015).[8] This dummy variable is our main proxy for policy surrender.

One weakness of our proxy is that it also captures termination at contract maturity. To account for this, we define a second proxy where we only consider a change in a household's life insurance portfolio to represent an insurance surrender, if the household held the life insurance policy for less than 12 years. Since most life insurance contracts have a time to maturity of at least 12 years[9], we believe that this refinement accounts for the fact that households' life insurance contracts mature. Note, however, that this proxy still captures the termination at maturity of policies with an original time to maturity of less than 12 years. Our main results are not sensitive to the definition of the insurance surrender proxy and we discuss the sensitivity of our results with respect to the proxy in Section A.2 of the Appendix A.[10]

[7] The questionnaire specifically asks: "Did you or another member of the household own any of the following savings or investment securities in the last year?" The households can then indicate "yes" or "no" for the following securities: Savings account; Savings contract for building a home; Life insurance; Fixed interest securities (e.g. saving bonds, mortgage bonds, federal savings bonds); Other securities (e.g. stocks, funds, bonds, equity warrant); Company assets (for your own company, other companies, agricultural assets). The question does not differentiate between various types of life insurance products but it aims to address life insurance as a savings or investment security.

[8] Note that we don't capture a change of owning more than one life insurance policy to owning only one (or one less) policy. Therefore, we might underestimate surrender for households that own multiple policies.

[9] 12 years are the minimum contract period that yields a (partial) tax exemption of investment returns.

[10] The SOEP data also provides information about households' income and wealth as well as information on whether money has been put aside for emergencies. Since the latter is provided for only certain years in the panel, it can be used conducting an analysis based on these years only. We use this information to define further proxies for life insurance surrender in order to run sensitivity analyses. Furthermore, we compare the proxies to surrender statistics from the German life insurance market and a single companies' life insurance portfolio. According to this

2.2.2 Life Event Variables

To investigate the effect of household characteristics, influenced by demographic change, on households' surrender behavior, we construct several independent variables from the data set.

Number of Children In the surveys prior to 1995, the number of children living in a household was not explicitly asked for. However, for earlier surveys, households were asked to report the number of children, the household received child allowance for. Thus, we approximate the number of children in the household by considering the number of children the household receives child allowance for if the survey year is earlier than 1995, and the reported number of children, living in the household if the survey year is later than 1994.

Birth of a Child We use information on the number of children in a household and define a dummy variable, taking on the value of one if the number of children in a household increased within the last two years, or zero otherwise. Unfortunately the birth of a child is not explicitly asked throughout the whole survey and hence we need to use information on the households characteristics to approximate for a birth. Due to this, we also consider a change in the number of children in the previous two years to allow for lags in the reporting.

Divorce An indicator variable equal to one if the status of partnership in the previous year was "spouse", or "probably spouse", and it is not anymore in the current year, captures whether the household head got divorced recently.

Acquisition of Dwelling We construct a dummy variable if the household head's status changed from "tenant" to "owner" in this year when asked about the dwelling. This way we account for home ownership.

The variables "Birth of a Child", "Divorce" and "Acquisition of Dwelling" describe life events that can possibly impose a liquidity shock on the household, forcing a household to surrender his life insurance policy.

cross-check with data provided by the German Insurance Association (GDV) and a German insurer, respectively, we have chosen the best proxy to conduct our empirical analyses. Furthermore, the chosen proxy allows us to exploit the panel structure fully.

2.2.3 Control Variables

Additionally, we introduce variables that capture a households' sensitivity to a liquidity shock: the dummy variable "Recently Unemployed" equals 1 if the household head is officially unemployed in the current year or was officially unemployed in the previous year or two years ago. Since the birth of a child might affect households differently, depending on whether they already have children, we define a dummy variable for being a "Parent" that equals 1 if number of children in the previous year was greater than zero. Furthermore we include the household income and the age of the household head as control variables. Moreover, we also account for a households savings or investment portfolio. In particular, we define an indicator variable, taking on the value of one if a household owns liquid savings or investment securities in the current year.[11] Because households may not own any other liquid savings or investments, we also construct an indicator variable, taking on the value of one if the household owns illiquid savings or investment securities in the current year.[12] To account for the simultaneous reduction of other assets than a life insurance contract, we construct a variable that equals 1 if the household owned savings or investment securities in the previous year but does not own any in the current year anymore. For all three dummies we have excluded life insurance policies from savings or investment securities.

2.3 Sample Construction

We utilize information from the years 1984 to 2013 and analyze data on the household level. Since the dependent variable for time t is constructed using information from $t-1$ and some control variables use information reported in the following year's survey, our sample ranges from 1985 to 2012. Moreover, we exclude all individuals that are not classified as the household head.

[11] From the possible answers to the question about savings or investment securities, we consider the following as liquid: savings account, fixed interest securities, other securities.

[12] We consider the following answer possibilities to characterize illiquid investments: Savings contract for building a home and company assets.

Table 1: **Summary Statistics**

This table shows summary statistics for the used sample. Households are represented by their household heads. The sample ranges from 1985 to 2012.

	Household Heads of Private Households					
	N	Mean	Std. Dev.	Min.	Max.	Median
Life Insurance	244,371	0.51	0.50	0	1	1
Life Insurance Surrender (SP2)	244,371	0.04	0.21	0	1	0
Birth of a Child	244,371	0.07	0.26	0	1	0
Divorce	244,371	0.01	0.11	0	1	0
Number of Children	244,371	0.63	0.97	0	12	0
Parent	244,371	0.44	0.50	0	1	0
Acquisition of Dwelling	244,371	0.01	0.12	0	1	0
Recently Unemployed	244,371	0.14	0.35	0	1	0
Age	244,371	50.67	16.55	17	102	49
Household Income	231,455	2,217	1,683	0	200,000	1,892
Liquid Assets	221,772	0.78	0.41	0	1	1
Illiquid Assets	244,371	0.45	0.50	0	1	0
Reduction of Assets	244,371	0.21	0.41	0	1	0

Throughout the whole sample period and among all households, life insurance ownership is around 0.51%, while in 4% of all observations, a household surrenders an existing life insurance contract. In 7% of the observations, a new child is born into the household, whereas the average number of children is 0.63. Among each year and household, our sample exhibits 1% divorces. The respondents' mean age is 50.67, reflecting the fact that only household heads are included in the sample.

3 Regression Analyses

3.1 Empirical Design

We hypothesize that households use life insurance policies as a liquidity buffer to withstand certain liquidity shocks. As mentioned earlier, we believe that the birth of a child or a divorce stress a household's finances. To buffer this shock, a households may decide to surrender an existing life insurance policy and receive the insurance's surrender value.

To examine how specific life events and life insurance surrender are related, we estimate the

following regression model using Ordinary-Least-Squares (OLS):

$$LS_{it} = \beta_0 + \beta_1 \text{Birth of a Child}_{it} + \beta_2 \text{Divorce}_{it} + \mathbf{X'}\gamma + \delta_i + \delta_t + \epsilon_{it}, \quad (1)$$

where LS_{it} is the aforementioned dummy variable, indicating whether household i surrendered his life insurance policy in year t; Birth of a Child$_{it}$ is a dummy variable for the birth of a child in year t and household i; Divorce$_{it}$ is a dummy variable, indicating whether household i divorced in year t; **X'** is a set of control variables, as mentioned earlier. δ_i, δ_t are household and year fixed effects, respectively.

Our main coefficients of interest are β_1 and β_2: a positive coefficient of either of them, indicates that households are more likely to surrender their life insurance policy when a child is born into their household, or when they divorce, respectively. In robustness tests we examine the robustness of our findings to the inclusion of additional fixed effects. Moreover, we also examine whether our findings differ if we use hazard models to examine how our life events are correlated with the time until surrender.

3.2 Results

3.2.1 Life Events and Life Insurance Policy Surrender

Regression results from estimating Equation 1 are presented in Table 2. Not accounting for other influences, the results in column (1) and (2) indicate that the birth of a child, or divorce are associated with a significant increase in the likelihood of surrendering life insurance policies. Since the dependent variable is a dummy variable, the coefficients in column (1) and (2) can be interpreted as probabilities. Hence, using the coefficient in column (1) we find that the birth of a child is associated with an increase in the likelihood of surrendering life insurance policy by about 1%-point. In column (3) we include both variables jointly and still find that the birth of a child or divorce is associated with a significantly higher likelihood of surrendering life insurance policies.

In column (4) we add additional control variables. Specifically, we control for additional financial shocks to the household by including a dummy variable, taking on the value of one if the household acquired a dwelling recently or the household head became recently (within last two years) unemployed. Moreover, we also include the natural logarithm of the household head's age as

Table 2: **Individual Characteristics and Life Insurance Surrender - OLS Regressions**

This table reports OLS regressions at the household level over the period 1985-2012. The dependent variable is life insurance surrender, measured by the proxy SP2, multiplied by 100. Therefore, the coefficients can be interepreted as a percentage change. All regressions include year fixed effects and state and household fixed effects as indicated. Standard errors are clustered at the household level, and reported in parentheses. *, **, *** mean significance at ten, five, and one percent, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Life Insurance Surrender (SP2)						
Birth of a Child	1.060***		1.065***	1.260***	1.253***	0.483**	0.449**
	(0.177)		(0.177)	(0.193)	(0.193)	(0.217)	(0.218)
Divorce		1.724***	1.741***	1.695***	1.671***	1.205**	1.167**
		(0.459)	(0.459)	(0.518)	(0.518)	(0.575)	(0.575)
Parent				-0.806***	-0.810***	-1.006***	-0.968***
				(0.116)	(0.116)	(0.154)	(0.155)
Acquisition of Dwelling				1.370***	1.358***	0.805*	0.834*
				(0.448)	(0.448)	(0.482)	(0.482)
Recently Unemployed				0.419**	0.490***	0.288	0.302
				(0.156)	(0.158)	(0.223)	(0.223)
ln(Age)				0.381**	0.387**	4.779***	4.622***
				(0.166)	(0.167)	(1.082)	(1.083)
ln(Income)				1.103***	1.058***	1.973***	1.920***
				(0.104)	(0.105)	(0.193)	(0.193)
Liquid Assets				-1.918***	-1.883***	-1.470***	-1.451***
				(0.158)	(0.158)	(0.222)	(0.223)
Illiquid Assets				-2.567***	-2.563***	-2.531***	-2.546***
				(0.124)	(0.124)	(0.187)	(0.187)
Reduction of Assets				3.790***	3.789***	3.682***	3.663***
				(0.141)	(0.141)	(0.161)	(0.161)
Constant	4.378***	4.436***	4.358***	-2.796***	-2.559***	-27.34***	-29.57***
	(0.0535)	(0.0528)	(0.0537)	(0.907)	(0.963)	(3.77)	(4.142)
Time FE	x	x	x	x	x	x	
State FE					x		
Household FE						x	x
State-Time FE							x
Observations	244,371	244,371	244,371	211,038	211,037	211,038	211,037
R-squared	0.001	0.001	0.001	0.014	0.014	0.132	0.134

well as income. Dummy variables, that indicate whether the household has any additional liquid or illiquid assets, respectively, as well as a dummy variable for the reduction of the household's assets capture differences in households' investment portfolio. Our results also hold if we control for additional household characteristics.

So far, the results indicate that birth of a child or divorce are associated with an increase in the likelihood of surrendering life insurance policies. In columns (1) to (4) we have only included year fixed effects to account for unobservable trends in the surrender behavior at the national level. Our data set, however, allows us to also capture unobservable changes in life insurance surrender at a subnational level. In particular, we use information on the location of the household, and account for differences across states, by including a state-fixed effect.

Earlier work has found evidence that there are regional differences in the investment behavior of German households.[13] In column (5) we therefore present the estimate of Equation 1 including state fixed effects. Again, we find that our life events are positively associated with an increase in life insurance policy surrender.

The SOEP is a representative sample of the German population. Thus, there is a large heterogeneity across households in our sample. While we control for observable characteristics, we are not able to account for unobservable features, such as a household's financial literacy or its aversion to or love of life insurance policies. To also account for these unobservable factors at the household level, we further include household fixed effects. These household fixed effects thus account for all additional time-invariant factors at the household level that shape a household's life insurance surrender decision. Our results (column (6)) indicate that the birth of a child or a divorce is associated with an increase in the likelihood of surrendering life insurance policy, even if we condition on unobservable household characteristics. Thus, a household's decision to cancel the life insurance policy is higher if that household head either divorces or the household grows due to the birth of a child. Note, that due to the household fixed effects, we can interpret the coefficients as an indicator of how much of a change in a regressor is associated with a change in a household's surrender probability.

To further allow the unobservable state-specific effect to vary over time, we combine the year

[13] Fuchs-Schündeln and Schündeln (2005) for instance show that East and West Germany differ in their stance towards investment.

and state fixed effect and include state-year fixed effects to capture unobservable changes in life insurance surrender at the state level over time. Column (7) shows that our results are robust to the inclusion of these state-time fixed effects.

Table 2 indicates that life events, such as the birth of a child or divorce are followed by an increase in the likelihood of canceling a life insurance contract. Moreover, this effect is also robust to the inclusion of additional fixed effects. This pattern is consistent with the idea that the life events birth of a child and divorce represent a liquidity shock to the household's finances, causing the household to surrender its life insurance contract to weather that liquidity shock.

4 Differential Exposure to liquidity shocks

4.1 Age

Our results are consistent with the idea that a liquidity shock to a household leads to an increase in the surrender of life insurance policies. Moreover, these findings are robust to several additional influences at the household level, as well as the inclusion of additional time-, state- and household fixed effects. Life cycle models suggest that a household's tendency to surrender life insurance policies to weather a liquidity shock may not only depend on the household's financial buffer, but also his demographic characteristics, particularly age. In our regressions we control for a household's age and thus account for the aforementioned effects. However, to examine whether younger households are indeed more exposed to liquidity shocks we do not explicitly examine whether our life events are associated with a differential response when it comes to surrender of life insurance policies.

To examine whether younger households respond differently to the birth of a child or divorce we split the sample according to age and determine three equally sized samples. Based on the age structure in the SOEP, we determine the following three groups: young: younger than 42, years; middle: 42, to 58 years; old: 59 years and older. We then estimate regression 1 for each subsample separately.

Regression results are reported in Table 3. We find that the birth of a child is associated with a statistically significant increase in the surrender of life insurance policies for younger households. For older households, this life event does not lead to a significant change in the surrender probability

of life insurance contracts. As before, we also find that divorce is associated with an increase in the surrender of life insurance policies. However, the results in Table 3 show that divorce only leads to a significant increase in the surrender probability for older households.

Table 3: **Individual Characteristics and Life Insurance Surrender - Age Specific Effects**

This table reports OLS regressions at the household level divided into three age groups over the period 1985-2012. Columns (1) and (2) present the results for the households with household heads younger than or at age 42. The age of household heads used in the regressions for columns (3) and (4) lies between 42 and 59 years. Columns (5) and (6) report the results for households with household heads older than or at age 59. The dependent variable is life insurance surrender, measured by the proxy SP2, multiplied by 100. Therefore, the coefficients can be interepreted as a percentage change. All regressions include year fixed effects and household fixed effects as indicated. Standard errors are clustered at the household level, and reported in parentheses. *, **, *** mean significance at ten, five, and one percent, respectively.

	Young		**Middle**		**Old**	
	(1)	(2)	(3)	(4)	(5)	(6)
	Life Insurance Surrender (SP2)					
Birth of a Child	0.822***	0.783***	0.363	0.372	-0.169	-0.123
	(0.292)	(0.292)	(0.42)	(0.421)	(0.935)	(0.927)
Divorce	0.262	0.235	1.097	1.081	1.580*	1.497
	(1.067)	(1.067)	(1.192)	(1.19)	(0.937)	(0.943)
Control Variables	x	x	x	x	x	x
Time FE	x		x		x	
Household FE	x	x	x	x	x	x
State-Time FE		x		x		x
Observations	70,536	70,535	70,687	70,687	69,815	69,815
R-squared	0.165	0.17	0.189	0.195	0.151	0.157

These effects are robust to the inclusion of household fixed effects. The fact that these two life events affect a household's surrender probability differently is consistent with the idea that these life events pose different liquidity shocks to households, depending on their age. Our results show that younger households are more affected by the birth of a child. Thus, the results are consistent with Fang and Kung (2012), who find that surrender at younger age is mainly driven by idiosyncratic shocks, uncorrelated with individual characteristics. We hypothesize that younger households have greater job insecurity as they are not working for a firm for that long and are therefore more vulnerable to idiosyncratic liquidity shocks, such as the birth of a child. This is in line with Adsera (2004) and Adsera (2006) who finds that particularly young women restrict their fertility below their ideal level due to high unemployment rates and unstable job contracts.

4.2 Unemployment

Birth of a child or divorce may also pose a different liquidity shock, depending on whether the household has been experiencing job insecurity already. Thus, we hypothesize that the effect of these life events should be stronger if the household is unemployed or was recently unemployed. To this end, we use information on the job reporting status of the household and determine whether the respondent was recently unemployed. By interacting then this dummy variable with our life event variables, we are able to examine whether the birth of a child or divorce has a stronger impact on life insurance policy surrender.

Table 4: **Individual Characteristics and Life Insurance Surrender - OLS with Interaction Effects**

This table reports OLS regressions at the household level over the period 1985-2012. The dependent variable is life insurance surrender, measured by the proxy SP2, multiplied by 100. Therefore, the coefficients can be interepreted as a percentage change. All regressions include the control variables used in the regressions before, year fixed effects and state and household fixed effects as indicated. Standard errors are clustered at the household level, and reported in parentheses. *, **, *** mean significance at ten, five, and one percent, respectively.

	(1)	(2)	(3)	(4)
	Life Insurance Surrender (SP2)			
NOT Recently Unemployed	1.137**	0.561**		
X Birth of a Child	(0.212)	(0.238)		
Recently Unemployed	0.446***	0.339		
X NO Birth of a Child	(0.164)	(0.229)		
Recently Unemployed	1.539***	0.504		
X Birth of a Child	(0.455)	(0.534)		
NOT Recently Unemployed			1.750***	1.342**
X Divorce			(0.567)	(0.628)
Recently Unemployed			0.466***	0.319
X NO Divorce			(0.159)	(0.223)
Recently Unemployed			1.415	0.461
X Divorce			(1.287)	(1.462)
Control Variables	x	x	x	x
Time FE	x	x	x	x
State FE	x		x	
Household FE		x		x
Observations	211,037	211,038	211,037	211,038
R-squared	0.014	0.132	0.014	0.132

Columns (1)-(4) in Table 4 display the regression results where we include the interaction of our life events with the Recently Unemployed dummy variable. The results indicate that the effect of life

insurance policy surrender is particularly pronounced for households that are recently unemployed. While we find that the birth of a child increases a household's probability of surrendering a life insurance policy, by 1.137%, the probability is about 40 basis points higher (1.539%) for households that became recently unemployed. While we control for unobservable state specific characteristics, we do not control for time-invariant household unobservables in column (1). In column (2) we thus add household fixed effects, but cannot confirm the earlier findings. This is consistent with the idea that a household's unemployment risk is time-invariant. The inclusion of household fixed effects then accounts for a household's selection into higher unemployment risk and thus explains the insignificant coefficient. Similarly, in column (3) and (4) we examine whether a divorce leads to a higher surrender probability for households that are unemployed, controlling for state fixed effects and household fixed effects respectively. However, interacting the variables Divorce and Recently Unemployed yields an insignificant coefficient, which might result from the small number of respondents who lost their job and got divorced within the same time frame.

5 Robustness Check: Survival Analyses

Thus far, we have employed OLS regressions to examine the link between life events and life insurance surrender decision. Since our dependent variable is the decision to surrender a life insurance policy, we are concerned that OLS may not be the most efficient econometric model. Thus, we assess the robustness of our results by employing a survival model, particularly a Cox Proportional Hazards model.[14] Note that the interpretation of the coefficients, obtained from estimating survival models is different from simple OLS coefficients, we cannot compare magnitudes between these models. We can, however, examine whether results obtained from a survival model support our OLS results qualitatively.

5.1 Survival Model

Survival analysis makes use of the Hazard function or Conditional failure rate:

$$h(t) = \lim_{\triangle t \to 0} \frac{Pr(t + \triangle t > T > t | T > t)}{\triangle t}, \tag{2}$$

[14] We also assess the robustness of our findings and employed a logit model instead. Results from this model are presented in the Appendix A.3.

In the context of life insurance policy surrender, the hazard function $h(t)$ describes the (limiting) probability of a household surrendering a life insurance policy in a given interval conditional upon that it has not been surrendered to the beginning of that interval, divided by the width of the interval.[15] In the hazard metric, a survival model that describes the effect of an individual covariate vector on the individual hazard rate is of the following form:

$$h(t, x_i) = h_0(t) \exp(\beta x_i'), \tag{3}$$

where h_0 is the common hazard rate, x_i displays the covariate vector of respondent i and $h(t_t, x_i)$ determines the hazard rate for observation i.

The Proportional Cox Hazards Model is a semi-parametric hazard model, i.e. the baseline hazard rate is estimated non-parametrically rather than being determined by an imposed functional form. Since the baseline hazard rate is an unspecified function, it is hard to interpret the marginal effects of a change in the covariates on the survival function. Therefore, we also estimate fully parametric models using the exponential distribution and the Weibull distribution.[16]

In order to allow for a monotonically decreasing, as well as a hump-shaped hazard rate, we follow Sirak (2015) and employ a loglogistic regression model from the class of accelerated failure-time models. Models of this class are written in the log-time metric or accelerated failure time (AFT) metric. The Loglogistic model is of the form

$$\ln(t_i) = \beta_0 + x_i \beta_x + u_i, \tag{4}$$

with $u_i \sim$loglogistic$(0, \frac{\pi\gamma}{\sqrt{3}})$.[17]

Table 5 displays the results from the survival regressions, whereas a higher probability of failure (surrender) in a given period corresponds with positive coefficients for the Proportional Cox Hazards Model, the Exponential model and the Weibull model and with negative coefficients in the Loglogistic model.

[15] Compare (Cleves et al., 2010, p.7)
[16] Our main results are robust to the alternative Gompertz distribution.
[17] For the derivation of the general form of accelerated failure-time models, see (Cleves et al., 2010, p.239ff)

All regressions from the survival analyses support our main results from the OLS regressions. The probability of life insurance surrender increases statistically significantly with the variables that potentially impose a liquidity need on the household, such as "Birth of a Child", "Divorce", "Acquisition of Dwelling" and "Recently Unemployed", while being a parent decreases the probability of surrender. However, the results of the survival analyses don't vary much when stratifying for age groups, i.e. allowing the effects to differ by agegroups.

Table 5: **Individual Characteristics and Life Insurance Surrender - Survival Models**

This table reports Cox Proportional Hazards regressions in columns (1) and (2) and fully parametric survival models using the Exponential, the Weibull, and the Loglogistic survival distribution in column (3), (4), and (5) respectively. For columns (1) to (4), hazard ratios were translated to the corresponding coefficients. For better readability, the acceleration or deceleration of time to failure in Column (5) were translated to time ratios. A higher probability of failure in a given period corresponds therefore with positive coefficients in columns (1) to (4) and with negative coefficients in column (5). All coefficients are estimated at the household level over the period 1985-2012. The dependent variable is time to failure. Standard errors are clustered at the household level, and reported in parentheses. *, **, *** mean significance at ten, five, and one percent, respectively.

	(1)	(2)	(3)	(4)	(5)
			t		
Birth of a Child	1.330***	1.088***	0.906***	1.069***	-0.007***
	(0.043)	(0.046)	(0.068)	(0.046)	(0.000)
Divorce	1.465***	0.932***	1.156***	0.923***	-0.008***
	(0.096)	(0.098)	(0.213)	(0.100)	(0.001)
Parent		-1.526***	-1.819***	-1.385***	0.008***
		(0.029)	(0.034)	(0.028)	(0.000)
Acquisition of Dwelling		0.525***	5.048***	0.487***	-0.006***
		(0.098)	(0.101)	(0.099)	(0.001)
Recently Unemployed		0.110***	0.338***	0.097**	-0.001***
		(0.037)	(0.046)	(0.0376)	(0.000)
ln(Age)		0.004	0.849***	-0.103***	0.000
		(0.031)	(0.035)	(0.032)	(0.000)
ln(Income)		0.000	0.000***	-0.000*	0.000
		(0.000)	(0.000)	(0.000)	(0.000)
Liquid Assets		-0.188***	-0.267***	-0.129***	0.001***
		(0.031)	(0.039)	(0.032)	(0.000)
Illiquid Assets		-0.498***	0.006	-0.540***	0.003***
		(0.031)	(0.036)	(0.032)	(0.000)
Reduction of Assets		0.667***	0.769***	0.675***	-0.004***
		(0.027)	(0.037)	(0.027)	(0.000)
Constant			-11.350***	-1,501***	7.604***
			(0.138)	(12.76)	(0.001)
Observations	192,424	165,421	165,421	165,421	165,421

6 Conclusion

In this article, we analyze whether and how life insurance surrender contributes to households' liquidity risk management. Specifically, we investigate empirically which individual and household specific sociodemographic factors influence the surrender behavior of life insurance policyholders. Using the Socio-Economic Panel (SOEP), we construct proxies to identify life insurance surrender in the data. We assess the relationship between household characteristics and surrender with fixed effects models, accounting for the households' geographical living situation and support our results with survival models. Furthermore, we divide the data into three age groups in order to analyze age group specific drivers of life insurance surrender.

We find that life events that possibly impose a liquidity shock to the household, such as birth of a child and divorce increase the likelihood to surrender an existing life insurance policy for an average household in the panel. These results are robust with respect to different models and hold conditioning on region specific trends. The acquisition of a dwelling and unemployment are further aspects that can foster life insurance surrender. A liquidity shock resulting from the birth of a child appears to be more severe, when households have experienced recent unemployment. We cannot find statistically significant evidence for the hypothesis that unemployed household heads are more vulnerable to a liquidity shock resulting from divorce. However, this might be due to the fact, that there are too few observations that exhibit both unemployment and divorce. Dividing our data into sub-samples by age of the household head shows that in the panel younger people are more vulnerable to liquidity shocks resulting from the birth of a child with respect to policy surrender, while the oldest age group is more affected by a liquidity shock resulting from divorce.

Overall, our analyses provide evidence that individual sociodemographic characteristics have an impact on life insurance surrender behavior. Specifically, we show that individual life events that can impose a liquidity shock to households are correlated with premature contract termination, indicating that surrender contributes to the liquidity risk management of households.

As birthrates decrease and divorce rates increase in most industrial economies, these characteristics are affected by the demographic change. Our goal for subsequent research will be to link the findings on the effect of demographic or societal changes on life insurance surrender rates with forecasts of sociodemographic factors, in order to make predictions about future surrender rates.

References

Adsera, A. (2004). Changing fertility rates in developed countries. the impact of labor market institutions. *Journal of Population Economics*, 17(1):17–43.

Adsera, A. (2006). An economic analysis of the gap between desired and actual fertility: The case of spain. *Review of Economics of the Household*, 4(1):75–95.

Andrews, D. and Sánchez, A. C. (2011). The evolution of homeownership rates in selected oecd countries: Demographic and public policy influences. *OECD Journal: Economic Studies*, 2011(1):1–37.

Belaygorod, A., Zardetto, A., and Liu, Y. (2014). Bayesian modeling of shock lapse rates provides new evidence for emergency fund hypothesis. *North American Actuarial Journal*, 18(4):501–514.

Cerchiara, R. R., Edwards, M., and Gambini, A. (2008). Generalized linear models in life insurance: Decrements and risk factor analysis under Solvency II. In *18th International AFIR Colloquium*.

Cleves, M. A., Gould, W. W., Gutierrez, R. G., and Marchenko, Y. V. (2010). *An introduction to survival analysis using Stata, 3rd ed. College Station*. TX: Stata Press.

Eling, M. and Kiesenbauer, D. (2014). What policy features determine life insurance lapse? An analysis of the German market. *Journal of Risk and Insurance*, 81(2):241–269.

Eling, M. and Kochanski, M. (2013). Research on lapse in life insurance: What has been done and what needs to be done? *The Journal of Risk Finance*, 14(4):392–413.

Fang, H. and Kung, E. (2012). Why do life insurance policyholders lapse? The roles of income, health and bequest motive shocks. *The National Bureau of Economic Research*.

Fier, S. G. and Liebenberg, A. P. (2013). Life insurance lapse behavior. *North American Actuarial Journal*, 17(2):153–167.

Fuchs-Schündeln, N. and Schündeln, M. (2005). Precautionary savings and self-selection: Evidence from the german reunification experiment. *The Quarterly Journal of Economics*, 120(3):1085–1120.

Gatzert, N., Hoermann, G., and Schmeiser, H. (2009). The impact of the secondary market on life insurers' surrender profits. *Journal of Risk and Insurance*, 76(4):887–908.

Kagraoka, Y. (2005). Modeling insurance surrenders by the negative binomial model. *Working paper*.

Kiesenbauer, D. (2012). Main determinants of lapse in the German life insurance industry. *North American Actuarial Journal*, 16(1):52–73.

Kim, C. (2005). Modeling surrender and lapse rates with economic variables. *North American Actuarial Journal*, 9(4):56–70.

Kuo, W., Tsai, C., and Chen, W.-K. (2003). An empirical study on the lapse rate: The cointegration approach. *Journal of Risk and Insurance*, 70(3):489–508.

Liebenberg, A. P., Carson, J. M., and Dumm, R. E. (2012). A dynamic analysis of the demand for life insurance. *Journal of Risk and Insurance*, 79(3):619–644.

MacKay, A., Augustyniak, M., Bernard, C., and Hardy, M. R. (2015). Risk management of policyholder behavior in equity linked life insurance. *Social Science Research Network Working Paper Series*.

Milhaud, X., Loisel, S., and Maume-Deschamps, V. (2011). Surrender triggers in life insurance: What main features affect the surrender behavior in a classical economic context? *Bulletin Français d'Actuariat*, 11(22):5–48.

Moenig, T. and Zhu, N. (2014). Lapse and reentry in variable annuities. *Social Science Research Network Working Paper Series*.

Mulholland, B. S. and Finke, M. S. (2014). Does cognitive ability impact life insurance policy lapsation? *Available at SSRN 2512076*.

Nolte, S. and Schneider, J. C. (2015). Don't lapse into temptation: A behavioral explanation for policy surrender. *Available at SSRN 2555268*.

Outreville, J. F. (1990). Whole-life insurance lapse rates and the emergency fund hypothesis. *Insurance: Mathematics and Economics*, 9(4):249–255.

Renshaw, A. and Haberman, S. (1986). Statistical analysis of life assurance lapses. *Journal of the Institute of Actuaries*, 113(03):459–497.

Russell, D. T., Fier, S. G., Carson, J. M., and Dumm, R. E. (2013). An empirical analysis of life insurance policy surrender activity. *Journal of Insurance Issues*, 36(1):35–57.

Sirak, A. S. (2015). Income and unemployment effects on life insurance lapse. *Working Paper*.

Socio-Economic Panel (SOEP) (2014). Data for years 1984-2013. Version 36, SOEP, 2015, doi: 10.5684/soep.v30.

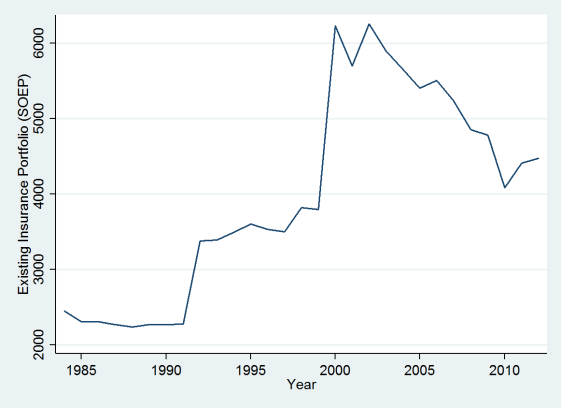
Statistisches Bundesamt (2015). Bevölkerung Deutschlands bis 2060: 13. koordinierte Bevölkerungsvorausberechnung. `https://www.destatis.de/DE/Publikationen/Thematisch/Bevoelkerung/VorausberechnungBevoelkerung/BevoelkerungDeutschland2060Presse5124204159004.pdf?__blob=publicationFile`.

The World Bank (2015). Databank. Life expectancy at birth. `http://data.worldbank.org/indicator/SP.DYN.LE00.IN`.

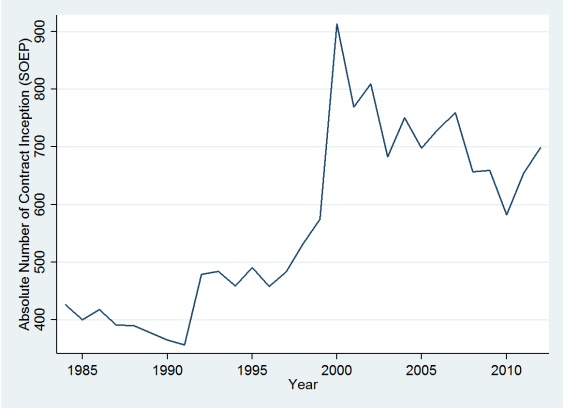
A Appendix

A.1 Data Description

To discuss the suitability of our proxy for life insurance surrender, we first look more closely at life insurance ownership among the *SOEP* respondents. Figure 1 and 2 show the aggregate number of life insurance contracts and new contract inceptions in the panel by year and by age, respectively.

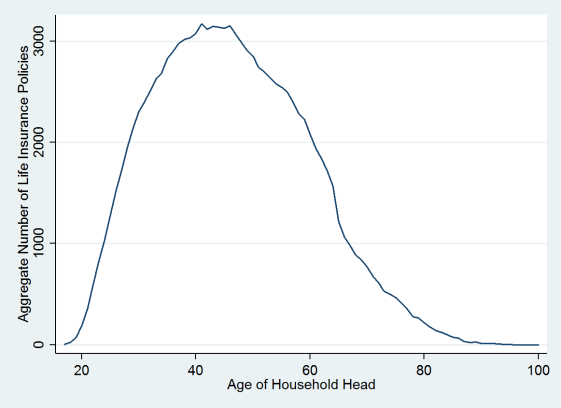


(a) Aggregate Number of Life Insurance Contracts in the Panel by Year

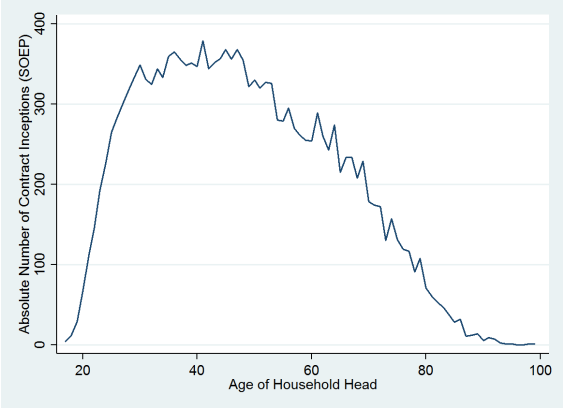


(b) Aggregate Number of Contract Inception in the Panel by Year

Figure 1: Life Insurance Contracts in the SOEP data by Year



(a) Aggregate Number of Life Insurance Contracts in the Panel by Age



(b) Aggregate Number of Contract Inception in the Panel by Age

Figure 2: Life Insurance Contracts in the SOEP data by Age

A.2 Sensitivity Analyses with respect to the Proxy for Life Insurance

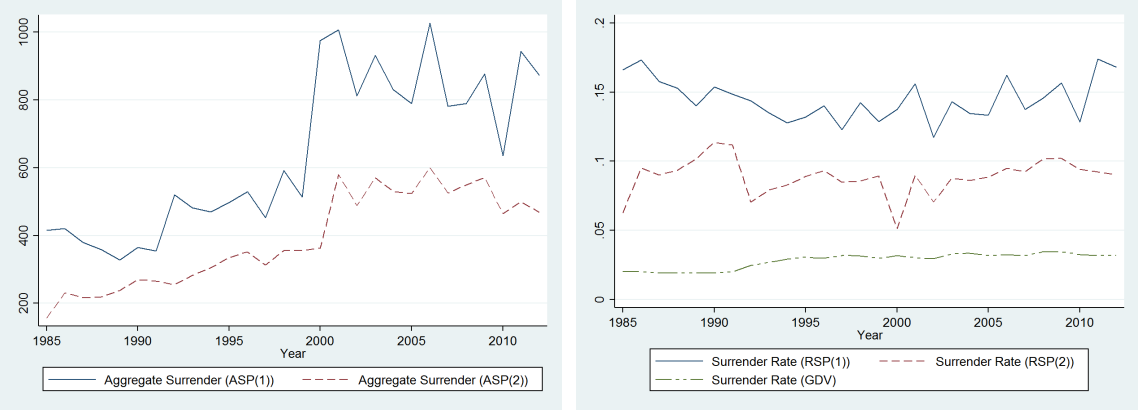
In order to compare the proxies for life insurance surrender $SP(1)_{it}$ and $SP(2)_{it}$ by year, Figure 3a shows the absolute number of all surrendered life insurance policies, i.e. for $K = 1, 2$ it is

$$ASP(K)_t = \sum_{i=1}^{n_t} SP(K)_{it}, \tag{5}$$

with $n_t \in \mathbb{N}$ being the number of households surveyed in the respective year. Figure 3b displays the surrender rate, i.e. the share of surrendered policies relative to the aggregate number of all

policies in the panel per year. The surrender rate is defined as

$$RSP(K)_t = \frac{ASP(K)_t}{\sum_{i=1}^{n_{t-1}} LI_{it-1}} \tag{6}$$



(a) Absolute Number of Surrendered Life Insurance Policies by Year

(b) Surrendered Life Insurance Policies Relative to the Aggregate Number of Policies in the Panel by Year

Figure 3: Life Insurance Policy Surrender by Year (SP(1) and SP(2))

The absolute number of surrenders per year in the panel illustrated in Figure 3a is increasing from 1985 to 2000 exhibiting minor drops and a large peak in 2000 that is explained by the peak in the existing insurance portfolio shown in Figure 1a in Appendix A.1. However, the peak in 2000 is less severe and aggregate surrender is overall less volatile, taking the contract duration into account for the definition of life insurance surrender ($ASP(2)_t$). Both, aggregate surrender and the surrender rate calculated with the proxy $SP(2)_{it}$ are strictly lower than if they are calculated using $SP(1)_{it}$ as a proxy for life insurance surrender, resulting from the fact that surrender determined by $SP(2)_{it}$ is a subset of surrender defined by $SP(1)_{it}$. Figure 3b displays that in comparison to the surrender rate calculated based on GDV data with a mean of 0.300, the surrender rates in the $SOEP$ based on the proxies $SP(1)_{it}$ and $SP(2)_{it}$ with a mean of 0.1442 and 0.0883, respectively, are higher and more volatile.[18] $SP(2)_{it}$ does not include policy termination at maturity of contracts that have an original time to maturity of at least 12 years. However, it might incorrectly declare policy termination at maturity as surrender, if the contract's original time to maturity was less than 12 years, for example if it was set in order to mature at retirement age. To display the relationship between age and surrender, we determine the aggregate number of surrender by age

[18] Table **??** provides descriptive statistics of the surrender rates.

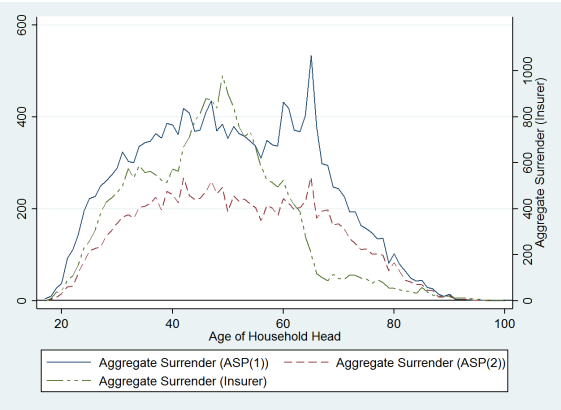
and the respective surrender rate by age, respectively as

$$ASP(K)_x = \sum_{i=1}^{n_x} SP(K)_{ix} \tag{7}$$

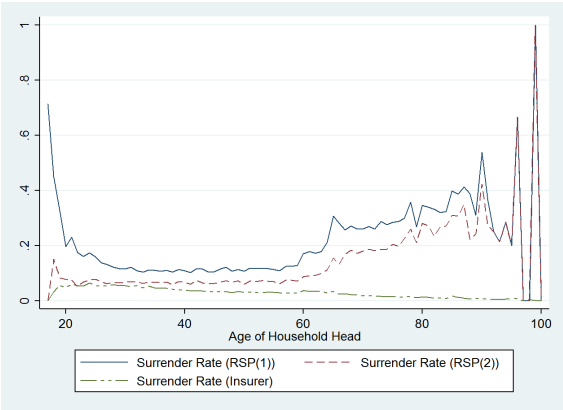
and

$$RSP(K)_x = \frac{ASP(K)_t}{\sum_{i=1}^{n_{x-1}} LI_{ix-1}}, \tag{8}$$

where x specifies the age with $x \in [17, 100]$ and n_x is the number of household heads at the respective age throughout the panel.



(a) Absolute Number of Surrendered Life Insurance Policies by Age



(b) Surrendered Life Insurance Policies Relative to the Aggregate Number of Policies in the Panel by Age

Figure 4: Life Insurance Policy Surrender by Age (SP(1) and SP(2))

Figure 4a compares aggregate surrender identified by the two proxies to aggregate surrender based on the life insurance portfolio of a German insurer. In contrast to $ASP(1)_x$ and $ASP(2)_x$, the data provided by the German insurer do not display a higher aggregate surrender around the age of 65, which implies that our proxies primarily overestimate surrender of life insurance contracts that were set to mature at retirement age. While $ASP(1)_x$ exhibits a large peak at the age of 65, this peak is much lower, however still visible taking into account the contract duration with $ASP(2)_x$, suggesting that identifying life insurance surrender with $SP(2)_{ix}$ partially accounts for this overestimation. While the graph for $ASP(2)_x$ is again strictly lower or equal than the one for $ASP(1)_x$ for all ages due to capturing less observations, both proxies and the data provided by the German insurer display a hump between the age of 40 and 55. However, Figure 4b shows that the hump shape is driven by the fact that a large fraction of life insurance policies is owned by this

age group, as in relative terms the hump disappears. For age groups above 65, both proxies show that absolute surrender decreases in age while relative surrender is increasing. This suggests that most life insurance contracts have already matured or surrendered before the age of 65, making the denominator in Equation (8) decrease faster than the numerator. The fact that only a very small fraction of the life insurance portfolio in the panel is held by households whose heads are younger than 20 or older than 80 years old[19] explains the high volatility of the surrender rate at the extreme ages.

To find an alternative approach to approximate life insurance policy surrender in the panel than by looking at the policy duration, we consider the drivers for life insurance surrender most commonly discussed in the scientific literature. (See Section 1.) Since we can only capture surrender based on the interest rate hypothesis in case the new policy was not acquired in the same year as the old policy was surrendered, we concentrate on the emergency fund hypothesis, more specifically on liquidity needs as a driver of life insurance policy surrender. From the panel we observe households that have claimed to not have put money aside for larger purchases, emergencies or to build savings. This information is provided for only certain years[20] and can therefore be used for conducting an analysis based on these years only. With this information we create further proxies for life insurance surrender and define the dummy variable for a household's reserves as follows.

$$RESERVES_{it} = \begin{cases} 1 & \text{if household i claims to have put aside money for emergencies at time } t \\ 0 & \text{otherwise.} \end{cases} \tag{9}$$

Given the assumption that respondents can assess correctly how much money they would need in case of an emergency, it is sensible to assume that household heads who claim to have put aside money for emergencies would use these reserves first rather than surrendering their life insurance policy if they face a need for liquidity. Therefore, we exclude these households from our next proxy, as for them contract termination seems more likely to occur due to contract maturity than due to policy surrender. For the years $t = 2001, 2003, 2005, 2007, 2011$[21], we define the proxy for

[19] Compare Figure 2a in Appendix A.1.
[20] More specifically for the years $t = 2001, 2003, 2005, 2007, 2011, 2013$.
[21] We cannot include the year 2013, because LI_{it} is defined until 2012 only.

life insurance surrender $SP(3L)_{it}$ as life insurance policy termination conditioning on that the household claims to have put aside money for emergencies in the current year, i.e.

$$SP(3L)_{it} = LI_{it-1} * (1 - LI_{it}) * (1 - RESERVES_{it}) \tag{10}$$

One might also consider this kind of proxy accounting for reserves which a household had put aside in the previous year. However, the results do not differ largely. Figure **??** gives a brief overview of this case displayed in the proxy $SP(4L)_{it}$, specified by Equation **??**.

Considering both, the contract duration and the question whether households have put money aside for emergencies combined, we define $SP(5L)_{it}$ as life insurance contract termination, conditional on that the household claims to not have put aside money for emergencies in the current year and to not have had life insurance at least once within the last 11 years, i.e.

$$SP(5L)_{it} = LI_{it-1} * (1 - LI_{it}) * (1 - \prod_{\tau=2}^{10} LI_{it-\tau}) * (1 - RESERVES_{it}) \tag{11}$$

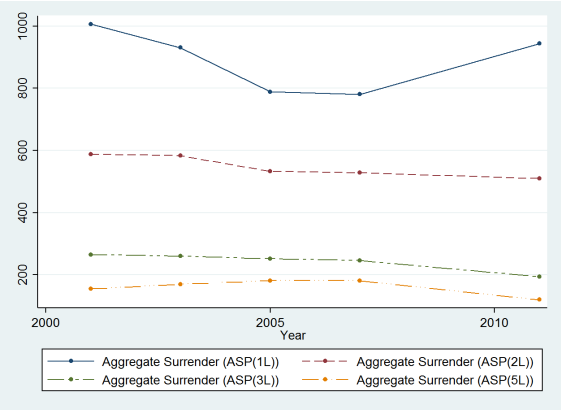
The verbal and technical definitions of the different proxies are summarized in Table 6.

Proxy	Definition	Formal Definition	Definition Period
$SP(1)_{it}$	Contract termination	$SP(1)_{it} = LI_{it-1} * (1 - LI_{it})$	1984-2012
$SP(2)_{it}$	Contract termination conditional on that the household has claimed to not have had life insurance at least once within the last 11 years.	$SP(2)_{it} = LI_{it-1} * (1 - LI_{it}) * (1 - \prod_{\tau=2}^{10} LI_{it-\tau})$	1984-2012
$SP(3L)_{it}$	Contract termination conditional on that the household claims to not have put aside money for emergencies in the current year	$SP(3L)_{it} = LI_{it-1} * (1 - LI_{it}) * (1 - RESERVES_{it})$	2001,2003, 2005,2007, 2011
$SP(4L)_{it}$	Contract termination conditional on that the household claims to not have put aside money for emergencies in the previous year	$SP(4L)_{it} = LI_{it-1} * (1 - LI_{it}) * (1 - RESERVES_{it-1})$	2001,2003, 2005,2007, 2011
$SP(5L)_{it}$	Contract termination conditional on that the household claims to not have put aside money for emergencies in the current year and to not have had life insurance at least once within the last 11 years	$SP(5L)_{it} = LI_{it-1} * (1 - LI_{it}) * (1 - \prod_{\tau=2}^{10} LI_{it-\tau}) * (1 - RESERVES_{it})$	2001,2003, 2005,2007, 2011

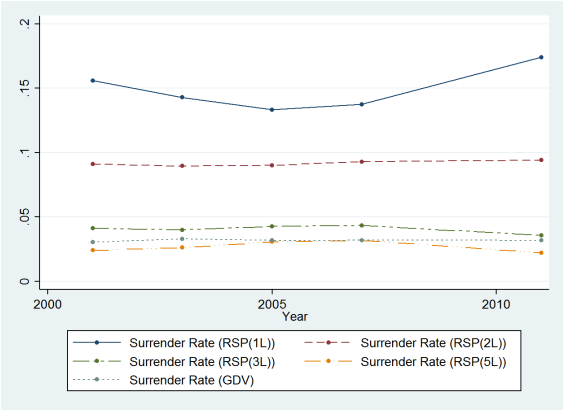
Table 6: Definition of the Proxies for Life Insurance Surrender

In order to compare life insurance surrender identified by the various proxies, we specify light versions for $SP(1)_{it}$ and $SP(2)_{it}$ that are only defined for the years $t = 2001, 2003, 2005, 2007, 2011$. We call them $SP(1L)_{it}$ and $SP(2L)_{it}$, respectively. The aggregate number of surrender and the respective surrender rate for these proxies are defined analogously to Equations (5), (6), (7) and

(8) for $t = 2001, 2003, 2005, 2007, 2011$ and $K = 1L, 2L, 3L, 4L, 5L$.



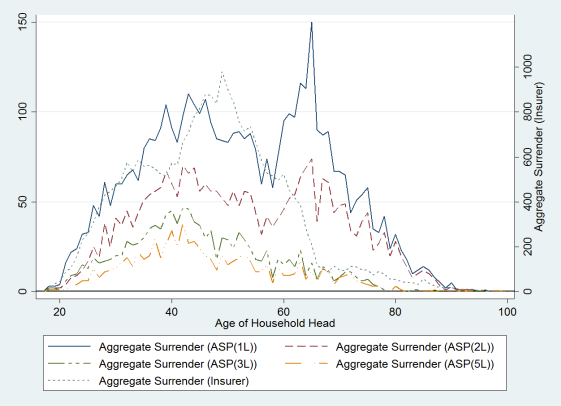
(a) Absolute Number of Surrendered Life Insurance Policies by Year



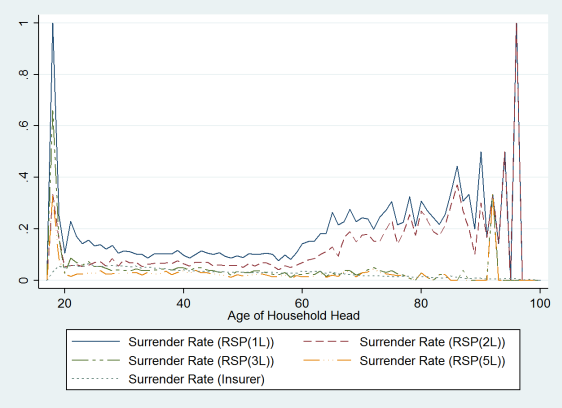
(b) Surrendered Life Insurance Policies Relative to the Aggregate Number of Policies in the Panel by Year

Figure 5: Life Insurance Policy Surrender for the years 2001, 2003, 2005, 2007 and 2011 (SP(1L), SP(2L), SP(3L), SP(5L))

Figure 5a shows that for the respective years, surrender rates determined by the proxies accounting for the variable $RESERVES_{it}$ are similar to the surrender rates based on the data provided by the GDV. For a more detailed comparison, Table **??** summarizes the different surrender rates. Again it is obvious that the absolute number of surrender is lower for proxies that define surrender based on more or stricter criteria than the others as they exclude more observations from the data. Therefore, also aggregate surrender by age measured with $SP(5L)_{ix}$ is strictly lower or equal than the absolute number of surrender measured by $SP(2L)_{ix}$ and $SP(3L)_{ix}$ for all ages. However, Figure 6a shows that including the question whether the households have put money aside for emergencies eliminates the peak between ages 60 and 65 in the aggregate surrender curve, while the hump around the age of 40 is still noticeable. The elimination of the peak between ages 60 and 65 in aggregate surrender offsets the effect of the increasing surrender rate for age groups above 65 and therefore, the surrender rates identified by $SP(3L)_{ix}$ and $SP(5L)_{ix}$ are very similar to the ones based on the data provided by the German insurer. Again, this suggests that the proxies $SP(1L)_{ix}$ and $SP(2L)_{ix}$ (to a lesser extent) tend to overestimate surrender primarily at the age groups starting from 65, capturing also the termination of life insurance policies that were set to mature at retirement age and life insurance policy surrender that occurred due to a different motive than the emergency fund hypothesis.



(a) Absolute Number of Surrendered Life Insurance Policies by Age



(b) Surrendered Life Insurance Policies Relative to the Aggregate Number of Policies in the Panel by Age

Figure 6: Life Insurance Policy Surrender by Age (SP(1L), SP(2L), SP(3L), SP(5L))

To cross-check our results obtained using $SP(2L)_{it}$ as dependent variable, we will compare them using $SP(3L)_{it}$ and $SP(5L)_{it}$ as dependent variable for an OLS regression over the years in which all three proxies are defined.

Table 7 suggests that our main results hold when using alternative proxies for life insurance surrender. The coefficient for "Birth of a Child" is positive and statistically significant for all proxies. While the positive sign for the coefficient of "Divorce" also holds for this selection of years in the panel, its statistical significance is lower in all three regressions.

Table 7: **OLS regressions for the years 2001, 2003, 2005, 2007, 2011 - Comparison of the Proxies**

This table reports OLS regressions at the household level over the years 2001, 2003, 2005, 2007, and 2011. The dependent variable is life insurance surrender, measured by the proxy SP2L, SP3L, and SP5L, respectively. *, **, *** mean significance at ten, five, and one percent, respectively.

	(1)	(2)	(3)
	SP(2L)	SP(3L)	SP(5L)
Birth of a Child	1.540***	0.721***	1.048***
	(0.402)	(0.273)	(0.224)
Divorce	1.748*	1.418**	0.0389
	(0.942)	(0.639)	(0.525)
Acquisition of Dwelling	2.080***	0.377	0.702*
	(0.72)	(0.488)	(0.401)
Recently Unemployed	-0.0663	0.880***	0.730***
	(0.292)	(0.198)	(0.163)
ln(Age)	0.912***	-2.186***	-1.002***
	(0.308)	(0.209)	(0.171)
ln(Income)	1.250E-05	-7.72e-05*	-6.54e-05**
	(5.93E-05)	(4.02E-05)	(3.30E-05)
Liquid Assets	-2.036***	-3.693***	-2.520***
	(0.259)	(0.175)	(0.144)
Illiquid Assets	-2.242***	-1.335***	-0.962***
	(0.224)	(0.152)	(0.125)
Reduction of Assets	3.635***	1.241***	0.532***
	(0.226)	(0.153)	(0.126)
Constant	3.254***	14.11***	7.758***
	(1.242)	(0.843)	(0.692)
Observations	50,825	50,825	50,825
R-squared	0.012	0.024	0.016

A.3 Robustness Check - Logit Regression

Table 8: **Individual Characteristics and Life Insurance Surrender**

This table reports OLS regressions in columns (1) and (2) and Logit regressions with conditional fixed effects in columns (3) and (4) at the household level over the period 1985-2012. The dependent variable is life insurance surrender, measured by the proxy SP2. All regressions include year fixed effects and state fixed effects as indicated. Standard errors are clustered at the household level, and reported in parentheses. *, **, *** mean significance at ten, five, and one percent, respectively.

	(1)	(2)	(3)	(4)
	Life Insurance Surrender (SP2)			
Birth of a Child	0.0126***	0.0125***	0.235***	0.234***
	(0.00193)	(0.0193)	(0.039)	(0.039)
Divorce	0.0169***	0.0167***	0.288***	0.284***
	(0.00518)	(0.00518)	(0.0853)	(0.0853)
Parent	-0.00806***	-0.00810***	-0.221***	-0.221***
	(0.00116)	(0.00116)	(0.0258)	(0.0258)
Acquisition of Dwelling	0.0137***	0.0136***	0.247***	0.246***
	(0.00448)	(0.00448)	(0.08)	(0.08)
Recently Unemployed	0.00419***	0.00490***	0.112***	0.122***
	(0.00156)	(0.00158)	(0.0326)	(0.0327)
ln(Age)	0.00381**	0.00387**	0.139***	0.139***
	(0.00166)	(0.00167)	(0.04)	(0.04)
ln(Income)	0.0110***	0.0106***	0.259***	0.250***
	(0.00104)	(0.00105)	(0.023)	(0.0232)
Liquid Assets	-0.0192***	-0.0188***	-0.323***	-0.319***
	(0.00158)	(0.00158)	(0.0268)	(0.0268)
Illiquid Assets	-0.0257***	-0.0256***	-0.566***	-0.564***
	(0.00124)	(0.00124)	(0.0258)	(0.0258)
Reduction of Assets	0.0379***	0.0379***	0.698***	0.698***
	(0.00141)	(0.00141)	(0.023)	(0.023)
Constant	-0.0280***	-0.0256***	-5.826***	-5.783***
	(0.00907)	(0.00963)	(0.233)	(0.244)
Time FE	x	x	x	x
State FE		x		x
Observations	211,038	211,037	211,038	211,037
R-squared	0.014	0.014		
Number of hid			25,052	25,052