DVfVW Annual Meeting 2016:
Life Insurance and Demographic Change: An Empirical Analysis of Surrender Decisions Based on Panel Data

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Motivation

- **Emergency Fund Hypothesis:** Policyholders surrender their life insurance in order to cover a need for liquidity.
- **Demographic Change:** The individual characteristics that impose a need for liquidity on policyholders might change.
- Which individual and household specific sociodemographic factors influence the surrender behavior of life insurance policyholders?
- In which way do demographic or societal changes affect life insurance surrender rates through the found characteristics?

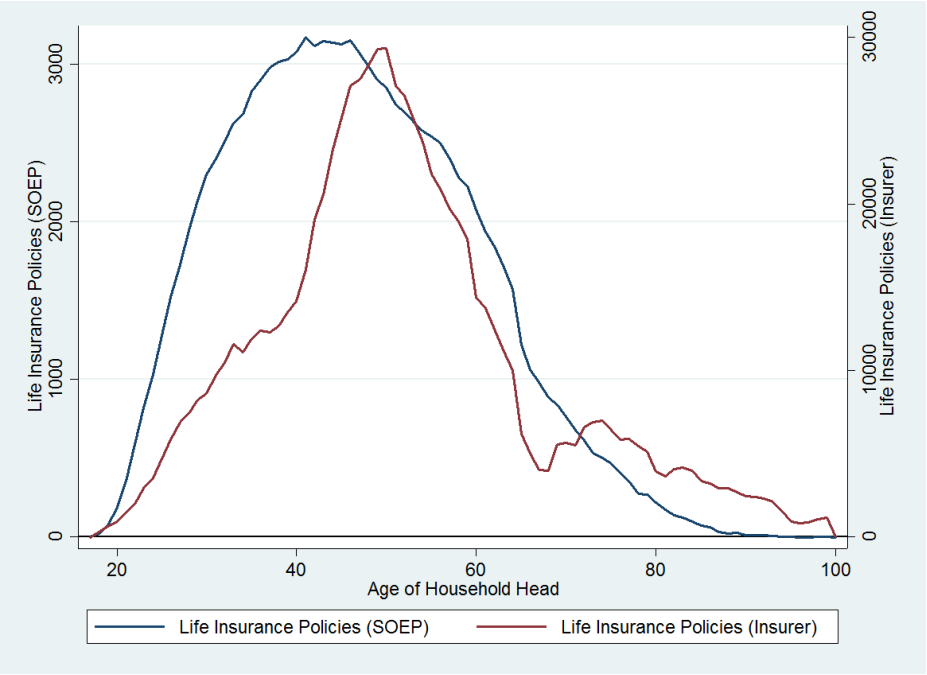
Data Description - The Socio-Economic Panel

- Ongoing wide-ranging representative longitudinal study
- Located at the *German Institute for Economic Research, DIW Berlin*.
- Around 11,000 private households
- For 1984-2013 (Version 30), around 30,000 people have been surveyed by the fieldwork organization *TNS Infratest Sozialforschung* each year
- Respondents are Germans and immigrants living in Germany
- Topics include household composition, wealth, employment, income, health, consumption and satisfaction indicators

Life Insurance in the Panel

$$LI_{it} = \begin{cases} 1 & \text{if hh } i \text{ claims at } t+1 \text{ to have owned life insurance at } t \\ 0 & \text{otherwise,} \end{cases}$$

LI_{it}	Frequency	Percent
0	148,962	56.36
1	115,356	43.64
Total	264,318	100.00

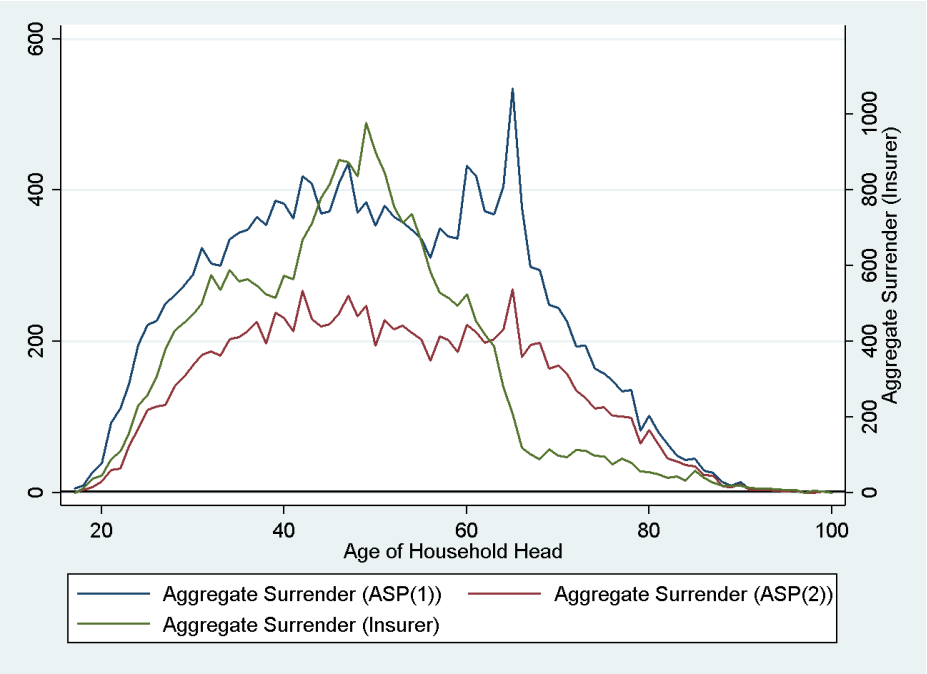


The Dependent Variable

$$SP(1)_{it} = LI_{it-1} * (1 - LI_{it}) \tag{1}$$

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

Life insurance surrender is identified as:
Contract termination conditional on that the household has claimed to not have had life insurance at least once within the last 11 years.



The Independent Variables (1)

Variable	Expected Effect on LI Surrender	Demographic Change
Number of Children	?	-[1]
Acquisition of Dwelling (previous or current year)	+	+[2]
Divorce (previous or current year)	+	+[3]
Burden due to Caring for a Person	+	+[4]

Table: The Explanatory Variables

1) *World Development Indicators* provided by *The World Bank*
2) Andrews, D. and Sanchez, 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.
3) *Eurostat database divorce indicators*
4) Felder, S. (2012). Gesundheitsausgaben und demographischer Wandel. Bundesgesundheitsblatt-Gesundheitsforschung-Gesundheitsschutz, 55(5):614-623

The Independent Variables (2)

Variable	Expected Effect on LI Surrender
Recent Unemployment (within last three years)	+
Log(Age)	?
Log(Income)	?
Liquid Assets Previous Year	-
Illiquid Assets Previous Year	-
New Assets	-
Reduction of Assets	+
Social Welfare Pays for Care	?/-
Household Pays for Care	+

Table: The Control Variables

Regression Results

	(1) SP(2)		(2) SP(2)	
Number of Children	0.00125**	(0.000560)	0.00258***	(0.000998)
Acquisition of Dwelling	0.0164***	(0.00382)	0.00948**	(0.00443)
Divorce	0.0174***	(0.00429)	0.01000*	(0.00525)
Recent Unemployment	0.00287**	(0.00135)	0.00259	(0.00200)
Log_Age	0.00873***	(0.00140)	0.0358***	(0.00958)
Log_Income	0.0122***	(0.000869)	0.0181***	(0.00172)
Liquid Assets Prev. Year	−0.00914***	(0.00128)	−0.0164***	(0.00224)
Illiquid Assets	−0.0116***	(0.00103)	−0.00915***	(0.00171)
New Assets	−0.0458***	(0.00238)	−0.0626***	(0.00189)
Reduction of Assets	0.202***	(0.00211)	0.207***	(0.00512)
Time and HH Fixed Effects	No		Yes	
Constant	−0.0741***	(0.00793)	−0.265***	(0.0335)
Observations	215936		215936	
Adjusted R^2	0.049		0.053	

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table: OLS and Fixed Effects Regression

Analysis of Different Age Groups

	Age < 36 SP(2)	35 <Age< 56 SP(2)	55 <Age SP(2)
Number of Children	0.00837***	-0.000810	-0.00299
Acquisition of Dwelling	0.0143**	0.0173***	0.0163**
Divorce	0.0173*	0.00733	0.0236***
Recent Unemployment	0.00493**	-0.00154	-0.00297
Log_Age	0.0257***	-0.000997	−0.0255***
Log_Income	0.0123***	0.00912***	0.0118***
Liquid Assets Prev. Year	−0.00992***	−0.0103***	−0.00393*
Illiquid Assets	−0.00478**	−0.0131***	−0.0113***
New Assets	−0.0368***	−0.0462***	−0.0478***
Reduction of Assets	0.202***	0.272***	0.132***
Constant	−0.140***	-0.0118	0.0732**
Observations	46165	87204	82567
Adjusted R^2	0.062	0.079	0.022

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table: OLS Regression for Different Age Groups

The Role of Costs for Care

	SP(2)	
Child Allowance Prev. Year	0.00496	(0.00600)
Acquisition of Dwelling	-0.0193	(0.0335)
Divorce	0.0160	(0.0254)
Recent Unemployment	0.0168*	(0.00958)
Log_Age	0.0262***	(0.00912)
Log_Income	0.00585	(0.00563)
Burden due to Caring for Person	0.0145**	(0.00730)
Social Welfare Pays for Care	-0.0839	(0.0701)
Household Pays for Care	0.0153	(0.0495)
Constant	−0.108**	(0.0543)
Observations	4776	
Adjusted R^2	0.002	

Standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table: Cross Section Analysis for the year 1987

Alternative Identification of Surrender (1)

From the panel we observe households that have claimed to not have put aside money for larger purchases, emergencies or to build savings:

$$RESERVES_{it} = \begin{cases} 1 & \text{if hh i has put aside money for emergencies at } t \\ 0 & \text{otherwise.} \end{cases}$$

with $t = 2001, 2003, 2005, 2007, 2011, 2013$.

We construct an alternative proxy for life insurance surrender:

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

with $t = 2001, 2003, 2005, 2007, 2011$.

Alternative Identification of Surrender (2)

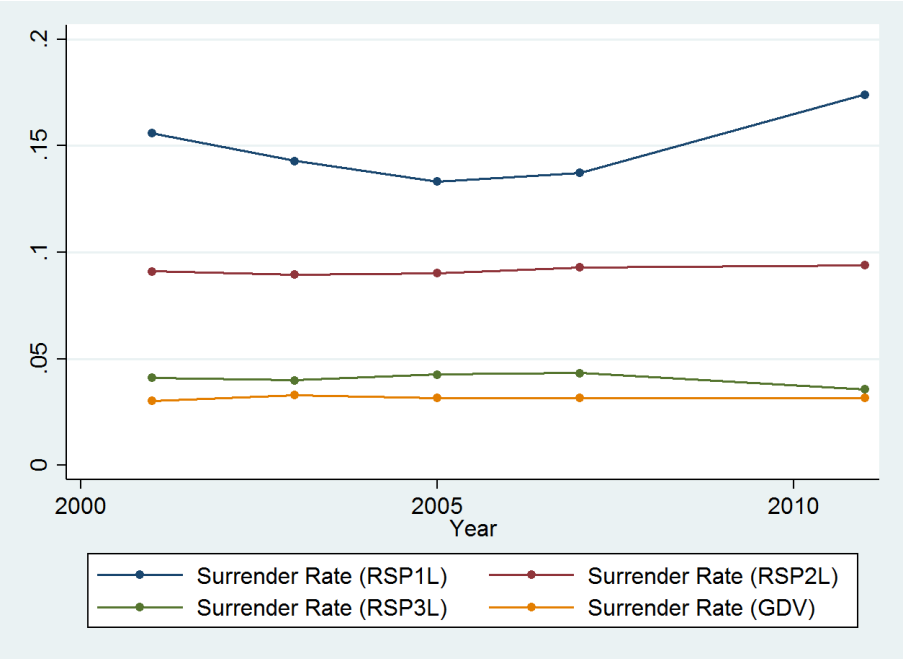


Figure: Surrender Rates by Year

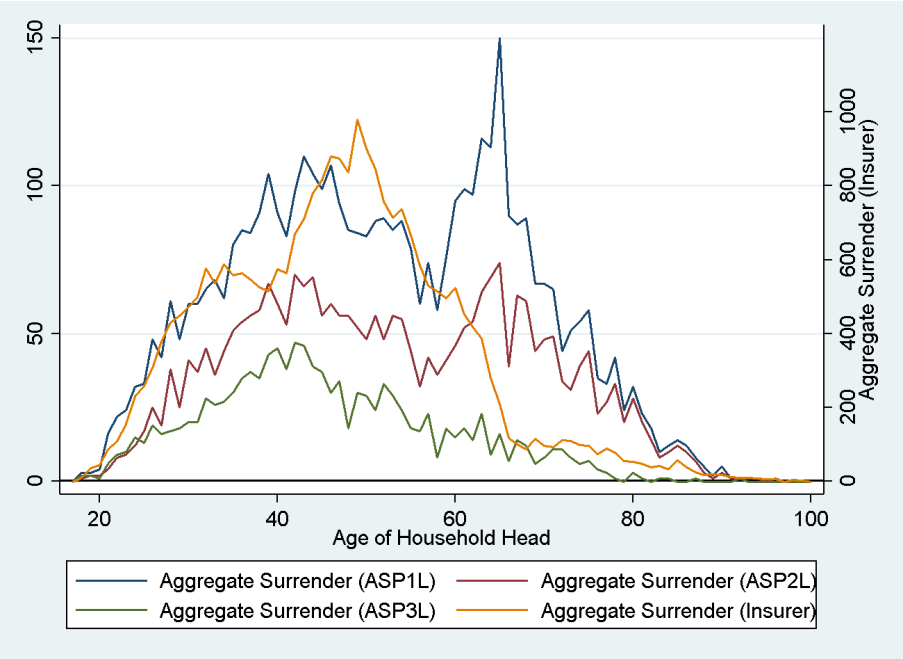


Figure: Aggregate Surrender by Age

Alternative Identification of Surrender (3)

	(1) SP(2L)		(2) SP(3L)	
Number of Children	0.00270	(0.00236)	0.00641***	(0.00159)
Acquisition of Dwelling	0.0160	(0.0140)	0.00352	(0.00936)
Divorce	0.00632	(0.0194)	0.0200	(0.0130)
Recent Unemployment	-0.00435	(0.00624)	0.00742*	(0.00418)
Log_Age	0.0137**	(0.00694)	−0.0132***	(0.00466)
Log_Income	0.00124	(0.00405)	−0.00598**	(0.00271)
Liquid Assets Prev. Year	−0.0107*	(0.00613)	−0.0356***	(0.00411)
Illiquid Assets	−0.00828*	(0.00499)	0.00677**	(0.00335)
New Assets	−0.0501***	(0.0120)	−0.0451***	(0.00807)
Reduction of Assets	0.249***	(0.0101)	0.228***	(0.00676)
Payments by Care Insurance	0.0132	(0.0142)	0.0141	(0.00952)
Constant	−0.0359	(0.0486)	0.103**	(0.0326)
Observations	10583		10583	
Adjusted R^2	0.063		0.118	

Standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table: Cross Section Analysis for the Year 2003

Conclusion

Variable	Expected Effect on LI Surrender	Observed Relationship with LI Surrender
Number of Children	?	+
Acquisition of Dwelling (previous or current year)	+	+
Divorce (previous or current year)	+	+
Burden due to Caring for a Person	+	+

The observed relationship of the explanatory variables and life insurance surrender varies for different age groups.

Outlook

Issues to address:

- Underestimation of life insurance surrender by excluding...
  - ...policies that are surrendered after more than 12 years (in $SP(2)$)
  - ...the possibility of having several life insurance policies
  - ...policy replacement within one year
- Overestimation of life insurance surrender for policies that were set to mature at retirement age (in $SP(2)$)
- Differentiation of various kinds of life insurance products

Further analyses:

- Cox Proportional Hazards Model
- Link the predictions on the demographic change to the panel

OLS

	(1) SP(2)		(2) SP(2)	
Liquid Assets Prev. Year	−0.00914***	(0.00128)	−0.00896***	(0.001285)
Illiquid Assets	−0.0116***	(0.00103)	−0.0115***	(0.00104)
Number of Children	0.00125**	(0.000560)	0.00122**	(0.000560)
Recent Unemployment	0.00287**	(0.00135)	0.00347**	(0.001365)
Acquisition of Dwelling	0.0164***	(0.00382)	0.0163***	(0.00382)
Log_Age	0.00873***	(0.00140)	0.00886***	(0.00140)
Log_Income	0.0122***	(0.000869)	0.0121***	(0.000873)
Divorce	0.0174***	(0.00429)	0.0172***	(0.00429)
New Assets	−0.0458***	(0.00238)	−0.0458***	(0.00238)
Reduction of Assets	0.202***	(0.00211)	0.2015***	(0.00211)
States included	no		yes	
Constant	−0.0741***	(0.00793)	-0.0851	(0.209)
Observations	215936		215936	
Adjusted R^2	0.049		0.049	

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table: OLS Regression

Analysis of Different Age Groups (2)

	Age < 36 SP(2)	35 <Age< 56 SP(2)	55 <Age SP(2)
Number of Children	0.00783***	-0.00122	0.000630
Acquisition of Dwelling	0.0148*	0.00708	0.00825
Divorce	0.00270	0.00541	0.0140*
Recent Unemployment	0.00798**	-0.000838	-0.000519
Log_Age	0.0916***	0.0450*	0.0551*
Log_Income	0.0118***	0.0173***	0.0178***
Liquid Assets Prev. Year	−0.0200***	−0.0166***	−0.0193***
Illiquid Assets	−0.00647*	−0.00834***	−0.0117***
New Assets	−0.0601***	−0.0725***	−0.0625***
Reduction of Assets	0.211***	0.268***	0.139***
Constant	−0.376***	−0.301***	−0.338***
Observations	46165	87204	82567
Adjusted R^2	0.069	0.081	0.025

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table: Fixed Effects Model for Different Age Groups

Fixed Effects

	(1) SP(2)		(2) SP(2)	
Liquid Assets Prev. Year	−0.0164***	(0.00224)	−0.0163***	(0.00224)
Illiquid Assets	−0.00915***	(0.00171)	−0.00911***	(0.00171)
Number of Children	0.00258***	(0.000998)	0.00260***	(0.000997)
Recent Unemployment	0.00259	(0.00200)	0.00261	(0.00200)
Acquisition of Dwelling	0.00948**	(0.00443)	0.00945**	(0.00443)
Log_Age	0.0358***	(0.00958)	0.0357***	(0.00960)
Log_Income	0.0181***	(0.00172)	0.0181***	(0.00172)
Divorce	0.01000*	(0.00525)	0.00996*	(0.00525)
New Assets	−0.0626***	(0.00189)	−0.0626***	(0.00189)
Reduction of Assets	0.207***	(0.00512)	0.207***	(0.00512)
States included	no		yes	
Constant	−0.265***	(0.0335)	−0.270***	(0.0346)
Observations	215936		215936	
Adjusted R^2	0.053		0.053	

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table: Fixed Effects Regression Model with Robust Standard Errors

OLS

	(1) Age < 36 SP(2)	
Liquid Assets Prev. Year	−0.00992***	(0.00249)
Illiquid Assets	−0.00478**	(0.00204)
Number of Children	0.00837***	(0.00112)
Recent Unemployment	0.00493**	(0.00226)
Acquisition of Dwelling	0.0143**	(0.00656)
Log_Age	0.0257***	(0.00671)
Log_Income	0.0123***	(0.00190)
Divorce	0.0173*	(0.00946)
New Assets	−0.0368***	(0.00437)
Reduction of Assets	0.202***	(0.00407)
Constant	−0.140***	(0.0222)
Observations	46165	
Adjusted R^2	0.062	

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table: OLS Regression for Different Age Groups

OLS

	(2) 35 <Age< 56 SP(2)		(3) 55 <Age SP(2)	
Liquid Assets Prev. Year	−0.0103***	(0.00194)	−0.00393*	(0.00232)
Illiquid Assets	−0.0131***	(0.00163)	−0.0113***	(0.00177)
Number of Children	-0.000810	(0.000722)	-0.00299	(0.00211)
Recent Unemployment	-0.00154	(0.00206)	-0.00297	(0.00294)
Acquisition of Dwelling	0.0173***	(0.00581)	0.0163**	(0.00752)
Log_Age	-0.000997	(0.00576)	−0.0255***	(0.00687)
Log_Income	0.00912***	(0.00149)	0.0118***	(0.00141)
Divorce	0.00733	(0.00707)	0.0236***	(0.00657)
New Assets	−0.0462***	(0.00379)	−0.0478***	(0.00417)
Reduction of Assets	0.272***	(0.00342)	0.132***	(0.00351)
Constant	-0.0118	(0.0234)	0.0732**	(0.0322)
Observations	87204		82567	
Adjusted R^2	0.079		0.022	

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table: OLS Regression for Different Age Groups

FE

	(1) Age < 36 SP(2)	
Liquid Assets Prev. Year	−0.0200***	(0.00448)
Illiquid Assets	−0.00647*	(0.00377)
Number of Children	0.00783***	(0.00238)
Recent Unemployment	0.00798**	(0.00375)
Acquisition of Dwelling	0.0148*	(0.00823)
Log_Age	0.0916***	(0.0349)
Log_Income	0.0118***	(0.00317)
Divorce	0.00270	(0.0126)
New Assets	−0.0601***	(0.00395)
Reduction of Assets	0.211***	(0.0102)
Constant	−0.376***	(0.0995)
Observations	46165	
Adjusted R^2	0.069	

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table: Fixed Effects Model for Different Age Groups

FE

	(2) 35 <Age< 56 SP(2)		(3) 55 <Age SP(2)	
Liquid Assets Prev. Year	−0.0166***	(0.00339)	−0.0193***	(0.00447)
Illiquid Assets	−0.00834***	(0.00283)	−0.0117***	(0.00305)
Number of Children	-0.00122	(0.00155)	0.000630	(0.00368)
Recent Unemployment	-0.000838	(0.00335)	-0.000519	(0.00442)
Acquisition of Dwelling	0.00708	(0.00671)	0.00825	(0.00918)
Log_Age	0.0450*	(0.0241)	0.0551*	(0.0294)
Log_Income	0.0173***	(0.00299)	0.0178***	(0.00363)
Divorce	0.00541	(0.00880)	0.0140*	(0.00802)
New Assets	−0.0725***	(0.00317)	−0.0625***	(0.00360)
Reduction of Assets	0.268***	(0.00857)	0.139***	(0.00738)
Constant (0.0995)	−0.301***	(0.0847)	−0.338***	(0.118)
Observations	87204		82567	
Adjusted R^2	0.081		0.025	

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table: Fixed Effects Model for Different Age Groups

Alternative Identification of Surrender (1)

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

Table: Definition of the Proxies for Life Insurance Surrender

Alternative Identification of Surrender (2)

	(1) SP(2L)	(2) SP(3L)	(3) SP(5L)
Liquid Assets Prev. Year	−0.0107*	−0.0356***	−0.0255***
Illiquid Assets	−0.00828*	0.00677**	0.00176
Number of Children	0.00270	0.00641***	0.00391***
Recent Unemployment	-0.00435	0.00742*	0.00426
Acquisition of Dwelling	0.0160	0.00352	0.00468
Log_Age	0.0137**	−0.0132***	−0.00657*
Log_Income	0.00124	−0.00598**	-0.00299
Divorce	0.00632	0.0200	0.00488
New Assets	−0.0501***	−0.0451***	−0.0314***
Reduction of Assets	0.249***	0.228***	0.148***
Payments by Care Insurance	0.0132	0.0141	0.0117
Constant	−0.0359	0.103**	0.0509*
Observations	10583	10583	10583
Adjusted R^2	0.063	0.118	0.077

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table: Cross Section Analysis for 2003 - Comparison of the Proxies