Determinants of Surrenders and Lapses of Life Insurance

Abstract

Understanding the causes of early terminations is important to the service quality, profitability, and risk management of the life insurer. This paper extends the literature on the determinants of the early termination propensities in four aspects. Firstly, we decompose early terminations into surrender and lapse and build models accordingly. This decomposition is important because the motives, causes, and consequences of lapse and surrender are distinct. Secondly, we construct models for the surrender and lapse propensities by product type. Without such construction, the insurer will over- or under-charge the policyholders with different characteristics who purchase different types of product. Thirdly, we introduce new explanatory variables in modeling the propensities to mitigate the omitted-variable bias. Fourthly, this is the first paper on the determinants of early terminations for the market of Taiwan and shed light on the early termination behaviors of Chinese.

Keywords: surrender, lapse, early terminations, life insurance.

I. INTRODUCTION

Life insurance policies are unilaterally binding contracts. Life insurers are bound by the terms of the sold policies as long as policyholders keep the policies valid by paying premiums under utmost good faith. Policyholders on the other hand may choose to surrender their policies at any time for cash values, or opt to stop paying premiums and leave policies to become invalid eventually. The former type of action is referred to as "surrender" while the latter act of omission is termed "lapse." Together, they are regarded as "early terminations" of policies.

Early terminations may have significant impacts on the profitability, or even on the solvency, of a life insurer. Most policies are sold with the expectation of profits being earned over the policy periods and early terminations reduce those profits. The early terminations resulting from adverse selection (e.g., deferred annuities surrendered by the insureds with deteriorating health conditions) are adverse to insurers. Furthermore, unexpected early terminations could cause losses to insurers since initial commissions and fixed costs incurred when policies commence might not yet have been recovered (Tsai, Kuo, and Chiang, 2009; Pinquet, Guillén and Ayuso, 2011). The unexpected increases in cash outflows and/or decreases in cash inflows also impair the effectiveness of an insurer's asset-liability management (Kim, 2005a; Eling and Kiesenbauer, 2014). Volumes of surrenders reacting to a significant downgrade in a solvency assessment of the insurer or to a surge of returns in financial markets may lead to "policyholder run" or "dis-intermediation", as experienced by US life insurers in the late 1980s. The resulting liquidity threats might force insurers to liquidate assets at depressed prices, which would impair insurers' profitabilities and further weaken their solvencies.

The literature further pinpoints the adverse impact on life insurers caused by the

sensitivities of early terminations to interest rates. Empirical papers such as Dar and Dodds (1989), Kuo, Tsai, and Chen (2003), Kim (2005b, 2005c), and Cox and Lin (2006) identify the interest sensitivities of early termination rates.[1] Such behaviors, originating from the exercises of surrender options, are detrimental to life insurers (Tsai et al., 2009), because policyholders tend to surrender their policies at the times when interest rates are high and policies are profitable to insurers while keep holding the policies in low interest rate eras in which these policies generate losses for insurers.[2] Many papers argue that the surrender option might account for a large proportion of the policy value, e.g., Albizzati and Geman (1994), Grosen and Jørgensen (2000), Bacinello (2003), Bauer, Kiesel, Kling and Ruβ (2006), Gatzert and Schmeiser (2008), and Consiglio and De Giovanni (2010). Kling, Ruez and Ruβ (2014) further indicate that how policyholders exercise surrender options determines the hedging efficiency for investment-oriented products such as variable annuities. Failing to adequately incorporate the option into pricing, reserving, and hedging may impose solvency threats on insurers therefore. The fifth Quantitative Impact Study (QIS5) conducted by the European Insurance and Occupational Pensions Authority (EIOPA, 2011) regarding the implementation of Solvency II confirms that the risk of early terminations is the largest risk associated with life insurance when compared with longevity risk, expenses risk, and catastrophe risk.[3] Indeed, the early termination risk accounts for about 50% of the life underwriting risk.

What causes policyholders to surrender or lapse their policies is thus essential for the

[1] The empirical data used in the literature do not usually differentiate surrender from lapse, but the numerical illustrations/analyses focus on how surrenders might affect insurers.

[2] On the other hand, Tsai, Kuo, and Chen (2002) demonstrate that rendering surrender options to policyholders might be beneficial to life insurers if policyholders do not exercise these options when the options have positive values to them (e.g., at times when interest rates are significantly higher than the crediting/pricing rates of the policies) but exercise the options when the option values are negative (e.g., when interest rates are significantly lower than the crediting rates).

[3] The term “lapse” used in QIS5 is indeed equivalent to our “early terminations” that include the behaviors of both surrender and lapse.

insurer to understand, and has attracted the attention of academics. We may classify the literature as being macro- or micro-oriented. Macro-oriented papers such as the empirical papers mentioned in the previous paragraph focus on how early termination rates (the proportion of the policies terminated early to the total number of sampled policies within a period of time) are affected by exogenous, environmental variables including interest rates, unemployment rates, gross domestic product, and returns in capital markets, as well as by company characteristics such as size and organizational form. The methodologies of these papers are time-series analyses.

Micro-oriented papers secure data on individual policies in order to investigate the determinants of the propensities/tendencies towards early terminations. The modeling approaches include logistic regression, generalized linear models (i.e., binomial and Poisson models), Classification and Regression Tree (CART) analysis, and the proportional hazards model. The major determinants are the characteristics of policyholders and the features of life insurance products/policies (see Renshaw and Haberman (1986), Kagraoka (2005), Cerchiara, Gambini and Edwards (2009), Milhaud, Loisel and Maume-Deschamps (2011), Pinquet et al., (2011), and Eling and Kiesenbauer (2014) among others.). Eling and Kochanski (2013) and Society of Actuaries (2014) provide extensive reviews of the literature on early terminations.[4]

Our paper is micro-oriented, and our first contribution to this line of literature is to decompose early terminations into surrender and lapse. This decomposition is important because the motives, causes, and consequences of lapse and surrender are distinct. An important motive to surrender a policy is to take advantage of the higher yields offered in

[4] There are some papers on the subject of modeling early terminations that do not fit our macro-micro classification on empirical, explanatory studies. They impose specific assumptions on the transition probabilities to early terminations (Buchardt, Moller, and Schmidt, 2015), the early terminations' intensity (Barsotti, Milhaud, and Salhi, 2016), or the early termination rates (Loisel and Milhaud, 2011; Milhaud, 2013).

financial markets; such a motive is much weaker in the case of lapse because the policyholder does not receive cash back from the insurer to invest in financial markets. Lapse therefore would be less sensitive to the states of financial markets than surrender. The inconvenience of paying premiums in person (versus automatic transfer from a credit card or bank account) may cause lapse, but such inconvenience would not be an issue in the case of surrender because the action of surrender has to be taken by the policyholder in person. Furthermore, lapse may be due to laziness, ignorance, and/or lack of motivation in paying premiums but surrender stems from the policyholder's evaluation and action. With regard to consequences, lapse does not involve immediate cash flows from the insurer while surrender does. This implies that surrender poses a greater liquidity impact on the insurer and causes more problems to the insurer's asset-liability management than lapse. Therefore, mixing surrender with lapse will impede our understanding of the reasons for which policyholders choose to terminate their policies early. It will lead us to mis-specify the interest sensitivities of lapse and surrender and erroneously estimate the value of the surrender option as well as the option to lapse. Without proper differentiation of surrender from lapse, it is impossible to gain an understanding of how these two types of behavior affect life insurers.

In Figure 1, we plot the policy-year structures of surrender rates and lapse rates as of 8/31/2013 using data for a whole life insurance product issued by a medium-size insurer in Taiwan during the period from 1998 to 2000. Lapse rates are much higher than the corresponding surrender rates in the first several policy years and remain higher till the end of August, 2013. Moreover, the increasing and decreasing rates across policy years of lapse rates are distinct from those of surrender rates. Figure 2 further illustrates the irregular relations between lapse and surrender rates with regard to policy years (and issue years). A regular relation would have led to a horizontal, smooth line, but that is not the case of the samples.

The ratio of lapse rate to surrender rate is large at early and late stages of policy lives while remains small in the middle. Therefore, building models upon aggregated data for surrender and lapse rates or propensities would lead to significant mis-specifications.

[Insert Figures 1 and 2 Here]

Our second contribution to the literature is that we identify the need to build models by product type and present these accordingly. In Figure 3, we plot the policy-year structures of surrender rates and lapse rates using data for a whole life insurance product with living benefits payable for the lifetime that was issued by the same insurer during the same period as the product behind Figure 1. It is obvious that the policy-year structures of surrender rates in Figure 3 differ significantly from those in Figure 1 (in terms of both scale and shape). Such differences mean that the surrender behaviors of the policyholders purchasing these two products are distinct. However, the models in the literature have not yet been built by product type.[5] The differences in the policy-year structures of lapse rates between Figure 3 and Figure 1 are much smaller on the other hand, and this further justifies the need to differentiate surrender from lapse.

[Insert Figure 3 Here]

We also examine the relations between lapse and surrender rates with regard to the policy year of this whole life insurance product with lifetime living benefits. As we can see from Figure 4, the relations are irregular. We should therefore construct surrender and lapse models separately. The significant differences between Figures 4 and 2 provide additional support for constructing early termination models by product type. Lacking individual models for major types of product will mis-specify the sensitivities of lapse and surrender with respect

[5] Some studies employ dummy variables to take into account the possible differences in the propensities towards early terminations across product types. Using dummy variables would not fully capture the differences however.

to various determinants and cause over- or under-charge on policyholders with different characteristics across product types.

[Insert Figure 4 Here]

Our third contribution is to advance the current understanding of the determinants of early terminations by introducing new explanatory variables as well as to examine conventional life insurance in greater detail. The new variables regarding policy/product features include the ratio of commissions to premiums and how premiums are paid (paying in convenience stores, through banks, or collected by agents). With regard to policyholder characteristics, we were able to secure data on the occupations of the insureds. Understanding how these features and characteristics affect early termination behaviors is beneficial to product design, pricing, reserving, and risk management. Compared with Eling and Kiesenbauer (2014) analyzing the differences across annuities, pension products, and life insurance, our paper focuses on traditional life insurance including one term life product, two types of whole-life insurance product, and two types of endowment product. We thus are able to examine how the significance of the savings component embedded in life insurance may affect early terminations.

The fourth contribution of this paper is that it is the first investigation into early termination behaviors in Taiwan. The literature covers Scottish (Renshaw and Haberman, 1986), Japanese (Kagraoka, 2005), Italian (Cerchiara et al., 2009), Spanish (Milhaud et al., 2011), and German (Eling and Kiesenbauer, 2014) life insurance markets. This study extends the literature to another significant market. The insurance penetration and density of the Taiwan life insurance market ranked number one (14.5%) and number three ($3,204) in the world in

2013 (Sigma, 2014).[6] Understanding the early termination behaviors in the Taiwan market may also have implications on the behaviors in Hong Kong, China, Singapore, and other countries with significant Chinese presence.

To accommodate the three choices that policyholders can make (i.e., surrender, lapse, or no early termination), we extend the binary (early termination or not) logistic regression used in the literature to the generalized logistic regression. The empirical results show that policy/product features and policyholder characteristics affect lapse and surrender propensities in distinct ways. Life insurance products composed of different proportions of protection and savings components exhibit distinctive lapse and surrender propensities as well. All newly-introduced explanatory variables are significant determinants of the propensities towards surrender and lapse. With regard to the variables investigated in the literature, some of our results are consistent with the literature; others indicate differences from the existing literature, reflecting the unique market structure of Taiwan and the distinctive behaviors of Chinese.

The remainder of the paper is organized as follows. In section 2 we describe our data, present descriptive statistics, and explain the adoption of the generalized logistic regression. Section 3 contains modeling results regarding the similarities and differences between surrender and lapse, the surrender and lapse behaviors across products, the significance of the new variables, and the similarities and differences in early termination behaviors between Taiwan and other countries. Section 4 summarizes and concludes the paper.

II. DATA AND METHODOLOGIES

A. Data

Our data are from a medium-sized life insurance company in Taiwan that had total assets

[6] Insurance penetration is defined as the total premiums of the market divided by the GDP of the country; insurance density means premiums per capita.

of 15 billion US dollars at the end of 2013. The data contain 741,162 conventional life insurance policies sold during the period from 1998 to 2013.[7] We categorize these policies into five types of product: term-life (denoted T), whole-life (W), endowment (E), endowment with living benefits payable to maturity (E/L), and whole-life insurance with living benefits payable for the lifetime (W/L). The importance of the savings component relative to the protection component increases in this order.[8] Of all samples, 85,803 policies were surrendered while 192,133 policies lapsed.

The data-providing insurer tracked changes in the statuses of policies. "Death = 1" signifies the death of the insured and the cease of the policy. "Surrender = 1" denotes that a policy is surrendered for the cash value. "Lapse = 1" indicates several circumstances resulting from that the policyholder stops paying premiums: a. deducting premiums from policy reserves; b. becoming a paid-up policy with reduced death benefits but the same policy term; c. becoming a paid-up policy with a shorter policy term but the same amount of death benefits; d. suspended if the policyholder does not take one of the first three options.[9] The last tracking date for policy status is 8/31/2013.

Table 1 displays the compositions of our samples. Plain whole-life insurance policies (W) make up the largest business book of the insurer, followed by the whole-life insurance with lifetime living benefits (W/L). Then we observe that lapse rates are much higher than surrender rates, except in the case of endowments (E). For instance, the lapse rates of product

[7] Examples of non-conventional life insurance are variable life, universal life, and interest-linked life insurance products.

[8] We define the savings component as the present value of expected premiums minus the present value of death benefit (i.e., the protection component). Take the policies in which the insureds are 30-year-old males with a face amount of 1 million dollars and 20 annual premium payments as an example. Term-life insurance has no savings component while the savings component of whole-life insurance is minimal (0.02%). The importance of the savings component jumps to 72% for E and increases to 80% for W/L.

[9] In this fourth case, the insurer would give back the cash value to the policyholder two years after the start of suspension. Few policies are in this category because the life insurance companies in Taiwan urge policyholders to select one of the first three options when making purchases.

types W and W/L are 26% and 25% while their surrender rates are 10% and 15% respectively. Both types of rate are much higher than the death rate (26% and 12% vs. 0.8% for all samples respectively), which implies that the early termination risks are higher than the mortality risk. We further see that both lapse and surrender rates vary across products to a significant extent. Term-life (T) has the highest lapse rate of 54% while the lapse rate of endowments (E) is 18%. The surrender rate ranges from 9% to 20%. The numbers in Table 1 illustrate the necessity to distinguish surrender from lapse and to build models by product type.

[Insert Table 1 Here]

We specify several explanatory variables based on the literature and the data provided by the insurer. Firstly, we identify the age, gender, and occupation of an insured at the time when the policy was issued.[10] Female insureds are designated 1 while males are designated 0 for the dummy variable of Gender. With regard to occupation, we refer to the six-tier classification used in the underwriting of life insurance in Taiwan. Representative examples of each tier are as follows. Office employees are classified as tier one while field employees of general businesses are classified as tier two. People who operate or maintain farming machines are classified as tier three, and those who feed animals are tier four. Lumberjacks are tier five while forest fire-fighters are tier six. The risk of the occupation increases with the tier number in general, and the insurers in Taiwan undertake extra screening/underwriting

[10] Information about policyholders is relevant as policyholders are by definition the decision-makers in cases of early terminations. Such information is unavailable, as in Cox, Laporte, Linney and Lombardi (1992), because underwriting focuses on the information about the insured. Furthermore, the insurer may not be in a legitimate position to secure personal information on policyholders unless there are underwriting concerns or moral hazard issues. We speculate that the insured and the policyholder is the same person for most policies. The effect of the missing information may therefore not be significant. Even when the policyholder is not the insured (e.g., a wife for a husband or vice versa), the early termination decision is probably jointly made by the insured and the policyholder. Only in cases in which parents purchase life insurance for their children will the policyholders be the dominant decision-makers. On the other hand, information about the insured is relevant since such information affects the fundamental demand for insurance. Our results thus may complement other results from using the information about policyholders and enhance the understanding of the determinants of early terminations.

when the insured's occupation classification is in tiers two to six. We thus designate the dummy variable Occupation as 1 for the occupations classified into tiers two to six.

We then calculate the "age" of the policy: the length of the period between the policy inception date and the date on which the status changes or the last tracking date if the policy remains valid. We establish a variable, Policy Value, to indicate the "size" of a policy by summing up the present values of all paid and expected premiums using the policy pricing rate as the compounding/discount rate. This is a better indicator than the nominal death benefit of the policy since the present values of premiums reflect the value of all benefits (e.g., death, living, and supplements). The value of this variable facilitates the calculation of the commission ratio: the first-year commissions paid to the distribution channel divided by the policy value.

Then we set up two dummy variables and two nominal variables. The first dummy variable indicates whether the policy is a single-premium one or not; the second indicates whether the policy provides coverage that is additional to death and living benefits (e.g., accident and health). We categorize distribution channels into Tied Agents (denoted by TA),[11] Direct Marketing (DM), and Banks (BK; also serving as the reference group). Premium payments are classified into three methods: collected by personnel of the insurer (Insurer; the reference group), automatic transfers from banks or payments by credit cards (denoted as B&C),[12] and going to a post office or convenience store in person (P&C).

Table 2 presents the descriptive statistics of the aforementioned explanatory variables. The average age of the sampled insureds is 25 years, and the standard deviation of the insureds' ages of the insured is 16. The minimum, medium, and maximum age is 0, 23, and 80

[11] The data-providing insurer did not sell traditional life insurance through brokers or independent agents.

[12] Paying premiums by automatic transfers from bank accounts or through recurring credit card payments is essentially the same to policyholders. We thus regard these two automatic/recurring payment methods as one.

respectively. To obtain a better profile of the age composition of our sample, we refer to demography and categorize the insured's age into five groups: Childhood [0, 14), Teenage/Young Adult [14, 25), Adult [25, 45), Middle-Age [45, 65), and Old-Age [65, 80]. The largest age group is "Adult", comprising over one-third of the samples. The second largest group is "Childhood," which may result from the phenomenon that Taiwanese parents like to prepare for their children's futures by purchasing products with living benefits and/or to purchase whole-life insurance for intergeneration wealth-transfer.[13] The group "Old-Age" contains approximately three-thousand policies only. This is reasonable since life insurance is expensive or even unavailable for the elderly. Table 2 also shows that our sample consists of equal proportions of male and female insureds. About 20% of the insureds are in riskier occupations that call for extra underwriting.

[Insert Table 2 Here]

The average policy age of the observed policies is 8 years. The average policy value is about eleven thousand US dollars,[14] while the variations in policy value are large. The standard deviation is twenty thousand dollars; the largest policy totals 1.5 million dollars and the smallest is merely 16 dollars.[15]

The commission ratio, mainly determined by product design, has a mean of 2.1% and a range of 0.5% to 12.3%. These figures appear small because the denominator is the present

[13] We further observe that more than 40% and 50% of insureds with W/L and E/L policies are in the age group of Childhood while another 30% of the insureds with W/L and E/L products are in the Teenage/Young Adult group. These figures imply that the target customers of the products with periodic living benefits are parents with young children.

[14] The exchange rate used in the paper is 32 NTD/1 USD.

[15] This very small policy is a whole-life insurance with a one-year-old insured for which the death benefit is ten thousand NTD (a little over three hundred USD). There are other similar, small policies with death benefits smaller than three thousand USD. We examined and confirmed the consistency of these policies with their specifications (e.g., the consistency between premiums and death benefit). Small policies constitute less than one percent of our samples and do not affect the empirical findings presented later.

value of all premiums, taking mortality rates into consideration, rather than annual premiums. Less than 2% of the sampled policies are single-premium ones. About 14% of the policies have supplementary coverage.

Selling life insurance through tied agents is the most popular way in Taiwan and this is the case for the data-providing insurer in this study. Bankassurance has been rising since the 2000s, but the data-providing insurer has neither affiliated nor allied banks. Direct marketing remains a minor channel although many people hold positive perspectives on its potential. The proportion of sampled policies sold through this channel is smaller than 2%.

Table 2 further shows that the most popular way of paying premiums nowadays is through automatic/recurring transfers from bank accounts or credit cards while it used to be having agents contact policyholders to collect premiums. The former payment method significantly reduces cost and operational risks. One interesting thing about Taiwan is that post offices and convenience stores that provide money-transfer services are easily accessible; approximately 8% of our samples pay premiums in person in places like these.

B. Hypotheses

Referring to the Financial Services Authority (FSA; 2013) as well as the insurance economic literature in general, we identify the factors driving the propensities towards early terminations to be: natural or unexpected changes in personal circumstances and characteristics, the quality of the sales process, and changes in the economic environments. Firstly, a policy may become unsuitable or unaffordable due to changes in the policyholder's and/or insured's circumstances and characteristics that may or may not have been foreseen at the time of sale. Examples of foreseeable changes may be marriage, having children, and the aging of not only the policyholder and insured but also dependents; examples of the

unexpected type include divorce, accident, sickness, job change, and unemployment. Secondly, should consumers be poorly informed when making purchasing decisions, they will terminate policies early once they find out the mismatch of the policies with their needs. Commissions, for instance, are unknown to consumers; salespersons however may have incentives to sell policies with high commissions even these policies are not the best fit with the needs of consumers. Thirdly, more policyholders are under financial pressure when economic conditions worsen. They might lapse their policies in order to reduce financial outgoings or may even surrender their policies for cash. Moreover, a policyholder might surrender his or her policy when the opportunity cost of holding the policy, i.e., interest rates and/or returns in financial markets, is high.

On the other hand, we consider the factors mitigating the propensities towards early terminations. Insurability is certainly one concern, especially for the elderly and for the people who are aware of their health issues. The second concern relates to replacement cost. Identical coverage would cost more to obtain if s/he terminates the policy bought at a younger age. Searching for a new policy after terminating the old one can be time-consuming and troublesome, especially when extra underwriting is involved.

In the following we discuss the impact on early termination decisions of the variables tested in the literature first and then form hypotheses about the new explanatory variables introduced in this paper.

Age

This variable is treated in different ways in the literature. It usually refers to the age of the policyholder at the time of policy inception (Renshaw and Haberman, 1986; Kagraoka, 2005; Milhaud et al., 2011); Cerchiara et al. (2009) and Eling and Kiesenbauer (2014) designate this variable as the time at which the policy is terminated or the time of the end of the observation

period, and call it the current age. Due to data availability, we define this variable as the age of the insured at policy inception. We are aware that the early termination decision is made by the policyholder, not by the insured, but consider such an alternatively-defined age variable acceptable because the policyholder and the insured are often the same person. Moreover, the demand for insurance may originate from not only the policyholder, but also the insured, should they not be the same person. Last but not least, this alternative definition may shed light on how the age of the insured might affect the early termination decisions.

We speculate that older people would be more reluctant to terminate their policies early due to the concerns about insurability and replacement cost. This speculation is consistent with the findings in the literature generally. Cerchiara et al. (2009), Milhaud et al. (2011), and Eling and Kiesenbauer (2014), however, find that inversions may appear in the youngest and/or oldest age groups. For instance, Eling and Kiesenbauer (2014) find that the policyholders under the age of 25 have lower propensities towards early termination than the next age group. Their explanation is that the contracts with policyholders under the age of 25 may be paid by the insureds' parents and hence the early termination propensities would be relatively low. We thus add a quadratic term to test whether non-linearity exists (in the market of Taiwan).

Gender Dummy

Kagraoka (2005) argues that the housewives in Japan purchase life insurance only if the household incomes are sufficiently high. They therefore would be less likely to terminate their policies early for the reason of them being unaffordable. Eling and Kiesenbauer (2014) refer to Halek and Eisenhauer (2001) in which they find that women are more risk-averse than men with regard to financial matters. This implies that women would be more careful in evaluating insurance purchases and early terminations, and Eling and Kiesenbauer (2014) find empirical support for this argument using the data from Germany. We learn from the behavior finance

literature (e.g., Barber and Odean, 2001) documenting that males tend to be more over-confident than females and thus trade more excessively. Similarly, men may be over-confident in making early termination decisions. These regional findings imply that males have higher early termination propensities than females. On the other hand, Milhaud et al. (2011) find opposite results using the data from Spain. It will be interesting to see how the empirical results from Taiwan differ from or agree with the results from other regions.

Policy Age *(also called contract age or policy year)*

All micro-oriented papers consider this variable, and the results are consistent: the early termination propensity/rate is high in the first few years and then reduces to a low level. The coefficient of *Policy Age* is thus expected to be negative. The high termination propensities in the first few policy years probably result from "mis-selling" in which consumers end up buying products that do not fit their needs and/or bring in financial pressures. Terminating policies in the first few policy years is harmful to policyholders since they can only recover a small portion of the premiums they have paid; it is also detrimental to the insurer because the insurer cannot recover the high expenses incurred in sales and underwriting.

Policy Value

Larger policy may have higher propensities towards early terminations for two reasons. Firstly, the demand for a large policy may be reduced by divorce, growing-up of children, and ageing which often implies a greater amount of accumulated assets. Secondly, the policyholder purchasing a larger policy, as indicated by a larger present value of total premiums, has a greater chance of running into the affordability issues, given the same level of wealth. On the other hand, there are two arguments for a lower propensity. A policyholder buying a larger policy is usually a richer one and wealthier people are more able to afford policies. Furthermore, a richer customer may attract a better salesperson, receive better service, and in

the end buy policies that better fit her or his needs. With regard to the literature, Milhaud et al. (2011) use two variables reflecting the policy size: sum insured and premiums. They find that propensities towards early terminations decrease with the sum insured but increases with premiums. As our measure of policy size differs from theirs and we have competing arguments, we have no specific expectation regarding the sign of the coefficient for *Policy Value*.

Single-Premium Dummy

By definition, a single-premium policy cannot be lapsed; it can only be surrendered for immediate cash. Single-premium policies have no affordability issue since premiums are paid-up. With regard to the suitability issue, Eling and Kiesenbauer (2014) suggest that the policyholder who invests a large amount into a single-premium policy probably understands the product well. We add that single-premium policies are more savings-oriented and thus encounter the suitability issue to a lesser degree. However, the savings-oriented feature makes these policies more sensitive to interest rates and returns in financial markets as they may be substituted by savings products offered in financial markets. We therefore expect single-premium policies to have lower surrender propensities, except during periods of significant rises in interest rates.

Supplementary Coverage Dummy

Supplementary coverage is usually proposed by salespersons and increases the complexity of the entire deal, which raises suitability concerns. Supplementary coverage may also raise affordability concerns due to the increased premiums. On the other hand, coverage purchased as supplements is cheaper and easier to secure than coverage purchased separately. This deters policyholders from early termination for the reasons of replacement costs and insurability. The sign of this variable is thus an empirical matter.

Distribution Channel

Distribution channel is probably the determining factor for the quality of sales while alternative channels have relative advantages and disadvantages over others. For instance, tied agents (also called exclusive agents) transferring to another company would probably encourage their customers to terminate the policies with the former insurer.[16] The banks selling insurance in Taiwan works more like independent agents,[17] in particular the banks associated with the data-providing insurer. Policies selected from the whole market by an independent intermediary have a better chance of meeting the needs of the investor (FSA, 2013). The potential brand loyalty of customers to banks in Bankassurance may further reduce the propensity towards early termination. We therefore expect the early termination propensity to be lower for the policies sold through Bankassurance than those through tied agents.[18]

In the case of direct offer contracts, investors choose the terms of the contract for themselves as opposed to being sold (FSA, 2013). As mis-selling is not an issue, these policies are expected to have lower propensities towards early terminations. On the other hand, whether individuals are capable of seeing through the differences among various products across insurers and then choosing the best-fit policies is questionable. This could be more of an issue in a newly-developed market like Taiwan. We thus withhold our position on whether this channel will have a higher or lower early termination propensity than other channels.

Calendar Year (a.k.a. happen year)

[16] Please note that most agents are exclusive agents in Taiwan.

[17] Trigo-Gamarra (2008) and Eckardt and Räthke-Döppner (2010) find that independent agents provide better services than exclusive agents in the German market, and Eling and Kiesenbauer (2014) further find that the channel of independent agents results in a lower early termination rate.

[18] Brokers remain an immaterial distribution channel in Taiwan. Independent agents are more popular than brokers but their market share is minor as well, in particular with the data-providing insurer.

This variable indicates the year in which the policy was surrendered, lapsed, or terminated due to the death of the insured,[19] and captures the effects of exogenous environments on voluntary as well as involuntary early terminations. Possible exogenous factors that may affect the voluntary early termination decision include interest rate, unemployment, GDP, and returns in capital markets, as identified in macro-oriented papers. Two competing hypotheses may make this variable insignificant however. The emergency fund hypothesis predicts a higher early termination rate in economic downturns while the interest rate hypothesis predicts a lower one in these times.

In addition, this variable may reflect the evolution of the insurance industry during the sampling period. The evolvements may occur in the quality of the sales process, product design, and the shift among distribution channels. The general perception in Taiwan is that the sales quality has been improving with better-trained salespersons and more educated buyers. We also observe that increasing proportions of single-premium, short-duration policies were sold during the sampling period and that bankassurance plays an increasingly important role. The early termination propensities thus may exhibit downward trends.

On the other hand, new types of insurance product started emerging in the early 2000s and captured significant market shares. Investment-linked products became dominant in the market and reached a peak before the financial crisis in 2008. Then, interest-adjusted life insurance took over the leading position as it seemingly guarantees the IRR (internal rate of return) of the policy to be higher than those offered by CDs (certificate of deposits). Variable and universal types of product also emerged during the sampling period. These new products

[19] Ideally, this variable should indicate the status change due to surrender and lapse only. We attempted to use this definition, but encountered the non-identification problem. The year dummies indicating surrender or lapse as a whole (there are 16-1 =15 year dummies) are almost the same as the dependent variable, the difference being merely one year dummy.

are attractive to policyholders and may cause them to surrender or lapse their policies. As the variable of Calendar Year contains much information about economic status, sales force, product trend, and so on, we have no explicit expectation of the signs of these dummy variables.

Occupation

The insureds with riskier occupations have higher probabilities of getting hurt in their jobs. The resulting injuries or disabilities might make insurance unaffordable and lead to early terminations. We further conjecture that field workers are generally less familiar with financial products and are thus more likely to make ill-informed decisions than office workers. On the other hand, the insureds with riskier occupations would have stronger motives to maintain their insurance owing to the concern regarding insurability since they have to go through more stringent underwriting procedures when purchasing replacement policies. The sign of this variable therefore depends on the relative significance of the issues of affordability, decision-making quality, and insurability.

Commission Ratio

One of the major agency problems involved in sales is that salespersons are inclined to sell the policies with higher commission ratios to customers even though these policies might not fit the customers' needs. We thus speculate that the policies with higher commission ratios have higher probabilities of early terminations when policyholders become aware of the mismatches between their needs and what the policies offer.

Premium Payment Method

We expect that the methods that encourage policyholders to pay premiums periodically, prevent policyholders from stopping premium payments, and make premium payment convenient for policyholders will reduce the propensities towards early terminations.

Setting-up an automatic/recurring transfer mechanism with a bank account or a credit card is probably the most convenient way of paying premiums and the most effective way of ensuring that policyholders pay premiums periodically. Furthermore, this premium payment method does not arouse policyholders' awareness/doubts/concerns regarding opportunity cost, fitness, and affordability. Having sales persons collect premiums from customers, a common practice in Taiwan, may arouse policyholders' awareness/doubt/concern. So does the method of asking policyholders to go to a post office or convenience store periodically to make premium payments. These latter two methods are inconvenient to customers since they involve appointments with agents or trips to stores. One distinction between these two methods is that the salespersons that policyholders come into contact with are motivated to sell new products and/or induce policy alterations to earn commissions. We thus speculate that this method of premium payment would result in the most early terminations.

Product Type

Eling and Kiesenbauer (2014) find that the rank of early termination tendency by product in Germany is endowment, Riester pensions, annuity, term life, and Rurup pensions. They do not provide explanations as to why a particular type of product has a higher or lower early termination rate than others.

We speculate that the product with a more significant savings component would have a surrender propensity more sensitive to interest rates and returns in capital markets since such a product may be substituted by other investment products. The early termination propensity of a protection-oriented product, on the other hand, would be more sensitive to the unemployment rate and will raise more insurance demand issues owing to economic downturns reducing the "value" to be protected. Economic downturns impair affordability regardless of product type, but the affordability issue would be of more concern with savings-type products

due to higher premiums.

Aside from the impacts of the economic environment, protection-type products including term- and whole-life insurance have higher probabilities of early terminations due to suitability. The concern regarding insurability, however, works the other way around since purchasing protection-type products has higher chances of running into insurability than buying savings-oriented products. On the other hand, the products with significant savings components may run into the affordability issue although they encounter the suitability issue to a lesser degree. We thus have no definite position in terms of which product types have higher or lower probabilities of early terminations due to the above contrasting arguments.

C. Methodologies

We conduct multinomial logistic regression (also called generalized logistic regression) as well as binary logistic regression analyses. We run the binary logistic regression on the binary dependent variable (early termination versus no early termination), as did Renshaw and Haberman (1986), Milhaud et al. (2011), and many insolvency prediction papers such as Grace, Harrington, and Klein (1998), Cummins, Grace, and Phillips (1999), and Pottier and Sommer (2002). The binary logistic regression model has the following specification as a generalized linear model:

$$\text{logit}(p_i) = \ln\frac{p_i}{1-p_i} = f(i) = \beta_0 + \beta_1 x_{1,i} + \beta_2 x_{2,i} + \ldots + \beta_m x_{m,i}, \quad (1)$$

where $\Pr(Y_i = y_i \mid x_{1,i}, x_{2,i}, \ldots, x_{m,i}) = \begin{cases} p_i & \text{if } y_i = 1 \\ 1-p_i & \text{if } y_i = 0 \end{cases}$ and p_i represents the unobserved propensity of a policyholder to terminate his or her policy early. The case of $y_i = 1$ corresponds to the case of early termination (i.e., lapse or surrender) while $y_i =$

0 corresponds to the case of no early termination (i.e., neither lapse nor surrender). $f(i)$ is a linear predictor function in which $x_{1,i}, x_{2,i}, ..., x_{m,i}$ denote the values of the explanatory variables for observation *i*. β_0 is the intercept coefficient and $\beta_1, ..., \beta_m$ are coefficients indicating the relative effect of a particular explanatory variable on the outcome.

We adopt this methodology when we do not differentiate lapse from surrender as in the existing literature. Using the same dependent variable definition and the same statistical method better illustrates how the new explanatory variables introduced in this paper affect the propensities towards early terminations in comparison with using different definitions and methods. Adopting the same dependent variable definition and statistical method also facilitates comparison of early termination behaviors across countries (e.g., Taiwan versus Scotland, Spain, Italy, Germany, and Japan).

The major contribution of this paper to the literature is that we differentiate lapse from surrender when analyzing the determinants of early termination propensities. This differentiation gives the nominal dependent variable three outcomes: lapse, surrender, or intact. Instead of running multiple binary logistic regressions separately, we adopt the multinomial logistic regression model in which the linear predictor function is generalized to become:

$$f(k,i) = \beta_{0,k} + \beta_{1,k} x_{1,i} + \beta_{2,k} x_{2,i} + ... + \beta_{m,k} x_{m,i}, \quad (2)$$

where $\beta_{0,k}, ..., \beta_{m,k}$ are the regression coefficients associated with the m^{th} explanatory variable and the k^{th} outcome. A multinomial logit model can be understood as running constrained *k*-1 binary logistic regression models in which one outcome is set as a "pivot" and other *k*-1 outcomes are separately regressed against the pivot outcome. For instance, we may construct the following two binary logistic regression models when the outcome “Intact” is the

pivot:

$$\ln \frac{\Pr(Y_i = \text{ lapse} \mid x_{1,i}, x_{2,i}, ..., x_{m,i})}{\Pr(Y_i = \text{ intact} \mid x_{1,i}, x_{2,i}, ..., x_{m,i})} = f(1,i) \quad \text{and}$$

$$\ln \frac{\Pr(Y_i = \text{ surrender} \mid x_{1,i}, x_{2,i}, ..., x_{m,i})}{\Pr(Y_i = \text{ intact} \mid x_{1,i}, x_{2,i}, ..., x_{m,i})} = f(2,i)$$

with the constraint that the probabilities of the three outcomes sum to one.

Multinomial logistic regression has two advantages over multiple logistic regressions in which binary logistic regressions are run on each pair of outcomes separately. First, multinomial logistic regression is run on the entire sample while each regression in multiple logistic regressions is run on a subset of the entire sample (e.g., the samples of lapse and intact or the samples of surrender and intact). Second, multinomial logistic regression ensures that the probabilities of possible outcomes aggregate to one while the aggregated probability may be greater than one with multiple logistic regressions.

III. Findings

A. Univariate Results

To obtain a preliminary understanding of how the variables set up in Section II affect the propensities towards early terminations, we first run univariate multinomial logistic regressions for metric variables including Age, Policy Age, Policy Value, and Commission Ratio. Then we examine the surrender rate and lapse rate with respect to each nominal variable. The results are presented in Table 3.

[Insert Table 3 Here]

From Table 3 we see that all four metric variables have significant coefficients. Moreover, three of them have propensities towards surrender distinct from the propensities towards lapse.

The insured of an older age has a higher propensity towards surrender but a lower propensity towards lapse (positive coefficient versus negative coefficient). So does the policy with a higher value. The policy with a higher commission ratio has a lower surrender propensity but a higher lapse propensity, on the other hand. Although both surrender and lapse rates decrease with policy age, the speed of decrease differs (-0.1986 vs. -0.4583) to a significant extent.[20] These univariate results, albeit preliminary, demonstrate the necessity to differentiate surrender from lapse in order to understand early termination behaviors.

With regard to nominal independent variables, we see from Table 3 that the male group has a higher lapse rate (28.0% vs. 23.8%) but an equivalent surrender rate (11.6% and 11.5%) to the female group. People with riskier occupations have higher lapse and surrender rates than those without: 35.5% vs. 23.6% and 14.0% vs. 11.0%, respectively. Single-premium policies have a slightly lower surrender rate. So do the policies with supplementary coverage in terms of both surrender and lapse rates. The policies sold through direct marketing exhibit the highest lapse and surrender rates (26.9% and 23.1%, respectively), and the policies with premiums paid through banks and credit cards have the lowest early termination rates (2.4% and 10.0%).[21] Moreover, the lapse rates of most nominal variables are distinct from the surrender rates. Most lapse rates are several times larger than the surrender rates. Such distinctions render further support for the necessity of differentiating these two types of behavior in modeling.

We further conduct cross analyses for all pairs of nominal variables. For instance, we

[20] We define "significantly different" as having coefficients that differ by more than 50%, and in this case -0.4583/-0.1986 = 2.31 > 1.5. We thus state that the propensity towards surrender is significantly different from that towards lapse.

[21] The surprisingly low lapse rate associated with the payment method of banks and credit cards might result from two factors. First, the policies with premiums paid through banks and credit cards consist of a higher proportion of single-premium policies. Second, these policies have higher face amount and higher equivalent single premiums than those paid through other methods.

examine the early termination rates of the five product types by the five age groups, by gender, by occupation, etc. The purpose of cross analyses is to detect interactions between two nominal variables. We observe that all of the policies with supplementary coverage are whole-life insurance, almost all single-premium policies are endowments (97%), and all single-premium policies have no supplementary coverage. These results lead us to replace these two dummy variables with two interaction terms: Supplementary Coverage * W and Single Premium * E.

In addition, we detect a potential co-linearity problem between the variables of Policy Age and Happen Year. The correlation coefficient is 70.5%, but the VIF (variance inflation factor) is smaller than 10. We ran all the following analyses at earlier stages of this study with the common factor of Policy Age and Happen Year, and obtained results providing stronger support for distinguishing surrender from lapse across life insurance products (i.e., more significant differences in the regression results regarding how various determinants affect lapse and surrender propensities). For the sake of conservativeness, we present the results of retaining both Policy Age and Happen Year as independent variables in the following analyses.

B. Similarities and Differences between Taiwan and Other Markets

The column titled Conventional Model in Table 4 displays the binary logistic regression results regarding how the explanatory variables that appear in the literature affect the early termination decisions in Taiwan. The results show that the propensities towards early terminations decreases non-linearly with age.[22] This means that in Taiwan, a policy with a younger insured has a higher probability of being terminated early and the probability

[22] With the coefficients of both variables Age and Age^2 being negative, the propensity towards early termination has a theoretical maximum in the second quadrant on the age-logit(p_i) plane and exhibits a non-linear decreasing curve in the first quadrant.

decreases at an increasing rate with age. The decreasing relation between age and early termination propensity is consistent with the observations in Scotland (Renshaw and Haberman, 1986), Japan (Kagraoka, 2005), and Spain (Pinquet el al., 2011). Non-linearity is not detected in these studies however. Cerchiara et al. (2009), Milhaud et al. (2011), Fier & Liebenberg (2013), and Eling and Kiesenbauer (2014) document non-linearity in Italy, Spain, US, and Germany, respectively, but the propensities towards early terminations as reported in these papers did not decrease monotonically.

[Insert Table 4 Here]

The Conventional Model column in Table 4 shows that the policies with female insureds have higher propensities towards early terminations than those with male insureds in Taiwan. This finding differs from those found in Germany (Eling and Kiesenbauer, 2014) and Japan (Kagraoka, 2005).[23] The difference might originate from the fact that the behaviors of policyholders are distinct across markets and/or that we use the insured's gender while the literature uses the policyholder's gender.

We propose three explanations for the possible distinct behaviors in Taiwan. The divorce rate in Taiwan is high while the average income of females is lower than that of males. Affordability is thus more of an issue to divorced females. Regarding the policies with young female insureds, parents would probably choose to terminate the policies that cover daughters first when facing financial distress, because patriarchy is common even among baby boomers (those born during 1945 to 1960) in Taiwan (not to mention older parents). Many parents in Taiwan indeed stop paying the premiums of the insurance policies they had bought for their daughters once they get married as married daughters are traditionally deemed to belong to

[23] The findings of Pinquet et al. (2011) and Milhaud et al. (2011) regarding the Spanish market are contradictory.

the families of the sons-in-law.

With regard to how policy/product features affect early termination decisions, the Conventional Model column shows that the policy with a higher value in terms of the present value of paid and expected premiums has a lower probability of being terminated early. This result implies that the wealth-service effect outweighs the affordability and reduced demand issues in Taiwan. Single-premium policies have lower probabilities of being terminated early. This is expected as a single-premium policy cannot be lapsed by default and lapses account for most early terminations. Milhaud et al. (2011) and Eling and Kiesenbauer (2014) report the same results in Spain and Germany. In Taiwan, the policies with supplementary coverage have lower probabilities of being terminated early. This implies that the lower cost and looser underwriting requirement when purchasing supplementary coverage outweigh the concerns of affordability and suitability in Taiwan. Such a result is different from the finding of Eling and Kiesenbauer (2014) in Germany.

We find that the policies sold by tied agents have the highest probabilities of being terminated early in Taiwan while policies sold through direct marketing have the lowest probabilities. In Germany, Bankassurance leads to higher propensities towards early terminations than tied agents do as Eling and Kiesenbauer (2014) report. We speculate that this difference originates from the different developments of Bankassurance in these two markets. Bankassurance has emerged as a significant channel in the last decade in Taiwan, and the major products sold through banks are savings-oriented. For instance, about 94% of the policies sold through banks are more savings-oriented than whole-life policies in the case of our data-providing insurer. Since savings-oriented policies are more sensitive to interest rates and the interest rates in Taiwan exhibited a downward trend during the sampling period, the early termination propensities of the policies sold through banks are lower. The lower early

termination probabilities are consistent with the potential brand loyalty of customers to the bank as well; it is also consistent with the findings of the FSA (2013) that an independent intermediary has a better chance of meeting the needs of the investor.

The policies sold through direct marketing have the lowest probabilities of early terminations, probably because the direct marketing channel has no mis-selling issue. This may also imply that insurance customers are mature enough to choose the policies that fit their needs.

We see from the Conventional Model column of Table 4 that the propensities towards early terminations decrease with policy age.[24] The decreasing relation is generally observed across most markets, but we are the first researchers to directly incorporate the non-linearity into the analysis.

The control variables of calendar years have significant coefficients in all cases. The coefficients are all positive, and exhibit an increasing trend with calendar year. Such results seem to support our speculation regarding the substituting effects of new products such as investment-linked products, interest-adjusted products, and universal types of product.

To facilitate comparisons across regions, we construct Table 5 summarizing the empirical findings in Scotland, Japan, Italy, Spain, Germany, and Taiwan.

[Insert Table 5 Here]

C. New Explanatory Variables

The column titled Model with New Variables in Table 4 contains the results regarding how the new explanatory variables introduced in this paper, along with the previously-analyzed

[24] With the coefficient of the variable Policy Age^2 being positive while that of the Policy Age variable being negative, the propensities towards early terminations exhibits a non-linear decreasing curve in the first quadrant. The curve is at a minimum between the 12th and 13th policy years.

variables, affect the early termination propensity. The signs and significance levels of the coefficients of all previously-analyzed variables remain intact. The results regarding how the features of single-premium and supplementary coverage affect the early termination propensities after controlling for their interrelations with product type also remain unchanged, as the coefficients of the two dummies at the bottom of the column show. The policies with supplementary coverage have lower propensities towards early terminations. So do the single-premium policies.

We find that the insureds with riskier occupations have larger propensities towards early terminations. This means that affordability and decision-making quality are the major determinants of early terminations of the policies with the insureds that have riskier occupations. The products offering higher commission ratios to sales induce higher probabilities of early terminations, which confirms the existence of the agency problem of distribution channels regarding commissions. The policies with premiums paid automatically through bank transfers or credit cards have the lowest propensities towards early terminations. Such results confirm our speculations that convenience and avoidance of arousing policyholders' awareness/doubts/concerns related to opportunity cost, fitness, and affordability reduce early termination propensities. On the other hand, the policies with premiums collected by the insurer's agents have the highest early termination propensities. This is consistent with our speculation that the contacting agents are motivated to sell new products and/or induce policy alterations to earn commissions.

The column titled Model with New Variables in Table 4 also shows that the propensities towards early terminations differ across product types. All coefficients are significant, which provides support for our argument that we should build models analyzing early termination propensities by product type rather than in an aggregated manner. Our results indicate that

endowment products have the lowest propensities towards early terminations. The products providing periodical living benefits exhibit higher early termination propensities, which suggests that affordability is an issue with these products.

D. Surrender versus Lapse

After examining the early termination behaviors in Taiwan and how the newly-introduced explanatory variables affect such behaviors, we analyze the determinants of lapse and surrender, respectively, using generalized logistic regression. The effects of the explanatory variables on lapse differ from those on surrender as we can see from the results presented in Table 6.

[Insert Table 6 Here]

The results in Table 6 show that the propensity towards lapse is affected by Occupation but the surrender propensity is not, because the coefficient of Occupation is significant in the case of lapse but insignificant for surrender. In other words, the insured with a riskier occupation have a higher propensity towards lapse while the surrender propensity is about the same across normal and riskier occupations. We further observe from Table 6 that the policies sold through direct marketing have significantly lower surrender propensities than those sold through banks, but the lapse propensities through the channels of direct marketing and banks are not significantly different from each other. Endowment products with living benefits have higher probabilities of being surrendered than term-life insurance while the lapse probabilities are the same for these two types of product. With regard to the early termination propensities of whole-life insurance versus term-life insurance, the surrender propensity of whole-life insurance is higher but the lapse propensity is lower. All the above distinctions signify the necessity of differentiating surrender propensity from lapse propensity.

Moreover, the propensity towards lapse is affected substantially[25] more by the variables Distribution Channel – TA and Policy Age than the surrender propensity. This means that the differences in the propensities towards lapse between the policies sold through tied agents and those through banks are substantially larger than the differences in the surrender propensities. The results in Table 6 also indicate that the lapse propensity of a policy decreases substantially faster with policy age than the surrender propensity. The lapse propensity reaches a minimum at 13 years while the minimum of the surrender propensity occurs at about 22 years.

On the other hand, the propensity towards surrender is more sensitive to Policy Value, Premium Payment Method - P&C, and Product Type - W/L than the lapse propensity. More specifically, the surrender propensity decreases substantially more with policy value than the lapse propensity. The differences in the surrender propensities between the policies of which premiums are paid at post offices or convenience stores and the policies of which premiums are collected by agents are larger than the differences in the lapse propensities. The difference in the surrender propensity between whole-life insurance with living benefits and term-life insurance is also larger than the difference in the lapse propensity.

Since lapse and surrender have differing impacts on insurers, differentiating lapse from surrender when modeling early termination behaviors could help insurers to assess the impacts more accurately. For instance, the differences between the premiums set for the insureds who need to go through extra underwriting and those for regular insureds would be more accurate if we are able to differentiate the probability of lapse from that of surrender. This is because the costs associated with lapses are smaller than those with surrenders. When we lump lapse and surrender together, we would either over-charge or under-charge the two groups who should or should not go through extra underwriting. Another example is the question of how much

[25] We define "substantial" to be that the difference in the magnitude of the coefficient is greater than 50%.

lower the loading rates for supplementary coverage should be than the rate for the main coverage. The commissions paid to alternative distribution channels should also be set differently to reflect the differences in the propensities towards lapse and surrender.

With regard to the variables of which the coefficients in the lapse equation are not substantially different from those in the surrender equation (i.e., Age, Gender, and Commission Ratio), the effects as to whether they increase or decrease the propensities towards early terminations are the same as those in Table 4. This indicates the robustness of the models. In addition, we find that single-premium endowment policies have smaller propensities towards surrenders. This is consistent with the affordability and suitability arguments.

E. Protection- versus Savings-Type Products

Since Table 1 and Figure 1 vs. Figure 2 imply that early termination behaviors are probably different across product types, we establish lapse and surrender models for two types of product using the generalized logistic regression method to formally investigate the implication. We select a whole-life insurance product (W) and a whole-life insurance product with lifetime living benefits (W/L) for the reasons that these two products have adequate samples (468,549 and 187,755 policies, respectively) and differ from each other significantly in terms of the proportions of protection versus savings components. The results are presented in Table 7.

[Insert Table 7 Here]

The results in Table 7 first confirm that the effects of the explanatory variables on lapse may differ from those on surrender for both products. The signs of the coefficients associated with lapse are usually consistent with those associated with surrender, but the magnitudes and/or significance levels may be different. More specifically, the lapse propensity of product W is more sensitive to the variables of Occupation, Distribution Channel, and Policy Age than

the surrender propensity while its surrender propensity is more sensitive to Premium Payment Method - P&C. The lapse propensity of product W/L is more sensitive to Distribution Channel - TA and Policy Age than the surrender propensity; the surrender propensity is more sensitive to Policy Value and Distribution Channel - DM. The results in Table 7 thus provide more justification for differentiating lapse from surrender.

The results presented in Table 7 further justify the necessity of building early termination models by product type. The products W and W/L have significant differences in the magnitudes and/or significance levels of the propensities towards early terminations with respect to many variables including: Gender, Occupation, Policy Value, Commission Ratio, Premium Payment Method – P&C, and Policy Age. More specifically, Policy Value is a significant determinant of the early termination propensities of product W/L but is an insignificant one for product W. Commission Ratio and Premium Payment Method – P&C affect the early termination propensities of product W significantly but have no impact on those of product W/L. The decreasing rate of surrender propensity with respect to age is much larger in the case of product W/L than product W.[26] The lapse propensity of product W is affected more by Gender but less by Occupation than that of product W/L. Occupation is a significant determinant of the surrender propensity of W/L but not that of product W. Moreover, the direct marketing channel affects the early termination propensities of product W in the opposite way to those of product W/L. The whole-life policies sold through direct marketing have higher early termination propensities than those sold through banks; direct marketing results in lower early termination propensities than banks in the case of whole-life policies with lifetime living benefits on the other hand. All the above results show that we

[26] The (theoretical) minimal surrender propensity of product W/L is reached at about 16 years while that of product W is reached at 30 years.

should build individual early termination models for major product types.

IV. Conclusions

Understanding the causes of early terminations of life insurance policies is important to the profitability, service quality, liquidity, risk management, and solvency of life insurance companies. Academics as well as practitioners have therefore devoted much effort to identifying the determinants and investigating how they affect early terminations. Some focus on the time-series behavior of early termination rates and examine how macroeconomic variables and company statuses drive early termination rates; others focus on the propensities of individual policies towards early terminations and examine how policyholder characteristics and product/policy features affect the propensities.

In this paper we contribute to the latter line of the literature in four aspects. First, we draw distinctions between lapse and surrender when modeling the propensities towards early terminations. Surrender is an action taken by the policyholder for the cash value of the policy while lapse is inaction in making premium payments. Furthermore, surrender causes immediate cash outflow from the insurer while lapse reduces future cash inflow. The differences in the nature, motivation, and purpose of surrender and lapse as well as the different financial impacts on the insurer caused by surrender and lapse call for differentiation in modeling. Statistics regarding surrender rates and lapse rates across policy years and/or across product types as shown by Figures 1 to 4 and Table 1, as well as the univariate analysis results, indicate the necessity to make distinctions between surrender and lapse. The results in Table 6 confirm the distinctions between surrender and lapse propensities with respect to various determinants.

Second, we observe significant differences in early termination rates across life insurance

products and establish individual models of early termination propensities by product. The literature merely uses dummy variables to accommodate the differences in the propensities across products. Our separate modeling sheds light on how the propensities towards early terminations of different products may be affected by various factors in different ways. Separate modeling will enhance the accuracy of pricing, reserving, and risk management across major types of product.

Third, we add new explanatory variables to those that currently exist in the literature including the insured's occupation, commission ratio of the product, and premium payment method. These results are relevant in setting loading rates across occupations and payment methods as well as in mitigating the agency problem regarding commissions. Last but not least, we are the first to study the determinants of early termination propensities for the market of Taiwan, the life insurance market of which ranks number one and number three in terms of penetration and density respectively. The results have implications on the early termination behaviors of Chinese over the world as well.

We conduct binary logistic regression on the propensities towards early terminations including both surrender and lapse as previous papers did with regard to the explanatory variables they examined to facilitate cross-country comparisons. Our data are from a medium-size life insurer in Taiwan and contain 741,162 life insurance policies sold during the period from 1998 to 2013. The effects of some variables, such as the dummies indicating single-premium and supplementary coverage, on the early termination propensities are consistent across markets; others reflect regional characteristics and distinct developments of the markets, e.g., gender, distribution channel, and product evolvement.

We then add new explanatory variables to the regression to advance our understanding of the determinants of the early termination propensities. We find that riskier occupations of

the insureds and higher commission ratios result in higher propensities towards early terminations. Automatic transfers from bank accounts or credit cards for premium payments lead to the lowest early termination propensities, while collecting premiums through the insurer's agents causes the highest propensities. We further found that endowment products have the lowest propensities towards early terminations and the products providing periodical living benefits exhibit higher early termination propensities. Such results also imply that we probably should build models of early termination propensities by product type rather than in an aggregated manner.

To analyze individual surrender and lapse propensities for the whole sample and maintain the sum of the probabilities of a policyholder's choices at one, we extend the literature by adopting the generalized logistic regression. The results indicate that the impacts of many explanatory variables on the propensities of surrender and lapse are distinct. We thus should differentiate lapse from surrender whenever possible to avoid misunderstanding of how their propensities are determined.

Then we move on to model the surrender and lapse propensities for two types of products. One focuses on providing protection while the other carries substantial savings components. The results first confirm the necessity of distinguishing surrender from lapse, as the surrender models and lapse models of both products exhibit material differences. The results further demonstrate significant differences in the early termination propensity models between these two products. Therefore, we should build individual models for distinct products rather than rely on one "universal" model.

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Table 1: Compositions of Samples (in terms of number of policies and percentage)

Product Type	T	**W**	**E**	E/L	**W/L**	Total
# of Policies /Status	25,904	468,549	52,899	6,055	187,755	**741,162**
Lapsed	14,102	119,769	9,740	2,016	46,506	**192,133**
Lapse Rate	**54%**	**26%**	**18%**	33%	**25%**	**26%**
Surrendered	2,341	46,208	7,782	1,186	28,286	**85,803**
Surrender Rate	**9%**	**10%**	15%	**20%**	**15%**	**12%**
Died	278	4,153	426	25	1,135	6,017
Death Rate	1.1%	0.9%	0.8%	0.4%	0.6%	**0.8%**

Table 2: Descriptive Statistics of Explanatory Variables

	Mean	Medium	Standard Deviation	Minimum	Maximum
Age	25	23	16	0	80
Age Group	[0, 14)	[14, 25)	[25, 45)	[45, 65)	[65, 80]
	202,821	188,447	248,704	97,991	3,199
Gender	Male	369,929	Female	371,233	
Occupation (requiring extra screening = 1)	1	143,648	0	597,514	
Policy Age (in year)	8	7	5	1	16
Policy Value (in US$)	11,063	5,969	20,281	16	1,526,125
Commission Ratio	2.1%	2.2%	0.6%	0.5%	12.3%
Single-Premium	Yes	13,932	No	727,230	
Supplementary Coverage	Yes	102,595	No	638,567	
Distribution Channel	TA	BK	DM		
	710,913	17,654	12,595		

Premium Payment Method	Insurer	B&C	P&C
	191,095	492,900	57,367

Table 3: Univariate Analyses

		Surrender	Lapse
		Coefficient	Coefficient
Age		0.00302***	-0.00580***
Policy Age		-0.1986***	-0.4583***
Policy Value		0.00523***	-0.0229***
Commission Ratio (%)		-7.4397***	9.7694***
Gender	Male	11.6%	28.0%
	Female	11.5%	23.8%
Occupation	Tiers requiring extra screening	14.0%	35.5%
	Lowest risk tier	11.0%	23.6%
Single-Premium	Yes	10.7%	-
	No	11.6%	26.4%
Supplementary Coverage	Yes	10.6%	25.3%
	No	11.7%	26.0%
Distribution Channel	TA	11.4%	26.5%
	BK	10.0%	2.4%
	DM	23.1%	26.9%
Premium Payment Method	Insurer	14.0%	51.0%
	B&C	10.0%	13.1%
	P&C	16.7%	52.6%
Calendar Year	1998	0.4%	11.9%
	1999	1.4%	21.2%
	2000	3.2%	11.2%
	2001	2.4%	8.1%
	2002	1.8%	4.8%
	2003	2.0%	4.9%
	2004	2.2%	3.3%
	2005	2.2%	2.4%
	2006	2.0%	3.0%
	2007	2.0%	2.7%
	2008	1.8%	2.3%

	2009	1.5%	2.3%
	2010	1.5%	1.7%
	2011	1.1%	1.7%
	2012	1.0%	1.6%
	2013	0.5%	1.1%

Table 4: Results of Binary Logistic Regressions

Variable/Model		Conventional Model	Model with New Variables
Intercept		1.8381***	0.8526***
Age		-0.0277***	-0.0113***
Age^2		-0.00071***	-0.00094***
Gender (male = 0)		0.2683***	0.4183***
Occupation (ref=0; requiring extra screening = 1)			0.0953***
Policy Value		-0.0162***	-0.00736***
Single-Premium or Not (single = 0)		1.2289***	
Supplementary Coverages (no = 0)		-1.5356***	
Commission Ratio (%)			38.517***
Premium Payment Method (reference: collected by insurer)	B&C		-1.3883***
	P&C		-0.4089***
Distribution Channel (reference: bank)	TA	0.7574***	1.7359***
	DM	-2.0523***	-0.7165***
Policy Age^2		-1.8369***	-1.4827***
Policy Age		0.0738***	0.0528***
Calendar Year (reference: 1998)	1999	5.1472***	4.4476***
	2000	6.5575***	5.8068***
	2001	6.6919***	6.1368***
	2002	7.3244***	6.8681***
	2003	7.8818***	7.4291***
	2004	8.6923***	8.1599***
	2005	9.2171***	8.6948***
	2006	9.6866***	9.2156***
	2007	10.3092***	9.8484***
	2008	10.8423***	10.4008***

	2009	10.7082***	10.3189***
	2010	11.0454***	10.6367***
	2011	10.8581***	10.6139***
	2012	11.1473***	10.9967***
	2013	12.1099***	12.0968***
Product Type (reference: T)	W		-0.2214***
	E		-1.3442***
	E/L		0.5396***
	W/L		0.7985***
dummy(W*Supplement)			-1.1019***
dummy(E*Single Premium)			2.1162***
Pseudo-R2		0.7122	0.7136

NOTE： *: significant at 0.1 level; **: significant at 0.05 level; ***: significant at 0.01 level; two-tailed χ^2 tests.

Table 5: Summaries of Empirical Findings in Scotland, Japan, Italy, Spain, Germany, and Taiwan

Explanatory Variable	Age	Gender	Policy Age
Scotland (Renshaw and Haberman, 1986)	Decreasing with three age groups (15~29, 30~39, 40~64)		Decreasing with three policy age groups except non-profit endowment for which the highest propensity happens in the second group (4~8 years)
Japan (Kagraoka, 2005)	Decreasing with four age groups ([25, 35), [35~45), [45, 55), [55~65))	Smaller propensities for females	Reaching the highest propensity in the third policy year (categorical)
Italy (Cerchiara et al., 2009)	Decreasing to the lowest propensity at the age group of 60~79 and bouncing back for the 80+ group		A parabola opening downward with a vertex at the 6th year (categorical)
Spain (Milhaud et al., 2011)	Starts decreasing from the 2nd age group [20, 30)	Higher propensities for females	Decreasing with 9 policy age groups
Spain (Pinquet et al., 2011)	Decreasing with age except a peak at 65	Smaller propensities for females	
Germany (Eling and Kiesenbauer, 2014)	Reaching the highest propensity at about age 25 and then decreasing with age up to 68 at which the propensity starts rising again (categorical)	Smaller propensities for females	Reaching the highest propensity in the second policy year (categorical)
Taiwan (current article)	Decreasing at increasing speeds with age	Higher propensities for females	Decreasing at decreasing speeds with age

Table 5 (continued)

Explanatory Variable	Policy Value	Single-Premium	Supplementary Coverage	Distribution Channel (ref: BK)	
				TA	DM
Spain (Milhaud et al., 2011)	Decreasing with three face amount groups; increasing with three saving premium groups; reaching the highest propensity at the 2nd risk premium group	Lowest propensities for single-premium policies			
Germany (Eling and Kiesenbauer, 2014)		Lower propensities for single-premium policies	Higher propensities for policies with supplementary coverage	The propensity is higher with banks but lower with brokers than with tied agents	
Taiwan (current article)	+***	Lower propensities for single-premium policies	Lower propensities for policies with supplementary coverage	The propensity is higher with tied agents	+***

Table 6: Results of Generalized Logistic Regressions

Variable/Early Termination		**Lapse**	**Surrender**
Intercept		0.6014***	-3.2407***
Age		-0.0097***	-0.00752**
Age^2		-0.00103***	-0.0009***
Gender (male = 0)		0.399**	0.4431***
Occupation (ref=0; requiring extra screening = 1)		**0.1302*** **	**0.0245**
Policy Value		**-0.00527*** **	**-0.00917*** **
Commission Ratio (%)		32.5585***	39.341***
Premium Payment Method (reference: collected by insurer)	B&C	-1.4979***	-1.1404***
	P&C	**-0.2443*** **	**-0.6924*** **
Distribution Channel (reference: bank)	TA	**2.5814*** **	**1.4413*** **
	DM	**-0.1143**	**-0.6391*** **
Policy Age		**-1.6001*** **	**-1.0757*** **
Policy Age^2		**0.0615*** **	**0.0241*** **
Calendar Year (reference: 1998)	1999	4.4297***	5.0354***
	2000	5.7144***	6.8047***
	2001	5.9185***	7.5192***
	2002	6.6267***	8.235***
	2003	7.118***	8.8544***
	2004	7.74***	9.6343***
	2005	8.0365***	10.3357***
	2006	8.6619***	10.7822***
	2007	9.2517***	11.4395***
	2008	9.7808***	12.0592***
	2009	9.7282***	12.0294***
	2010	10.0014***	12.4064***
	2011	10.072***	12.354***
	2012	10.51***	12.7294***
	2013	11.7793***	13.5131***
Product Type (reference: T)	W	**-0.3754*** **	**0.1224***
	E	-14.9237	0.1232

	E/L	**0.0859**	**1.3248*** **
	W/L	**0.3146*** **	**1.6696*** **
dummy(W*Supplement)		-1.0617***	-1.1539***
dummy(E*Single Premium)		NA	**1.761*** **
Pseudo-R2		0.7331	

NOTE：*: significant at 0.1 level; **: significant at 0.05 level; ***: significant at 0.01 level; two-tailed χ^2 tests.

Table 7: Results of Generalized Logistic Regression Models on Two Types of Product

Variable / Product	Early Termination	**Whole Life**		**Whole Life with Life-Time Living Benefits**	
		Lapse	**Surrender**	**Lapse**	**Surrender**
Intercept		-2.0025***	-5.0896***	3.1884***	0.5538**
Age		-0.0126***	-0.0138***	-0.0101	-0.0119*
Age^2		-0.00097***	-0.00083***	-0.00112***	-0.00085***
Gender (male = 0)		***0.4791******	0.4923***	***0.3122******	0.3869***
Occupation (ref=0; requiring extra screening = 1)		***0.0757****	***-0.0326***	***0.2904******	***0.2083******
Policy Value		***0.00175***	***-0.00328***	***-0.0115******	***-0.0199******
Supplementary Coverages (no = 0)		-0.8519***	-0.9882***		
Commission Ratio (%)		***35.2568******	***42.0402******	***-5.6237***	***7.7317***
Premium Payment Method (reference: collected by insurer)	B&C	-1.3268***	-1.0155***	-1.3808***	-1.1227***
	P&C	***-0.1219******	***-0.6347******	***0.0709***	***-0.2662***
Distribution Channel (reference: bank)	TA	**3.5361*****	**1.7328*****	**2.7865*****	**1.8443*****
	DM	***1.4388******	***0.625****	***-1.0401******	***-1.7174******
Policy Age		***-1.3837******	***-0.8166******	***-2.0453******	***-1.6183******
Policy Age^2		***0.0544******	***0.0137******	***0.0796******	***0.0493******
Calendar Year (reference: 1998)	1999	5.3222***	6.131***	3.5703***	4.186***
	2000	6.5986***	7.8621***	4.7143***	6.0715***
	2001	6.7049***	8.3339***	5.128***	7.0904***
	2002	7.2321***	9.0163***	6.4576***	8.3842***
	2003	7.5921***	9.6967***	6.873***	8.8296***
	2004	7.8688***	10.329***	8.2215***	10.0858***
	2005	8.2232***	11.0281***	8.349***	10.7003***
	2006	8.6624***	11.3282***	9.1818***	11.1773***
	2007	9.1161***	11.8237***	9.7856***	11.9777***
	2008	9.6735***	12.4386***	10.1977***	12.5142***
	2009	9.4692***	12.2814***	10.3248***	12.6016***
	2010	9.8148***	12.7159***	10.0436***	12.4087***
	2011	9.804***	12.5669***	10.4307***	12.6072***

	2012	10.1831***	12.9027***	11.0659***	13.0209***
	2013	11.3258***	13.6957***	12.3454***	13.5309***
Pseudo-R2		0.7222		0.7417	

NOTE：*: significant at 0.1 level; **: significant at 0.05 level; ***: significant at 0.01 level; two-tailed χ^2 tests.

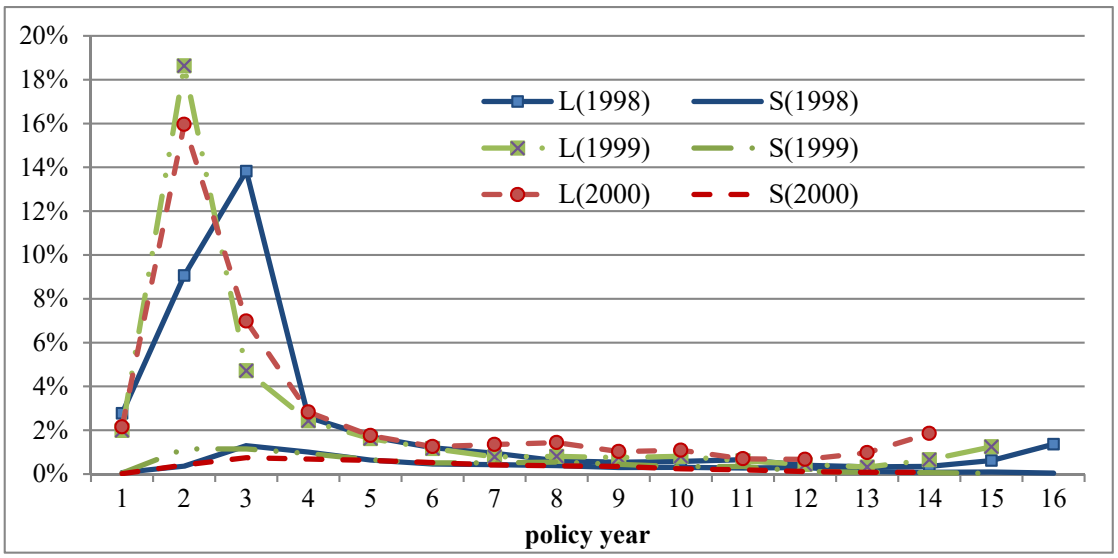

Figure 1: Policy-Year Structures of Lapse Rates (L) and Surrender Rates (S) of a Whole Life Insurance Product

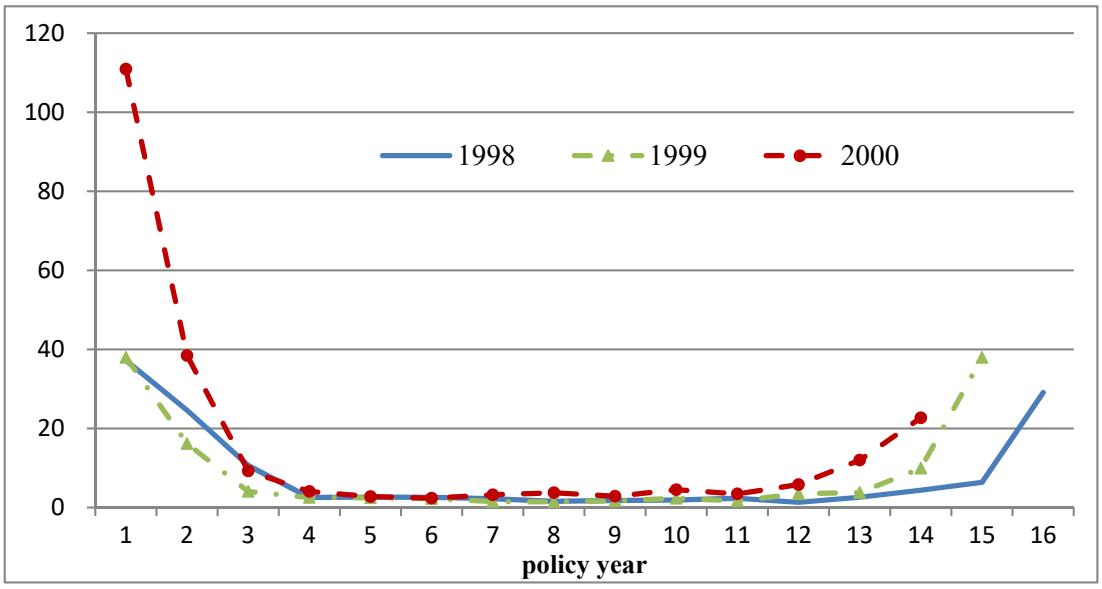

Figure 2: Ratios of Lapse Rate to Surrender Rate of the Whole Life Insurance Product

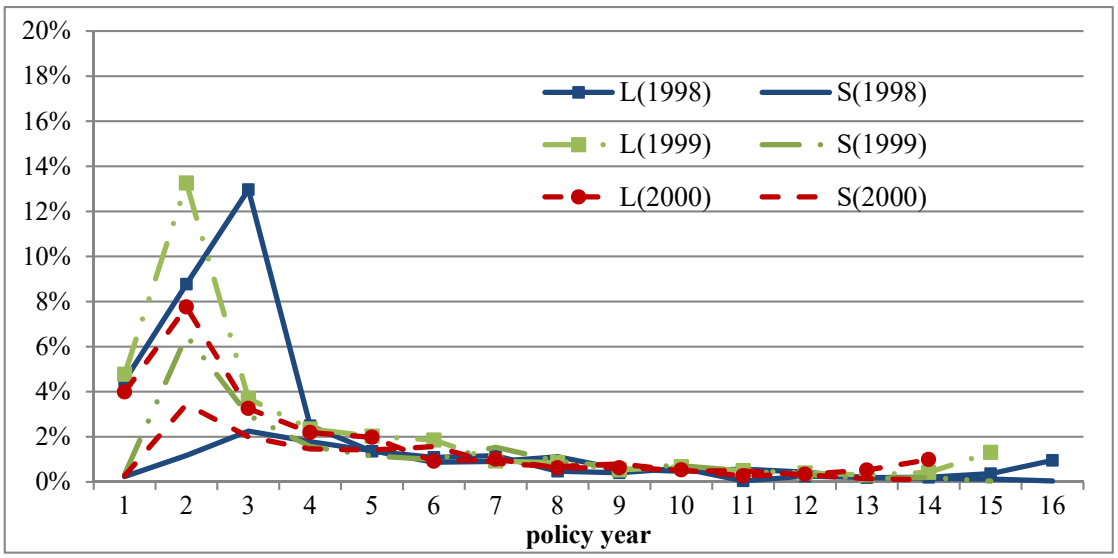

Figure 3: Policy-Year Structures of Lapse Rates (L) and Surrender Rates (S) of a Whole Life Insurance Product with Lifetime Living Benefits

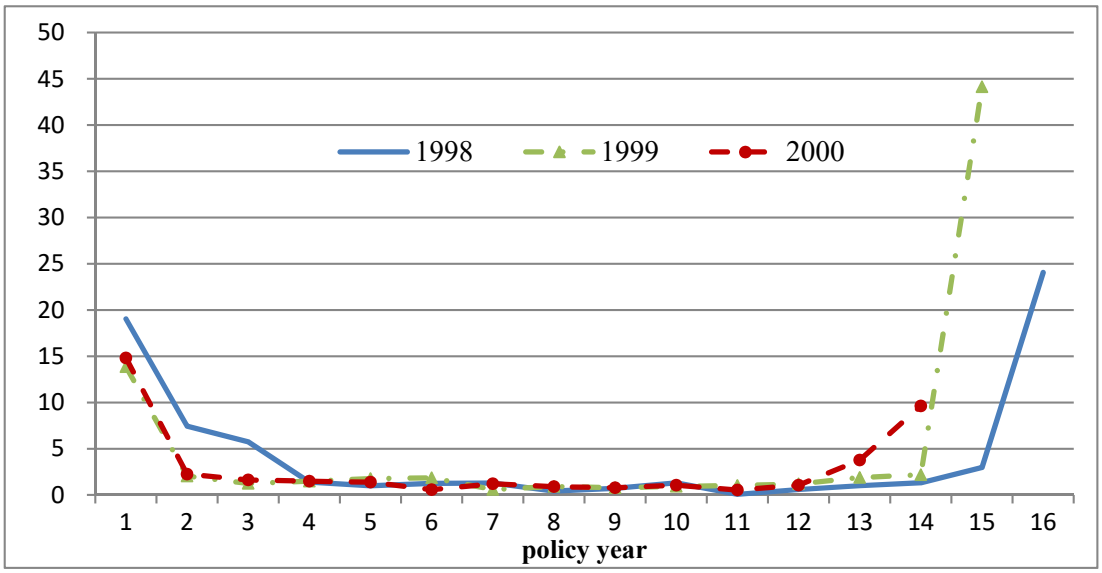

Figure 4: Ratios of Lapse Rate to Surrender Rate of the Whole Life Insurance Product with Lifetime Living Benefits