MILLIMAN BRIEFING NOTE

Dynamic partial surrenders – deep dive into modelling approaches

Eoin King, FSAI
Ankur Jain, FSAI
Erin Moorhead, FSAI

Introduction

"Partial surrenders" refers to an individual exercising the option to withdraw a portion of the value of a life insurance investment policy without full termination of the policy. This option is generally applicable for unit-linked and variable annuity business.

The option to partially surrender provides flexibility to the policyholder but can be a source of risk for the insurer, as significant partial surrenders can lead to quicker runoff of the assets under management and loss of the associated charges (such as a fund management charge) on such surrenders. This can reduce the expected profitability of the insurance policy and can also limit the extent to which firms can cover the fixed expenses and guarantee costs. Conversely, partial surrenders can reduce the exposure for a company which offers products with guaranteed benefits, as the guaranteed payments might be reduced in the event of partial surrenders.

Hence, firms need to monitor the behaviour of partial surrenders and appropriately allow for them in their valuation and pricing bases.

It is widely accepted that the decision to surrender a policy (either partially or in full) can be linked to the economic environment and policyholders' personal circumstances. In this paper, we discuss potential drivers of partial surrenders in a life insurance policy and some ways to model dynamic partial surrenders, particularly in response to the economic factors. We would note that the drivers for full surrenders will also mostly overlap with those for partial surrenders.

In this paper we discuss approaches from a relatively simplified static partial surrender assumption to dynamic partial surrenders (both on deterministic and stochastic bases). The choice of modelling approach will be dependent on the nature of the business and its risk profile. For example, a company with a unit-linked book with no guarantees might opt for static partial surrenders or dynamic partial surrenders on a deterministic basis. Whereas a company with a portfolio of variable annuities may be more likely to evaluate advanced modelling techniques such as dynamic partial surrenders either on a stochastic or deterministic basis.

We lastly examine some of the practical considerations in modelling partial surrenders.

Options to model partial surrenders

There are a few different ways firms can model partial surrenders for valuation and pricing purposes, which we discuss in this section:

- **Static partial surrender assumption on a deterministic basis:** Here the partial surrender assumption is a fixed rate, which is reviewed at periodic intervals (typically, annual review is carried out). This can be modelled as either:
  - An adjustment to the main lapse assumption
  - A separate assumption

  Here, the assumptions are typically set based on historical experience observed over a defined period and potentially can allow for expected future experience based on external data or expert judgements. These assumptions generally remain the same until the next review cycle, which could be either once a year or in some cases every few years. Thus, this approach doesn't capture any changes due to the changes in economic environment (or policyholder personal circumstances) until the next review cycle.

  Modelling partial surrenders as an adjustment to the main lapse assumption can have a limitation that the projected number of policies runs off faster than intended, leading to a lower expense cash flow projection (if expenses are modelled on a per-policy basis) and a potential understatement of expense reserves.

  Modelling partial surrenders as a separate assumption can help to overcome this limitation. They can be modelled as a percentage of fund value so that there is no impact on the runoff of policies (and thus avoiding the understatement of expense cash flows).

  The advantages of this approach are its simplicity, and less data and expert judgements required compared to the other approaches discussed below. However, this simplified approach is unlikely to capture any possible dynamic nature of potential partial surrenders and the potential impact on reserves. This approach can, therefore, potentially lead to misstatement of reserves or prices.

- **Dynamic partial surrenders on a deterministic basis:** Under this approach the dynamic nature of partial surrenders is modelled in response to an external factor such as moneyness of guarantee, level of interest rates, policyholder personal circumstances etc. The level of partial surrenders will vary depending on the level or pattern of an input driver over a period of time. For example, low interest rates is a driver which may make a guarantee more valuable to the policyholder and might reduce the propensity to withdraw funds from such a policy (assuming rational policyholder behaviour).

  Under this approach the level of partial surrenders is determined as a function of a single or some combination of variable inputs. For example, the partial surrender function can be defined as a function which varies by the level of moneyness of a guarantee.

  This approach defines partial surrenders depending on the guaranteed value associated with a policy at the valuation date. This assumption can therefore vary from one valuation period to the next depending on how the moneyness of the guarantee evolves over a period. However, once the pattern of assumptions is determined at the valuation date, then they remain the same throughout the projection period.

- **Dynamic partial surrenders on a stochastic basis:** The dynamic partial surrenders modelling discussed above can be extended to modelling on a stochastic basis. Here, the dynamic nature of this assumption is modelled over several scenarios to assess its variability.

  For example, the level of interest rates can be stochastically modelled for a given number of simulations. The level of partial surrender assumption is then allowed to vary depending on how interest rate evolve in each simulation.

  We would note that this level of advanced modelling is generally only worth considering for unit-linked and variable annuity products with embedded guarantees where a stochastic model is used to model the guarantee accurately.

We note that the modelling of dynamic partial surrenders is a complex topic and requires sophisticated modelling techniques. However, this approach has the merit of leading to a potentially more appropriate valuation of partial surrenders and might be less onerous if the existing simplified techniques lead to prudent assessment of the reserves. In the next section, we discuss in detail some of the approaches to modelling the dynamic partial surrenders.

Modelling of dynamic partial surrenders

Companies first need to consider whether the partial surrender behaviour is linked to external factors. The movement in these external factors could significantly alter the level of partial surrenders from the current assumed rates, in which case companies should consider modelling the dynamic nature of these partial surrenders.

In this section, we consider a few different modelling approaches to model dynamic partial surrenders. We first discuss what factors companies need to consider before modelling a dynamic lapse function.

The starting point for companies is to identify the products which are exposed to partial surrenders. They would primarily include unit-linked products and variable annuities. It is then worth identifying products which are materially impacted or expected to have a material impact. The decision to model all or only the material products would likely depend upon the complexity of modelling, the availability of data and the time required.

After identifying the products exposed to partial surrenders, it is important to identify the factors which influence the level of partial surrenders. In general, they are influenced by a multitude of factors, some of which are market-dependent, and others that depend on a policyholder's personal circumstances or product characteristics.

The market factors include level of moneyness of the guarantee, interest rates, performance of equity markets and state of the economy, among others. We discussed how moneyness of the guarantee can alter the level of partial surrenders in the previous section. As another example, unemployment levels tend to increase when the economy enters into recession. This can lead to policyholders opting to take a partial surrender from their life insurance policies and thus the partial surrender rate can be higher when unemployment levels are higher and the economy is in a recession.

The policyholder characteristics include policyholders' financial circumstances, age and income, tax status, among others. There could be other product characteristics as well, such as distribution channel and duration of contract, which could influence policyholder behaviour. Policyholders might opt to partially withdraw from the policy at certain life events such as marriage, birth of a child etc. and thus age can act as a driver which influences the level of partial surrenders. Similarly, duration of a contract can potentially be a driver because policyholders are less likely to partially withdraw from the policy closer to maturity if there are guarantees applicable at maturity.

It may be possible to identify the relationship between partial surrenders and policyholder or product characteristics which remain the same (such as distribution channel), or change with known pattern (such as age, policy duration etc.). However, the level of analysis would depend on the availability of sufficient and credible data. Other policyholder characteristics, such as financial circumstances and income, are relatively challenging to model given that these factors can change frequently and the insurer might not have such data to hand.

We explore the link between partial surrenders and market dependent factors in further detail in the next section.

FIGURE 1: POSSIBLE DRIVERS OF PARTIAL SURRENDERS

Market-related	Policyholder/product characteristics
▪ Moneyness of the guarantee	▪ Age
▪ Interest rates	▪ Income
▪ Equity markets	▪ Personal financial circumstances
▪ State of the economy	▪ Term to maturity
	▪ Distribution channel

Once the dynamic function to model the partial surrender rates has been specified, firms should back-test the results over the last few valuation periods to assess whether the model gives reasonable results. It is also important to test the sensitivity of the dynamic lapse function to different factors. The factors would depend on the nature of the business and the model. They could include sensitivities on different model parameters, switching off the minimum and maximum level of surrenders, using a different set of key assumptions and other key risk drivers.

The review and monitoring mechanism should also be considered. This would include at what frequency the parameters would be reviewed and updated, the situations in which the dynamic lapse function will itself be reviewed and the associated governance and controls required to make the changes.

The infographic in Figure 2 shows the broad map of modelling dynamic partial surrenders.

FIGURE 2: MODELLING DYNAMIC PARTIAL SURRENDERS

1 Identification of products exposed to partial surrenders

2 Identification of drivers of partial surrenders

3 Modelling of the dynamic lapse function

4 Back-testing of results

5 Sensitivity analysis

6 Review and governance

DYNAMIC LINK OF POLICYHOLDER BEHAVIOUR AND MARKET FACTORS

The dynamic nature of partial surrenders is usually associated with variable annuities or unit-linked products with guarantees. We can also expect dynamic policyholder behaviour for unit-linked products without guarantees to an extent. We discuss each of these scenarios below.

For variable annuities (or unit-linked products with guarantees), the dynamic behaviour is generally linked to the moneyness of the guarantee. If the guaranteed value of the policy is greater than the policy fund value then it’s said to be in-the-money (ITM), whereas, if the guaranteed value of the policy is less than the policy fund value, then it’s said to be out-of-the-money (OTM). If the two are equal, then it’s at-the-money (ATM).

If a policy is ITM, then it is expected to have lower levels of partial surrenders because the guarantee is more valuable to the policyholder. Conversely, if a policy is OTM, then it is expected to have higher levels of partial surrenders compared to the base rates. And finally, if a policy is ATM, then the partial surrender rate would be expected to be close to the base level of partial surrender rates. Note that we have assumed rational policyholder behaviour in these cases discussed here.

For a unit-linked product without guarantees, other external factors could alter the policyholder partial surrender experience. For instance, a sharp downturn in the equity market can lead to higher level of withdrawals due to greater uncertainty in the market. In such cases, companies can consider the option of modelling dynamic partial surrenders on a deterministic basis.

Given that there are no guarantee levels associated with such products, it would be necessary to define a benchmark to assess the policy fund value in order to ascertain its relationship with policyholder behaviour to withdraw money. The dynamic partial surrenders can thus be modelled based on this relationship (as discussed in the next section).

The below examples could serve as potential benchmarks to assess the same.

- Performance of equity market over a period compared to returns over the past few periods.
- Level of unemployment in the economy.
- Return on policyholders’ funds versus return on competitors’ funds for the same asset classes.
- Return on policyholders’ funds versus historical return of the same fund (e.g., average of last three to five years).

As an example, if the policyholder's return on their fund is higher than the benchmark return, then the level of withdrawals might be expected to be lower because policyholders are more likely to hold the money in the existing fund which provides them with a higher return, and vice versa (assuming policyholders exercise rational options). Note that the benchmarks included above are likely to influence full surrenders as well as partial surrenders. It would be necessary to establish this relationship for partial surrenders through experience analysis on the company's data and other industry data.

We explore some different approaches to model the above-mentioned dynamic links in the next section.

MODELLING OF DYNAMIC LAPSE FUNCTION

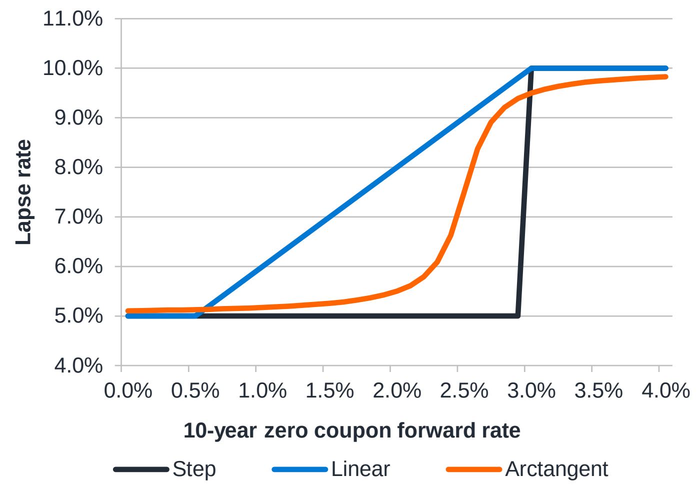
We first discuss how a dynamic lapse function can be modelled for products with guaranteed benefits and then subsequently cover how this function can be adopted for products with no guarantees. Although it is important to note that simplified dynamic lapse functions might be suitable for simple unit-linked products with no guarantees.

A starting point for modelling could be to specify the minimum and maximum bounds of the partial surrender rate. It could be set as an absolute amount, or as a multiplier applicable to the base rates or as some other forms of bounds.

These bounds can be set based on the experience analysis of the company's own data, if it is sufficient and credible, using expert judgement or trends in the local and international market where similar products are sold.

The behaviour of partial surrenders between the minimum and maximum bounds can be modelled depending on the nature of products and expected experience. Specimen relationships between lapse rates and interest rates have been shown in the graph in Figure 3, based on Milliman research published in 2013.[1]

FIGURE 3: RELATIONSHIPS BETWEEN LAPSE RATES AND INTEREST RATES



As is seen in Figure 3, the lapse rates or partial surrender rates can be modelled as a step rate increase, linear increase or an arctangent pattern.

Under a step rate increase model, it is assumed that policyholders are insensitive to small changes in interest rates. However, after interest rates reach a certain level, policyholders will become aware of the material change in them, due to a combination of financial news and word of mouth, which will lead them to lapse (or partially surrender) the policy in their economic interests. Under this model, further interest rate increases have no impact on the propensity to lapse once interest rates have risen to a maximum set threshold.

Under a linear increase model, lapse rates increase gradually and continuously as interest rates increase. It is assumed that there will be even more frequent news about interest rates and competitors will aggressively market alternative investment products, which will lead to a higher propensity of the policyholders to lapse all or part of their policies.

The arctangent approach has characteristics of both the step rate and the linear increase. Similar to the step rate, the arctangent formula exhibits relatively low lapse sensitivity below and above certain interest rate thresholds. As interest rates increase, there is at first a gradual increase in lapse rates. After a certain threshold rate is reached, lapse rates begin to rise significantly. Above a certain point, further increases in interest rates lead to only moderate additional levels of lapsation.

[1] Conwill, S., Furuya, Y. & Ito, K. (October 2013). Dynamic Lapse Risk in an Era of Quantitative Easing. Milliman Research Report. Retrieved 10 November 2023 from https://www.milliman.com/-/media/milliman/importedfiles/uploadedfiles/insight/2013/dynamic-lapse-risk.ashx

In the following subsections, we discuss how to model the dynamic lapse multiplier to calculate the sensitivity of the lapse rate to the varying levels of a defined factor for different products (e.g., to varying levels of interest rates).

A. VARIABLE ANNUITIES OR UNIT-LINKED WITH GUARANTEES

In case of variable annuity business or unit-linked products with guarantees, the formula below is an example of one that could be used to calculate the dynamic lapse multiplier for the products with minimum guaranteed maturity benefits.

Note that the below formula is based on the VM-21 for the US principle-based reserve set by the National Association of Insurance Commissioners (NAIC).[2] It has set this formula for variable annuities with guaranteed minimum death benefits with prescribed parameters which are not applicable for partial surrenders.

However, we have here suggested that this formula could be used for modelling dynamic partial surrenders which have guaranteed minimum maturity benefits through calibration of suitable parameters listed beneath the formula.

$$Dynamic\ lapse\ multiplier\ (\lambda) = MIN\left[U, MAX\left[L, 1 - M * \left(\frac{GV}{AV} - D\right)\right]\right]$$

where:

GV: Guaranteed value

AV: Policyholder account value

U,L: Upper and lower coefficients

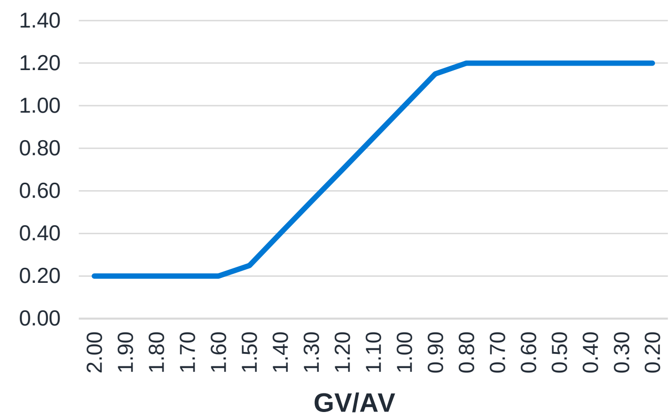
M: Sensitivity coefficients

D: Adjustment factor

The upper and lower coefficients, sensitivity coefficient and adjustment factor need to be set based on past experience, industry data or expert judgement. The sensitivity coefficient in particular is calibrated to capture how sensitive the withdrawal rate is to the moneyness of the guarantee. The adjustment factor is the additional parameter to set the value of the multiplier according to varying levels of guaranteed value and account value.

Here, it is assumed that policyholders are less likely to withdraw when the guarantee is higher than the account value i.e., when the policy is in-the-money. When the account value increases relative to guaranteed value, the $\frac{GV}{AV}$ value in the above formula will reduce and the dynamic lapse multiplier (λ) will increase (up to a maximum of the upper coefficient). As the multiplier increases, the partial surrender assumption will increase when this dynamic lapse multiplier is used with the base rate of partial surrenders.

FIGURE 4: DYNAMIC LAPSE MULTIPLIER



There could be various other parametrisations of the above formula or other algorithms to model the dynamic nature of partial surrenders which would depend upon the specifics of the products and the expected experience.

B. UNIT-LINKED WITH NO GUARANTEES

In the case of unit-linked products without guarantees, there is generally a risk that, if partial withdrawals are higher than expected, then a company may lose out on future fund management charges and other fund-related charges. This would prove onerous to the company and hence it might be required to model the dynamic behaviour of policyholders in response to the market conditions. We have considered two of the possible examples of the approaches below.

[2] NAIC (1 January 2023). Valuation Manual. Retrieved 10 November 2023 from https://content.naic.org/sites/default/files/pbr_data_valuation_manual_current_edition.pdf.

1. **Level of unemployment:** If the level of unemployment in the economy is high, then we might expect higher levels of partial surrenders from life insurance policies. This can be modelled as a dynamic function. For example, if a level of unemployment exceeds a defined percentage, then partial surrenders would increase by a certain percentage and vice versa if the unemployment rate decreases. This is a relatively simplified approach but it can further be enhanced to allow for mean reversion of partial surrender rates after a defined period of time in projections or other enhancements if suitable.

   Note that there could be a delay in the statistics for unemployment rates. In such cases, the unemployment rate beyond which partial surrenders increase can be set to a lower rate of unemployment to allow for the time lag between general increase in unemployment and published statistics.

2. **Policyholder's return compared to a benchmark:** We discussed that that there could be various benchmarks against which a policy's return can be compared. Here we take returns on competitors' funds in the same asset classes as an example. The average return of top five competitors' funds can be taken as a benchmark to compare a policyholder's return.

   If the return on the competitors' fund is greater than the policyholder's return over a defined period of time (say, one year), then we might expect an increase in partial surrender rates and, conversely, lower partial surrender rates if the policyholder's return is higher than what they may get in the market (assuming rational policyholder behaviour).

   To model this dynamic link, the above formula for guaranteed benefits can be appropriately modified to account for the delta of competitors' returns compared to the policyholder return. If the return in the market is higher, then the multiplier would be positive, which would tend to increase the base level of the partial surrender rate. The opposite would hold true if competitor returns are lower. The minimum and maximum bounds can serve to limit the movement of the multiplier if it is expected that there is no change in the base level of partial surrenders for a low level of differences in returns and, conversely, no further increase in the multiplier once a maximum level of partial surrenders has been reached.

ADDITIONAL CONSIDERATIONS IN MODELLING DYNAMIC PARTIAL SURRENDERS

The modelling and calibration of a dynamic partial surrender function could be limited by the data available for experience analysis, for example across all the market conditions and levels of moneyness. If the experience is concentrated for a particular level of moneyness (say, ITM or ATM), then it becomes difficult to evaluate the appropriateness of the entire range of the dynamic lapse function.

A possible solution could be to compare it with the experience analysis of full surrenders, industry data or experience analysis from different geographies with similar products and economic environments.

The modelling of the parameters is likely to involve expert judgements given that the full set of sufficient and credible data might not be available.

Insurers should also consider whether partial surrender experience is different for premium-paying policies compared to policies which are paid up, or if there is a higher propensity of withdrawal for the policies which have withdrawn in the past. This of course would be dependent on the extent of data available to carry out such an analysis.

Insurers that model partial surrenders as an increase to the full surrender rate assumption should consider the potential impact on the expense projections. Modelling partial surrender rates through this approach will lead to a quicker runoff of policies and an understatement of expenses if they are modelled on a per-policy basis. The impact is expected to be material if the partial surrender rate is significant. This can be particularly crucial where high partial surrenders are observed on selected cohorts of policies, leading to higher overall partial lapse rates and thus higher surrender rates, leading to quicker runoffs of policies than expected. In such cases, insurers should consider modelling an explicit partial lapse assumption.

Furthermore, consideration should be given to the fund-related expenses if the partial surrenders are modelled as an explicit assumption linked to the fund value (instead of the policy count). Here, fund-related expenses which do not vary significantly with the level of fund can be modelled as per-policy expenses, which would avoid understatement of expenses under this approach.

Conclusion

Partial surrenders can pose a significant risk to insurers offering unit-linked and variable annuity products. They can limit the profitability of the firm and the extent to which it can cover costs if not accounted for suitably in the valuation or pricing basis.

In this paper, we have discussed various options to model partial surrenders, from simplified modelling techniques (i.e., a static partial surrender assumption) to more sophisticated dynamic assumptions which link the policyholder behaviour to an external factor such as moneyness of the guarantee.

We discussed the potential limitations of the simplified modelling techniques, particularly where partial surrenders are modelled as an adjustment to the main lapse assumption, which can lead to the faster runoff of policies and a potential understatement of expenses in the valuation basis.

The modelling of dynamic partial surrenders can be considered as an alternative to simplified techniques which overcomes some of the limitations of the latter. It should be noted that dynamic partial surrenders can be quite complex to model and will be limited by the extent of data available. We have discussed some of the approaches to model this for variable annuity products and how this approach can be adopted for unit-linked products without guarantees.

Insurance companies should evaluate the various modelling techniques and identify the option which is the most suitable approach for their business.

CONTACT

Eoin King
eoin.king@milliman.com

Ankur Jain
ankur.jain@milliman.com

Erin Moorhead
erin.moorhead@milliman.com