Retail Portfolio Optimization

What blend of products maximizes profit while minimizing capital requirements and profit volatility? Despite a 54-year history, modern portfolio theory and the benefits of diversification still have a ways to go to be effective in many institutions. Besides data issues, failure to change old perceptions of loss and risk continues to hamper institutions.

Optimization carries many different connotations throughout a banking institution, but portfolio optimization focuses on strategic questions around how to obtain the best possible performance for the organization. Although the results from portfolio optimization impact many aspects of the organization, we can summarize the goal in one question:

What is the ideal blend of products to maximize profit while minimizing capital requirements and profit volatility?

When considering the matrix of possible products offered to each consumer segment, the goal is to make the proper trade-off between risk and reward. The most common mistake in retail lending is to equate loss rate with risk. Loss rates are not a measure of risk. They are one component of reward. Risk refers to the uncertainty in being able to obtain the expected reward.

So why do we care about volatility? Why not just maximize return? The answer is that companies are valued both on their historical rate of return and the certainty of those returns. Many studies indicate that the market values companies that demonstrate reliable returns over time (low volatility) more highly than those with volatile returns. One study of bank stock performance showed that a one-standard-deviation increase in volatility of corporate profits corresponded to a 32% lower stock price.¹

Because the ultimate goal of any publicly traded company should be to maximize its market value, decreasing the volatility of profits is the often-overlooked aspect of growing value.

Modern Portfolio Theory

Harry Markowitz initiated modern portfolio theory with his landmark paper in 1952. The question was essentially the same as stated above. How does one choose the optimal investment blend across a set of different opportunities?

His insight was that the optimal portfolio is one that maximizes return while simultaneously minimizing the volatility of returns. The ratio of return over volatility is referred to as the Sharpe Ratio. For a set of investment opportunities,

\[ S_j = \frac{r_j - r_f}{\sigma_j} \]

where \( S_j \) is the \( j \)th Sharpe Ratio for the \( j \)th investment opportunity, \( r_j \) is the expected return, \( \sigma_j \) is the expected volatility, and \( r_f \) is the risk-free rate of return, such as from a U.S. government bond. In retail lending: 1) return would be the expected margin for the loan or pool of loans, 2) the portfolio’s hurdle rate should be substituted for the risk-free rate, and 3) the volatility is the uncertainty in obtaining the anticipated margin.

The answer so far would be quite simple, but Markowitz also recognized the importance of the correlation between investment opportunities and included this in his solution. In retail lending, it would not be sufficient to determine that five mid-tier credit card segments all had the highest profit-volatility ratio, because they are likely to move in unison relative to the economy. Placing all the portfolio’s growth in those five segments would not be optimal, because it does not confer any diversification benefit.

The idea behind a diversification benefit is that the less correlation there is between investments, the lower the overall volatility of the portfolio. If two products provided equal returns...

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but were highly anti-correlated\(^2\), the best answer would be to invest in both equally. The average return would be unchanged, but the net volatility would be much lower. [Note: When two products are correlated, it means that their ups and downs occur at the same time. If they are anti-correlated, it means that their returns usually move opposite to each other. Uncorrelated products have an apparently random and unpredictable relationship.]

Unfortunately, anti-correlated products rarely exist in retail lending. The retail book in total might be anti-correlated to other bank products and services, but for now let’s focus our discussion on creating the optimal blend within the retail book. Within retail, the best we can usually hope for is to identify uncorrelated products so that we can avoid amplifying the volatility by being concentrated in correlated products.

Figure 1 shows three retail loan portfolios through a typical economic cycle. In general, all products will be affected by the economy, but with differing lags and severity. When comparing across products, the result is that some products (mortgage) may look less correlated to the rest (auto and card).

Markowitz provided a simple solution to this optimization problem. Subsequent work incorporated the notion of business constraints so that more realistic solutions can be derived. Many commercial packages are available to compute the ideal portfolio blend using Markowitz’s theory, as long as the user provides the expected profit and volatility for each instrument and covariance between instruments. More on this issue later.

The efficient frontier. One of the most interesting results of Markowitz’s work was the concept of the efficient frontier. A large body of literature exists on this topic, but the simple answer is that there is no single solution to the problem Markowitz posed. Rather, a plot of the possible solutions in profit versus volatility shows a line capturing the optimal blend of the available instruments. The portfolio manager can set any point along the upper half of this line as a goal.

The reality is that the efficient frontier is never reached. Business constraints and estimation problems make this a theoretical ideal that one should constantly strive to achieve.

Predicting returns, volatility, and covariance. Almost all the literature around modern portfolio theory\(^3\) focuses on its application to market-traded instruments, such as stocks and bonds. However, the reader might be surprised to learn that many research papers exist to explain why portfolio optimization is a bad idea.\(^4\) If fact, the author’s own experience with forecasting tradable instruments is that uniform weighting usually performed better in real life than the “optimal” solution from portfolio theory.

The reason for the difficulty is in trying to estimate expected

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\(^1\) Retail Risk Management Conference

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\(^4\) Predicting returns, volatility, and covariance.
return, volatility, and covariance. Predictive models of stock price movements are notoriously unstable, because as soon as a given structure is widely known, it is traded away. Predicting returns is synonymous with being able to forecast the financial markets. Predicting volatility or covariance is no less challenging, because those quantities are also tradable through options contracts and are therefore inherently unstable.

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So why spend so much time on something that is unusable? The answer is that, as usual, retail is different. Retail loan consumers, for the most part, do not care what you might predict about their behavior. Consumers know that credit scores exist to predict their behavior, but they do not take financially unreasonable actions to defeat those scores. Consumer balance sheets are not tradable instruments, so retail loans do not have the same forecasting instabilities as stock portfolios. When a recession comes, retail loans will default with much higher forecast accuracy than anything obtainable in the stock market. The same holds true for volatility and covariance, as long as sufficient data exists to create the estimate.

Unique Retail Dynamics
Retail portfolios are predictable only if the unique dynamics of those portfolios are taken into consideration. Previous articles in *The RMA Journal* have explained how models of retail portfolios must consider loan maturation, credit risk, and environmental impacts. As long as those elements of the retail portfolio dynamics are incorporated in the model, the profit forecasts should be sufficiently accurate.

Unfortunately, many portfolio optimization implementations use historical averages for the rate of return. Taking such a backward-looking view of the portfolio has led to some of the major portfolio failures of the last decade. If no reliable forecasts are available, portfolio optimization should not be attempted.

The largest uncertainty in a retail portfolio model will always be the future macroeconomic environment. Macroeconomic scenarios tend to provide a reasonable scenario for the first 12 months. Beyond that, a relaxation to historical averages is most appropriate.

For purposes of portfolio optimization, the most important feature of any macroeconomic scenario is that the same scenario must be used for all product/segment forecasts.

Correctly estimating volatility and covariance. The profit volatility of product segments and the covariance between them are challenging to measure but only because practitioners do not usually think of it correctly. Remember that we are trying to estimate the expected future volatility. Taking the historical profitability time series and computing the volatility does not correctly reflect future volatility because of the impact of marketing.

Consider an auto loan portfolio that management decides to grow dramatically. In one year, the portfolio grows 30%. Because of the maturation process surrounding loan delinquency, we expect the loss rate to fall and the profitability to rise for the portfolio during this year and into the next. However, within 18 months and continuing another one to two years, loss rates will rise dramatically, simply because those loans are reaching peak delinquency. About three years after booking, we expect the impact of that program to be disappearing and loss rates to be stabilizing. All of this volatility is artificial and has nothing to do with our expected future volatility for the

Figure 3

![Figure 3](image-url)
Volatility derived from macroeconomic cycles (recessions) is the kind of uncertainty we expect to persist irrespective of marketing campaigns or management actions.

Now imagine that the manager of the mortgage portfolio, not to be outdone by auto, implemented a similar growth strategy, increasing the mortgage portfolio’s receivables by 20% over the same time period. This portfolio would go through a similar boom-bust cycle, again driven purely by the marketing plan. Computing the correlation between the profitability time series for those two products would show them to be highly correlated, when again this is just a management artifact that cannot be expected to recur.

Therefore, to compute the proper metrics for portfolio optimization, the historical profitability series must be normalized for the volume of bookings and the maturation process (seasoning) of those originations. In the end, we are looking for the volatility and covariance derived primarily from the macroeconomic environment. However, there will always be unexplained “noise” in the historical data coming from day-to-day management actions on the portfolio.

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Economic capital. Although this article focuses on computing economic capital, it must be pointed out that everything discussed so far would still apply if the term losses were substituted for profit. The preceding discussion of how past marketing actions can distort expected profit volatility is equally true when computing expected future loss volatility. The best economic capital systems will normalize for artificially introduced volatility derived from past marketing plans.

Alternative metrics. If the Sharpe Ratio is so useful, why do most retail loan portfolios use something else? Actually, almost all retail portfolios today use intuition rather than optimization to guide portfolio management. Historically, this made sense because the available models and data were insufficient to support true optimization. Performance metrics have been computed by finance departments for decades, but these are almost universally retrospective measures of how things have performed in the past—not how they will perform in the future. As mentioned above, performing optimization based on historical average performance metrics is dangerous at best.

RAROC/RORAC. Some may consider it strange to describe RAROC (risk-adjusted return on capital) and RORAC (return on risk-adjusted capital) as alternate metrics, since collectively they are probably the most popular metrics in use. Because economic capital is so often used as the “volatility” of the portfolio, both of these metrics could be viewed as approximations of the Sharpe Ratio.

Both metrics can be used for portfolio optimization analogous to what has been described so far. The appropriate covariances would also need to be computed, but products exist for performing the optimization given the appropriate inputs.

Maximizing Profit

Optimizing the portfolio to maximize profit is an obvious approach and common at an intuitive level. EVA (economic value added) and SVA (shareholder value added) both fall into this category. They adjust for hurdle rates or the cost of capital, but they do not explicitly consider the profit/volatility trade-off.

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EVA = \text{Net Return after Taxes} \times \text{Economic Capital} \times rf
\]

\[
SVA = (\text{Return-on-equity} - rf) \times \text{Average Equity}
\]

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Volume or loss rate. The most common approach performed on a daily basis is perhaps the worst. Too often, management objectives are stated in terms of maximizing portfolio growth or minimizing loss rate. Most of the famous portfolio failures of the last decade have occurred for exactly this reason. Growth without regard to losses or profitability can lead to disaster. Minimizing loss rate alone causes portfolio under-performance by failure to assume reasonable risks. In the best cases, different groups are given competing objectives and forced to negotiate toward the kind of risk/reward trade-off represented explicitly in the preceding discussion.

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Optimizing without an optimizer. One can easily become immersed in technology when discussing portfolio optimization and forget that enormous gains can be achieved just by implementing part of the solution. A good first step is to compute true expected profitability and profit volatility for each product segment and make a plot. Figure 4 shows a hypothetical example, with one point for each product segment indicating the expected profitability and profit volatility for each. A few points are labeled for discussion. Three main categories emerge when examining the plot.

1. In the upper left are product segments that produce abnormally high returns relative to the amount of volatility. Called the “desirable” category, such segments will be the most difficult to find.
2. Through the middle, in a roughly diagonal band, is the “business as usual” region. Most products are expected to be priced such that riskier products provide higher returns.
3. The lower right represents the “avoid” category. Product segments in this region are not producing a high enough expected return relative to the volatility they bring to the portfolio.

While examining this plot, remember that loss rate is not volatility. Subprime segments typically have higher loss rates, but often are less volatile than prime products relative to the macroeconomic cycle.

Optimizing the portfolio intuitively given the information in Figure 4 is relatively straightforward.

- Add more from the “desirable” category.
- Curtail originations in the “avoid” category.
- Maintain a blend across the “business as usual” category.
- Be wary of concentrations in a certain product or segment area (shifting purely into cards or subprime).

With any optimization exercise, be aware that product segments will move in this diagram. Competitive pressures will cause changes in the profitability of product segments that can significantly alter the perspective.

Whether managing intuitively or with an optimizer, reevaluate the answers quarterly to annually to make sure the portfolio is still steering along the correct path.

Get Started

Most organizations need to
improve their techniques around portfolio optimization. The theory is well known. The issues are all around execution. Regardless of where your organization is today, consider the following points to make the next step:

• Collect time-series data at least at the product/segment/vintage level suitable for computing profitability over time for each campaign.

• Implement models incorporating known retail portfolio dynamics to predict profit and profit volatility across products and segments using consistent macroeconomic scenarios.

• Either perform judgmental optimization via comparative plots or employ optimization software incorporating the product segment covariances.

• Align management objectives with sound portfolio performance metrics.

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Notes

2 When two products are correlated, it means that their ups and downs occur at the same time. If they are anti-correlated, it means that their returns usually move opposite to each other. Uncorrelated products have an apparently random and unpredictable relationship.


5 Covariance is similar in concept to correlation. It measures the cross-volatility between two instruments. If the correlation is positive, the covariance will be positive. A negative correlation coincides with a negative covariance. Correlation is essentially a normalized measure of covariance.
