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Asset Location & Uncertainty

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1 Overview

Asset allocation requires investors to determine the appropriate allocation of each asset class – Canadian equities, US equities, International equities, fixed income – in their portfolio. Asset location is the decision about which accounts – RRSP, TFSA, taxable – these asset classes should be located in order to maximize after-tax wealth. The alternative to asset location is holding the same mix of assets in each account type – we will refer to this as a balanced strategy. It is the goal of an asset location strategy to outperform a balanced strategy on a post-liquidation after-tax basis. If you do not believe that it is possible to gain a performance edge through security selection or market timing, a focus on asset location seems like an obvious way to add value.

1.1 The Rules of Thumb

Asset location follows some general rules of thumb which are based on simple logical justifications. These rules of thumb are the basis for much of the work that has been done on asset location. The rules of thumb follow:

Table 1 - Asset Location Rules of Thumb

RULE OF THUMB	LOGIC
Hold Fixed Income in your RRSP	→ Interest income is taxable at your full marginal tax rate → Lower expected returns should lead to lower RRIF minimums → Premium bonds are tax-inefficient
Hold Canadian Equities in your personal taxable account	→ Canadian dividends are taxed at a more favourable rate than interest or foreign dividends
Hold International Equities in your TFSA	→ International stocks tend to have higher yields → Foreign dividends are fully taxable
Hold U.S. Equities in your RRSP (but not before Fixed Income)	→ A U.S. listed ETF of U.S. stocks will avoid withholding tax, which would otherwise be unrecoverable in an RRSP

1.2 Past Work

Many papers have addressed the asset location problem. O'Reilly (2009) looked at asset location in both a single-period and a multi-period setting. For single period asset location, he concludes that optimization requires holding the assets with the highest tax costs in non-taxable accounts. While this is intuitive, it also makes it difficult to identify an optimal location strategy because optimization depends on the expected return and tax rate assumptions used. For multi-period asset location, O'Reilly explains that the optimal location strategy is decided by the relative tax cost of each asset class, the method used to rebalance the portfolio, and the investment time horizon. He concludes that the model is too sensitive to its inputs to identify an optimal asset location strategy.

Blanchett and Kaplan (2013) analyzed locating equity and fixed income assets in two account types and withdrawing from those accounts in different orders through multiple scenarios using Monte Carlo simulation. They assumed that the target asset mix matched the distribution of assets between taxable and non-taxable accounts, and that the investor paid tax at a constant tax rate of 30%. Their analysis took rebalancing into account. They found that optimal asset location and withdrawal sequence can add 0.23% per year of value on average over a balanced strategy.

Kinniry, Jaconetti, DiJoseph, Zilbering, and Bennyhoff (2016) used a static expected return model to compare the pre-tax and after-tax returns of various asset location mixes for a single year of returns, before liquidation. They found that it was possible to add 0.30% of value over a balanced strategy by locating fixed income assets in tax-deferred accounts and equities in the taxable accounts.

Bender and Bortolotti (2014) used historical ETF returns between 2003 and 2012, including rebalancing, to test an optimal asset location strategy. They found that locating fixed income ETFs in the RRSP and equity ETFs in the taxable account would have added 0.30% per year to after-tax returns over a balanced strategy. Most of these papers have reported an average value-add from asset location. O'Reilly does not report an average value-add, instead taking the position that he is not able to identify the optimal location of assets due to the sensitivity of the model to its inputs.

1.3 Introduction

In this paper, we assume that investors will attempt to implement an asset location strategy based on what they believe to be optimal at the time. We model the initial optimization decision using assumptions for expected returns and tax rates to maximize after-tax wealth. Once we have arrived at an optimal asset location strategy, we test it against time-varying returns using Monte Carlo simulation. We first assume that the mean expected return remains constant in both the optimization model and the Monte Carlo analysis, modelling variation about this constant mean using Monte Carlo simulation. We then test the efficacy of our optimal asset location when the mean return used in the optimization model differs from the mean return used in the Monte Carlo analysis. In other words, we test the model against our inability to precisely predict future average returns.

2 Optimization Model

The optimization model is constructed by assigning a target overall asset mix for all accounts, and a starting dollar amount for each account type. All investment income is taxed according to its characterization and the type of account that it has been earned in. Withholding tax is also considered in the optimization decision.

2.1 Optimization Expected Returns

The following pre-tax expected return assumptions are used in developing the optimal asset location. The methodology for estimating these expected returns can be seen in Bortolotti and Kerzérho (2016).

ASSET CLASS	INCOME	CANADIAN DIVIDENDS	DEFERRED CAPITAL GAINS
Fixed Income	2.68%	-	0.36%
US Equity	1.88%	-	3.92%
Canadian Equity	0.00%	2.72%	3.53%
International Equity	2.85%	-	4.27%

To model foreign withholding tax, US equity has an unrecoverable Level I withholding tax of 15% applied in the TFSA; International equity has an unrecoverable Level II withholding tax of 7.45% applied in the taxable account and RRSP; International equity also has both the 15% Level I and 7.45% Level II withholding tax applied in the TFSA. After-tax returns are calculated each year over a ten-year period, and at the end of the tenth year the accounts are liquidated. Taxable accounts pay tax on unrealized capital gains, and the RRSP asset is received as taxable income and taxed at the liquidation tax rate.

To arrive at the optimal location of assets, the sum of the after-tax ending value of all accounts is maximized by iterating the location of each asset class over 1,000 trials.

2.2 Optimization Results

As a base case for testing the optimization model, we choose to model an investor with $600,000 in a taxable account, $348,000 in an RRSP, and $52,000 in a TFSA. The investor is taxed at the highest marginal rate in Ontario in 2017 for the duration of the sample period, and has a target asset allocation consisting of 60% equities and 40% fixed income with their equity being split equally between Canadian, U.S., and International stocks.

Not surprisingly, the optimal result mostly agrees with conventional wisdom and past analysis. The model directs the majority of fixed income to the RRSP and the majority of equities to the taxable account.

Table 2 - Optimal Asset Location

ASSET CLASS	RRSP	TFSA	TAXABLE
Fixed Income	$348,000	-	$52,000
US Equity	-	-	$200,000
Canadian Equity	-	-	$200,000
International Equity	-	$52,000	$148,000

3 Unexpected Returns

Building a forward-looking optimization model based on an average expected return is an interesting exercise, but it does little to tell us how effective that optimal asset location strategy might be if the actual returns for each asset class end up varying about the average return used in the optimization model. We use Monte Carlo analysis to test our optimal asset location against time-varying returns.

3.1 Monte Carlo Methodology

The Monte Carlo simulation takes the optimal asset location recommendation from our optimization model, and applies a randomly generated return based on a normal distribution to each asset class for each of the ten years in the analysis period. The return assigned to each asset class in each year is selected from the normal distributions defined in Table 3. Income distributions have been assumed to remain constant each year.

Table 3 - Monte Carlo Assumptions

ASSET CLASS	INCOME RETURN (FIXED)	EXPECTED TOTAL RETURN	STANDARD DEVIATION OF TOTAL RETURN
Fixed Income	2.68%	3.05%	3.83%
US Equity	1.88%	5.80%	12.59%
Canadian Equity	2.72%	6.25%	12.38%
International Equity	2.85%	7.12%	13.03%

To properly model the returns of the overall investment portfolio, it was important to take correlation into account. The Monte Carlo simulation draws randomly from the normal distribution while also taking account into account the correlation matrix defined in Table 4.

Table 4 – Correlations

ASSET CLASS	CANADIAN EQUITY	US EQUITY	INTERNATIONAL EQUITY	FIXED INCOME
Canadian Equity	1	0.46	0.57	0.06
US Equity	0.46	1	0.74	0.19
International Equity	0.57	0.74	1	0.3
Fixed Income	0.06	0.19	0.3	1

In accounting for uncertain returns, it was important to consider the tax-cost of rebalancing. For example, if we have made the decision to hold all U.S. equities in the taxable account, and U.S. equities exhibit relatively strong performance, a portion of them will need to be sold, triggering a capital gain. This realized capital gain will be larger for the investor who has all of their U.S. equity in a taxable account than for the investor who has a balanced portfolio in each account. In other words, the balanced strategy allows for a portion of rebalancing to occur on a tax-free basis.

In order to create a baseline for comparison, the Monte Carlo simulation runs the asset location optimized portfolio alongside a balanced portfolio in all accounts. The average annual post-liquidation performance difference between the asset location optimized portfolio and the balanced portfolio is used to determine the value added from optimal asset location.

3.2 Monte Carlo Simulation Results

Coming back to our initial case of an investor taxed at the highest marginal rate in Ontario in 2017 with $600,000 in a taxable account, $348,000 in an RRSP, $52,000 in a TFSA, with a 60% equity and 40% fixed income target asset allocation, we can assess the impact of implementing our optimized asset location strategy in the face of time-varying returns. Over 1,000 trials, we find that implementing the optimized asset location strategy results in an average value-add of 0.23% per year over a balanced strategy. Interestingly, but perhaps not surprisingly, this result further corroborates past findings on the quantified value of optimal asset location.

Table 5 - Optimal Case Results

	AVERAGE VALUE-ADD / YEAR	BEST VALUE-ADD / YEAR	WORST VALUE-ADD / YEAR	WIN RATE (LOCATION > BALANCED)
Optimal Case	0.23%	0.76%	-0.55%	80%

In addition to determining an average value-add over 1,000 trials, the Monte Carlo simulation allows us to observe the possible range of outcomes. Specifically, we can see that attempting to add value through asset location has the potential to increase or reduce post-liquidation after-tax returns compared to a balanced strategy.

While we find that asset location adds 0.23% per year of value on average, we also find that optimal location adds value in 80% of trials. The remaining 20% of trials result in a reduction in after-tax performance compared to a balanced strategy. This occurs when the simulated returns are significantly different from the forward-looking assumptions used in the optimization model.

In an optimal case, asset location might add an average of 0.23% per year over 1,000 trials, but any given trial may have a better or worse outcome based on the actual returns realized in that instance. For example, the best trial in the simulation exhibited a value-add of 0.76% per year, while the worst exhibited an average value-add of -0.55% per year. A positive outcome might be expected 80% of the time.

4 Intuition Building

We have shown that asset location can be expected to add value on average in an ideal case where the investor is taxed at the highest marginal rate in Ontario in 2017 and holds amounts in taxable and non-taxable accounts such that the majority of fixed income for their target allocation can fit in the RRSP account. However, our ideal case is not realistic. An investor with a net worth of $1M split between their taxable account, RRSP, and TFSA is highly unlikely to pay tax at the highest marginal rate when they begin drawing from their portfolio. To follow up on this, we attempt to build intuition by assessing some cases that might be more realistic.

4.1 Lowering the Tax Rate at Liquidation

Assigning a more reasonable tax rate at liquidation has a significant effect on the magnitude of value added by our optimal asset location strategy. We will use the tax rate for income between $86,177 and $90,563 in Ontario in 2017 at liquidation, and the same starting account balances as our initial example. Based on these assumptions, the optimal asset location recommendation remains the same.

Table 6 - Lower Liquidation Tax Rate: Optimal Asset Location

ASSET CLASS	RRSP	TFSA	TAXABLE
Fixed Income	$348,000	-	$52,000
US Equity	-	-	$200,000
Canadian Equity	-	-	$200,000
International Equity	-	$52,000	$148,000

In this case we find that asset location might add an average of 0.14% per year over 1,000 trials, and that value is added over a balanced strategy 80% of the time. The best trial in the simulation exhibited a value-add of 0.46% per year, while the worst trial exhibited a value-add of -0.46% per year.

Table 7 - Lower Liquidation Tax Rate: Results

	AVERAGE VALUE-ADD / YEAR	BEST VALUE-ADD / YEAR	WORST VALUE-ADD / YEAR	WIN RATE (LOCATION > BALANCED)
Lower Liquidation Tax Rate	0.14%	0.46%	-0.46%	80%

4.2 Increasing the RRSP Balance

Our initial examples allowed for the majority of fixed income to be held in the RRSP and equities in the taxable account. If the account balances do not match up with the target asset allocation, we would expect a different result. We start with $600,000 in the taxable account, $948,000 in the RRSP, and $52,000 in the TFSA. We assume the highest marginal tax rate in Ontario in 2017 currently, and the tax rate for income between $86,177 and $90,563 in Ontario in 2017 at liquidation. Alongside fixed income, we observe U.S. equities being allocated to the RRSP in the optimization model.

Table 8 - Lower Liquidation Tax Rate and Higher RRSP Balance: Optimal Asset Location

ASSET CLASS	RRSP	TFSA	TAXABLE
Fixed Income	$640,000	-	-
US Equity	$308,000	-	$12,000
Canadian Equity	-	-	$320,000
International Equity	-	$52,000	$268,000

In this case, we find that asset location might add an average of 0.14% per year over 1,000 trials, and that value is added over a balanced strategy 80% of the time. The best trial in the simulation exhibited a value-add of 0.54% per year, while the worst trial exhibited a value-add of -0.43% per year. It is notable that these results are nearly identical to the case in section 4.1.

Table 9 - Lower Liquidation Tax Rate and Higher RRSP Balance: Results

	AVERAGE VALUE-ADD / YEAR	BEST VALUE-ADD / YEAR	WORST VALUE-ADD / YEAR	WIN RATE (LOCATION > BALANCED)
Lower Liquidation Tax Rate and Higher RRSP Balance	0.14%	0.46%	-0.46%	80%

4.3 Increasing the Taxable Account Balance

Similar to the example in section 4.2, but switching the accounts, we test a case where the majority of assets are held in the taxable account. We start with $1,200,000 in the taxable account, $348,000 in the RRSP, and $52,000 in the TFSA. We assume the highest marginal tax rate in Ontario in 2017 currently and the tax rate for income between $86,177 and $90,563 in Ontario in 2017 at liquidation.

Table 10 - Lower Liquidation Tax Rate and Higher Taxable Account Balance: Optimal Asset Location

ASSET CLASS	RRSP	TFSA	TAXABLE
Fixed Income	$348,000	-	$292,000
US Equity	-	-	$268,000
Canadian Equity	-	-	$320,000
International Equity	-	$52,000	$320,000

In this case we find that asset location might add an average of 0.08% per year over 1,000 trials, and that value is added over a balanced strategy 76% of the time. The best trial in the simulation exhibited a value-add of 0.29% per year, while the worst trial exhibited a value-add of -0.38% per year.

Table 11 - Lower Liquidation Tax Rate and Higher Taxable Account Balance Results

	AVERAGE VALUE-ADD / YEAR	BEST VALUE-ADD / YEAR	WORST VALUE-ADD / YEAR	WIN RATE (LOCATION > BALANCED)
Lower Liquidation Tax Rate and Higher Taxable Account Balance	0.08%	0.29%	-0.38%	76%

4.4 Lower Tax Rates Now and At Liquidation

So far, we have looked at cases where the investor is taxed at the highest marginal rate now and continues to be taxed at a relatively high rate at liquidation. In this case we will return to the account balances in our optimal case – $600,000 in the taxable account, $348,000 in the RRSP, $52,000 in the TFSA – which allows most fixed income to be held in the RRSP. We will test this case against the current tax rate for income between $86,177 and $90,563 in Ontario in 2017, and the liquidation tax rate for income between $45,283 and $73,145. The optimal asset location results are identical to results observed in the optimal case.

Table 12 - Lower Current and Liquidation Tax Rates: Optimal Asset Location

ASSET CLASS	RRSP	TFSA	TAXABLE
Fixed Income	$348,000	-	$52,000
US Equity	-	-	$200,000
Canadian Equity	-	-	$200,000
International Equity	-	$52,000	$148,000

In this case we find that optimal asset location might add an average of 0.08% per year over 1,000 trials, and that value is added over a balanced strategy 74% of the time. The best trial in the simulation exhibited a value-add of 0.35% per year, while the worst trial exhibited a value-add of -0.34% per year.

Table 13 - Lower Current and Liquidation Tax Rates Results

ASSET CLASS	AVERAGE VALUE-ADD / YEAR	BEST VALUE-ADD / YEAR	WORST VALUE-ADD / YEAR	WIN RATE (LOCATION > BALANCED)
Lower Current and Liquidation Tax Rates	0.08%	0.35%	-0.34%	74%

4.5 Summary

We have used our optimization model and Monte Carlo simulation to analyze five different cases, and each case has produced a slightly different result. As tax rates fall, we see a lower average annual value-add and lower win rate from implementing an optimal asset location. When it is possible to hold most fixed income in the RRSP, we see a higher average value-add from optimal asset location. This makes intuitive sense and is in line with current thinking. The most interesting aspect of the results is that while we observe a positive result on average, adding value through optimal asset location is not guaranteed.

5 Missing the Mark

So far in this paper we have examined the effects of uncertainty about a known mean return on the efficacy of optimal asset location. In other words, we are assuming that while there may be some volatility, we are able to accurately estimate future average returns. Estimating future average returns is exceptionally difficult to do with any precision. In this section we examine the effects of uncertainty of the mean itself.

5.1 Revisiting The Optimal Case

In order to test the efficacy of optimized asset location against our inability to accurately predict future mean returns, we return to our optimal case for asset location of an investor taxed at the highest marginal rate in Ontario in 2017 with $600,000 in a taxable account, $348,000 in an RRSP, $52,000 in a TFSA, with a 60% equity and 40% fixed income target asset allocation. Under our initial analysis of this case we found an average annual value-add of 0.23%, and that value was added in 80% of trials. In this section we will continue to use the original expected return assumptions to arrive at an optimal asset location, but we will use the actual 10-year trailing returns for each asset class as inputs for the Monte Carlo simulation.

Table 14 - Modified Monte Carlo Assumptions (10-year trailing average returns)

ASSET CLASS	INCOME RETURN (FIXED)	EXPECTED TOTAL RETURN	STANDARD DEVIATION OF TOTAL RETURN
Fixed Income	2.68%	4.85%	4.04%
US Equity	1.88%	10.85%	11.62%
Canadian Equity	2.72%	3.95%	8.19%
International Equity	2.85%	4.73%	12.49%

Our initial optimal asset location is identical to that in Table 2. Running the Monte Carlo simulation yields a materially different result. Over 1,000 trials, we see an average value-add of 0.07%, and we see that value is added in 58% of trials. The best trial in the simulation shows an average value-add of 0.59% per year, while the worst shows an average value-add of -0.95% per year. It is important to note that the results could have gone the other way (better than expected as opposed to worse than expected) if the actual average returns had been different. There are infinite possible outcomes.

ASSET CLASS	AVERAGE VALUE-ADD / YEAR	BEST VALUE-ADD / YEAR	WORST VALUE-ADD / YEAR	WIN RATE (LOCATION > BALANCED)
Optimal Case with Mean Estimation Error	0.07%	0.59%	-0.95%	58%

6 What do you Have to Lose?

We have shown that it is possible to add value through optimal asset location. There are a few important things to consider before you set out to optimize the location of your assets.

6.1 No Guarantees

It would be optimistic to conclude that asset location can be expected to result in a 0.23% after-tax performance advantage over a balanced strategy. In a best-case scenario, and assuming that we are able to precisely estimate average future returns, optimized asset location outperforms a balanced strategy 80% of the time. Over 1,000 trials you might expect 0.23% of added value on average. If we make an error in estimating the future returns used in our optimal asset location, we might expect a lower or higher probability of success, and a lower or higher average value-add over 1,000 trials.

The result depends solely on our ability to precisely predict future returns. Assuming that we are able to predict future average returns, a 20% chance at underperformance is reasonably low, but it is still a risk that should be considered relative to the expected benefit of 0.23% per year. If we are not able to predict future average returns, a 42% chance at underperformance is quite high, especially in return for an expected benefit of 0.07% per year, as seen in the example in 5.1.

6.2 The Cost of Liquidity

We have assumed in our analysis that there are no required liquidity events prior to final liquidation of all assets. If an asset location strategy directs all equities into the taxable account and all fixed income to the RRSP, an unexpected expense or change in circumstance may result in the realization of substantial capital gains to access liquid assets. Holding a proportional split between equities and fixed income in each account may reduce the tax-cost of unexpected liquidity needs.

6.3 Regulatory Risk

An optimal asset location strategy may be tax efficient today, but tax rates and the tax treatment of different types of investment income can change very quickly. If a portfolio is structured to optimize based on today's tax regime, there is an increased risk of that structure being suboptimal under a future tax regime. Maintaining a balanced strategy mitigates this risk.

6.4 Model Risk

Considering a range of possible outcomes using Monte Carlo simulation adds an element of uncertainty to the optimal asset location analysis, but both the optimization model and the Monte Carlo simulation are highly dependent on their input assumptions. The model captures uncertainty about the mean, but it does not capture uncertainty of the mean itself. Small estimation errors in the input parameters may lead to large errors in the optimal location strategy. This was demonstrated, to an extent, in Section 5.

6.5 Implementation Costs

Asset location requires additional attention to detail which inevitably reduces the scalability for financial advisors implementing asset location strategies for their clients. Reduced scale leads to increased costs, which are ultimately reflected in fees. It would be expected that higher fees should be at least offset by higher after-tax returns through asset location. While this may be true on average, fees are guaranteed, and value-added through asset location is not.

Conclusion

In this paper we have shown that, on average, optimal asset location may be expected to add value to after-tax investment returns. While it may be possible to add value, it is also possible to subtract value if the actual performance of assets ends up being materially different from the parameter assumptions used in defining the optimal asset location strategy. Whether value is added or subtracted through asset location in practice will depend on the composition, magnitude, and sequence of actual realized returns, and on the actual tax rates now and at liquidation.

In an ideal case, such as our example of an investor taxed at the highest marginal rate now and at liquidation with just enough RRSP room to hold all of their fixed income, there is a good (80%) chance that asset location will add value with an average expected magnitude of 0.23% per year if we are able to precisely estimate future average returns. As we move away from this ideal case by lowering tax rates, adjusting relative account balances away from the target asset allocation, and accounting for estimation errors, we observe a quickly diminishing average value add, and an increasing probability of inadvertently subtracting value relative to a balanced strategy.

The analysis in this paper has compared an asset location strategy using individual asset class components to a balanced strategy likewise using individual asset class components. In both cases, there are tax costs for rebalancing between the individual asset class components. O'Reilly (2009) points out "the advantage of allocating the majority of the investor's assets to a single, tax-efficient mutual fund that has characteristics close to the investor's desired total portfolio characteristics." To the extent that this single tax-efficient mutual fund exists, it may reduce the relative value-add of a location optimized strategy over a balanced strategy by reducing the tax costs of rebalancing.

While asset location might be a consideration when building an investment strategy, it comes with risks and costs of its own, and is not a guaranteed path a better investment experience.

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