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# Optimal Asset Location

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# Content

1 Overview	4
2 Testing Optimal Location for Pre and After-tax Allocations	5
3 Asset Location Constrained by Pre-Tax Asset Allocation	6
4 Asset Location Constrained by After-Tax Asset Allocation	8
5 Asset Location for Utility Maximization	10
6 Yield Drives the Optimal Location	12
7 Foreign Withholding Tax	13
8 Practical Applications	14
9 Conclusion	16
10 References	17
The Author	18

# 1 Overview

In my 2017 paper, [Asset Location and Uncertainty](#), I demonstrated that the failure to accurately predict future returns can quickly make an ex ante optimal asset location strategy ex post sub-optimal. That paper focused on the value-added from optimal asset location through the lens of pre-tax asset allocation. I focused on pre-tax asset allocation because that is how most practitioner literature approaches the topic.

The problem with comparing various asset location strategies through the lens of pre-tax asset allocation is that it provides a poor framework for comparing expected investment outcomes. Two portfolios with the same pre-tax asset allocation can have materially different risk-return characteristics. This is the most important point to be made in this paper.

For example, assuming a 50% tax rate, take a \$600,000 taxable account and a \$400,000 RRSP with the RRSP full of bonds and the taxable account full of stocks. This portfolio has a **pre-tax** asset allocation of 60% stocks and 40% bonds, but it has an **after-tax** asset allocation of 75% stocks and 25% bonds. It is important to recognize that the after-tax asset allocation is measuring the allocation of the capital that you own. The pre-tax asset allocation is skewed by the government's capital – your future tax bill. While counterintuitive to consider, the after-tax asset allocation is the driver of your expected outcome.

If we optimize asset location for a given **pre-tax** asset allocation, our optimization will always lead us to hold bonds in the RRSP account, leading to a more aggressive **after-tax** asset allocation, which drives higher expected returns. The problem with this approach is that we are not comparing apples to apples; a more aggressive portfolio is not necessarily a more tax efficient portfolio. We will examine this issue with examples throughout this paper.

Finally, even comparing two portfolios with the same after-tax asset allocation may not be rational. In a 2004 paper in the Journal of Finance aptly titled [Optimal Asset Location and Allocation with Taxable and Tax-Deferred Investing](#) the authors take it one step further: they adjust asset location to maximize the utility of after-tax wealth.

Utility maximization is not as easy to understand as asset allocation; the simplest explanation is that the risk and expected return characteristics are entirely different in a taxable and a tax-free account. Stocks are less risky and have lower expected returns in a taxable account due to taxes. Adjusting the location of assets may also require an asset allocation adjustment to maintain the desired portfolio characteristics. Approaching the problem from the perspective of utility leads to an interesting and easy to apply conclusion on the optimal location of assets.

## 2 Testing Optimal Location for Pre and After-tax Allocations

To demonstrate the effects of asset location on pre and after-tax asset allocation we will test a two-asset portfolio over a single time period to find the location strategy that results in the highest level of ending after-tax wealth. All gains will be realized at the end of the period, and tax will be due on any income. We will constrain the model by either pre or after-tax asset allocation to examine the impact of these constraints on the investment outcome. Portfolio optimizations will be done using the Solver tool in Microsoft Excel, subject to the appropriate constraints.

We will use a simple portfolio consisting of a riskless bond and a risky stock allocated across an RRSP and a taxable investment account. In our simple model we will assume that stocks have a capital return of 4% and a fully taxable income return of 2% while bonds have no capital return and an income return of 3%. This is not reflective of the current environment where stock yields for International and Emerging Markets equities are higher than bond yields; this issue will be addressed later in the paper.

We assume that there is a constant income tax rate of 50% both now and in the future; in reality the future tax rate is highly uncertain as it depends on an unknown future level of income and an unknown future tax regime.

### 3 Asset Location Constrained by Pre-Tax Asset Allocation

If we optimize a portfolio for the optimal asset location while using the pre-tax asset allocation as a constraint, we will always find that bonds are directed to the RRSP. This is for the simple but counterintuitive reason that holdings bonds in the RRSP is effectively increasing the portfolio's exposure to stocks.

Take the portfolio outlined in Table 1: a pre-tax 60% equity and 40% fixed income (60/40) portfolio owned within a \$600,000 taxable investment account and a \$400,000 RRSP. We want to optimize for the largest possible after-tax ending wealth by locating the right assets in the right account types, with our constraint being that we must maintain the 60/40 **pre-tax** asset allocation to match our perceived risk preferences. The implication of this constraint is that the **after-tax** asset allocation will be *more aggressive* than 60/40.

As expected, running this scenario through Solver results in a portfolio with 100% of the equities in the taxable account, and 100% of the fixed income in the RRSP, which follows the conventional wisdom on asset location.

**Table 1 - Optimal Location Constrained by 60/40 Pre-Tax Allocation**

	Pre-Tax Dollars	Pre-Tax Allocation	After-Tax Allocation
RRSP			
Bond	400,000	40.00%	25.00%
Stock	-	-	-
Taxable			
Bond	-	-	-
Stock	600,000	60.00%	75.00%
Total bond	400,000	40.00%	25.00%
Total stock	600,000	60.00%	75.00%

Source: PWL Capital Inc.

This optimal location produces an annualized after-tax return of 3.78%. As a benchmark, we will compare the result of the pre-tax constrained optimal location in Table 1 against a location strategy that is equal-weighted across all accounts; in other words, a 60% stock and 40% bond mix in both the RRSP and the taxable account, as outlined in Table 2. Holding the same mix across all account types guarantees that the pre and after-tax asset allocations will be identical – each asset class in the RRSP is reduced proportionally by taxes, leaving the after-tax asset allocation unaffected.

**Table 2 - Balanced Location with 60/40 Pre and After-tax Allocation**

	Pre-Tax Dollars	Pre-Tax Allocation	After-Tax Allocation
RRSP			
Bond	160,000	16.00%	10.00%
Stock	240,000	24.00%	15.00%
Taxable			
Bond	240,000	24.00%	30.00%
Stock	360,000	36.00%	45.00%
Total bond	400,000	40.00%	40.00%
Total stock	600,000	60.00%	60.00%

Source: PWL Capital Inc.

The balanced location demonstrated in Table 2 produces an annualized after-tax return of 3.47%, which is 31 bps **less** than our pre-tax optimal portfolio. This finding is in line with the past work on the estimated value-added from optimal asset location.

The problem with comparing these two location strategies with a constraint for pre-tax allocation is that they result in materially different portfolios; it is the **after-tax** asset allocation that determines the expected risk and return characteristics of a portfolio. The optimal location of assets under the pre-tax asset allocation constraint places all bonds in the RRSP because placing bonds in the RRSP increases the after-tax allocation to higher expected returning equities, not because bonds are necessarily more tax efficient in the RRSP account.

When we are comparing the two examples above, we are truly comparing a 75/25 after-tax portfolio in Table 1 to a 60/40 portfolio after-tax portfolio in Table 2. We would expect the 75/25 portfolio to produce a better after-tax result than the 60/40 portfolio, but that expectation is not explained by bonds being optimal in the RRSP; it is explained by differences in the after-tax asset allocation.

## 4 Asset Location Constrained by After-Tax Asset Allocation

If we want to gauge relative tax efficiency, we need to compare two portfolios with the same after-tax asset allocation. To start, we will examine a portfolio with a balanced asset mix of 75/25 in both the RRSP and the taxable account as detailed in Table 3. This is a true 75/25 pre and after-tax asset allocation. If bonds are tax-optimal in the RRSP, and not just a way to trick ourselves into a more aggressive portfolio, then we would expect this balanced mix to result in a lower after-tax return compared to the example in Table 1 with all bonds in the RRSP.

**Table 3 – Balanced Location with 75/25 Pre and After-tax Allocation**

	Pre-Tax Dollars	Pre-Tax Allocation	After-Tax Allocation
RRSP			
Bond	100,000	10.00%	6.25%
Stock	300,000	30.00%	18.75%
Taxable			
Bond	150,000	15.00%	18.75%
Stock	450,000	45.00%	56.25%
Total bond	250,000	25.00%	25.00%
Total stock	750,000	75.00%	75.00%

Source: PWL Capital Inc.

In this case, we see an after-tax return of 3.87%, 9 bps better than when we had all bonds in the RRSP to achieve the same 75/25 after-tax asset allocation. It is clear, then, that holding bonds in the RRSP is in fact sub-optimal under the assumptions in our model. Any benefit gained from holding bonds in the RRSP is derived from the effect on after-tax asset allocation.

The question that follows is whether or not there is a truly optimal location of assets when we control for after-tax asset allocation. Using Solver, we can test this by setting the asset allocation constraint to the desired after-tax asset allocation as outlined in Table 4.

## Table 4 - Optimal Location with 75/25 After-tax Allocation

	Pre-Tax Dollars	Pre-Tax Allocation	After-Tax Allocation
RRSP			
Bond	-	-	-
Stock	400,000	40.00%	25.00%
Taxable			
Bond	200,000	20.00%	25.00%
Stock	400,000	40.00%	50.00%
Total bond	200,000	20.00%	25.00%
Total stock	800,000	80.00%	75.00%

Source: PWL Capital Inc.

In the optimal scenario we see a 3.90% annualized after-tax return; 12 bps higher than the case shown in Table 1 with all bonds located in the RRSP. From this we can conclude that there is indeed an optimal location of assets. However, contrary to the common belief of many Canadian investors, the optimal location does not necessarily place bonds in the RRSP.

# 5 Asset Location for Utility Maximization

Using the after-tax asset allocation framework is more accurate than pre-tax asset allocation, but it is still not a theoretically consistent comparison. Identical after-tax asset allocations may still have different characteristics in terms of meeting investor preferences.

In their 2004 paper [\*Optimal Asset Location and Allocation with Taxable and Tax-Deferred Investing\*](#), Robert Dammon, Chester Spatt, and Harold Zhang demonstrate an approach to optimizing the location of assets in order to maximize utility. An important component of the utility maximization framework is the different risk and return characteristics of stocks and bonds depending on the type of account that they are held in.

In the paper, the authors model the marginal change in wealth gained from moving one after-tax dollar from stocks to bonds in the tax-deferred account, offset by a shift of  $x_i$  dollars from the riskless taxable bond to stocks in the taxable account.

The term  $x_i$  is important; it reflects the need to shift more capital into stocks in the taxable account to offset a shift away from stocks in the tax-deferred account. Stocks are less valuable and less risky (due to losses offsetting taxes) in the taxable account. Following this model, we can see the utility maximizing location strategy for a given allocation. Based on our assumptions,  $x_i$  ends up equalling 1.34<sup>1</sup>; that is, for every dollar of stocks that we shift into bonds in the RRSP, we must shift 1.34 dollars into stocks in the taxable account.

Starting from our benchmark portfolio of a balanced 60/40 mix in both the RRSP and the taxable account we will shift bonds out of the RRSP, matched by a shift of  $x_i$  into stocks in the taxable account. We could shift the overall asset allocation by shifting further away from bonds in the taxable account, but the  $x_i$  shift is specifically designed to be a *risk-free* payoff. That is, we are not theoretically taking any more risk than the 60/40 balanced location strategy by making this change.

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<sup>1</sup> Mathematically,  $x_i = (1 + d_i) / [1 + d_i (1 - \tau_d) - \tau_g]$ , where  $d_i$  is the income yield on stocks,  $\tau_d$  is the tax rate on income, and  $\tau_g$  is the tax rate on gains.

## Table 5 - Utility Maximized Asset Location

	Pre-Tax Dollars	Pre-Tax Allocation	After-Tax Allocation
RRSP			
Bond	400,000	40.00%	25.00%
Stock	-	-	-
Taxable			
Bond	78,947	7.89%	9.86%
Stock	521,053	52.10%	65.14%
Total bond	478,947	52.10%	34.86%
Total stock	521,053	60.00%	65.14%

Source: PWL Capital Inc.

The after-tax return of the location strategy in Table 5 clocks in at 3.53% - higher than the balanced 60/40 location strategy in Table 2, with theoretically the same amount of risk. According to this methodology there is an opportunity to incrementally increase expected wealth *without increasing risk* by shifting toward bonds in the RRSP, offset by an  $x_i$  shift into stocks in the taxable account.

## 6 Yield Drives the Optimal Location

Where the utility maximization framework gets particularly interesting for our discussion is that the marginal change in wealth for shifting from stocks in the RRSP to  $x_1$  stocks in the taxable account is constant for all values of the capital return on stocks, referred to in the paper as  $g$ .

The payoff being true for all values of  $g$  means that from the perspective of maximizing utility by adjusting asset location it is only the **yield** and the **tax rate** on investment income that matter. As long as the tax rate on income,  $\tau_d$ , is greater than the tax rate on gains,  $\tau_g$ , we have a preference for holding the asset with the highest yield in the tax-deferred account. As the authors explain:

Thus, when  $\tau_d > \tau_g$  the investor prefers to allocate his entire tax-deferred wealth to the asset with the *highest yield*, with all other assets held in the taxable account.

There is a consideration here for differences in tax rates between dividends and income. Canadian dividends, for example, are taxed at a lower rate than foreign dividends and interest. Based on this it is highly unlikely that it will be optimal to hold Canadian equities in the tax-deferred account.

The case for International stocks is very different. At the time of writing this paper, most bond ETFs have a lower yield to maturity, and some have a lower average coupon, than the dividend yield on International and Emerging Market stocks.

XEF, the iShares Core MSCI EAFE IMI Index ETF, has a 12-month trailing yield of 2.72% and XEC, the iShares Core MSCI Emerging Markets IMI Index ETF, has a 12-month trailing yield of 2.77%. VBG, the Vanguard Global ex-U.S. Aggregate Bond Index ETF (CAD-hedged) has a yield to maturity of 0.40% and an average coupon of 2.1%; VBU, the Vanguard U.S. Aggregate Bond Index ETF (CAD-hedged) has a yield to maturity of 2.10% and an average coupon of 3.20%; VAB, the Vanguard Canadian Aggregate Bond Index ETF, has a yield to maturity of 1.90% and an average coupon of 3.20%. Over the long-term it would be reasonable to expect, all else equal, average coupons to converge on the yield to maturity.

It is important to point out that in Dammon, Spatt, and Zhang (2004), the authors conclude that bonds **are** optimal in the tax-deferred account. However, at the time of their publication interest rates were much higher relative to equity yields than they are today. Another important part of their conclusion to hold bonds in the tax-deferred account is the fact that in the US, the cost base of assets in a taxable account are stepped up to their current values at death. In other words, accrued gains are not taxed at death. In Canada, gains are generally taxable at death, resulting in a potentially large tax liability if there are substantial accrued gains in a taxable account.

# 7 Foreign Withholding Tax

There is some consideration here for foreign withholding tax. We will use XEF as an example: XEF holds securities directly, meaning that there is one level of foreign withholding tax. This withholding tax is recoverable in a taxable account, and unrecoverable in a non-taxable account; it can be estimated at about 22 bps<sup>2</sup>. That is 22 bps that can be recovered in a taxable account, but is lost forever in a non-taxable account. Interestingly, adding this unrecoverable cost to the model roughly offsets the 12 bps estimated benefit of the optimal location described by Table 4. However, our 12 bps estimated value-added from optimal location is based on a 2% equity yield and a 3% fixed income yield. If we instead model a scenario closer to current yields, with stocks at 2.70% and bonds at 2.00%, the value-added from optimal location increases to 32 bps which makes the optimal location described by Table 4 attractive in the current environment, even after unrecoverable foreign withholding tax is considered.

Complicating this matter further is that there may be foreign withholding tax to consider with bonds. VBG, which holds global bonds, similarly has a level of foreign withholding tax that is recoverable in a taxable account and unrecoverable in a non-taxable account; it can be estimated at about 27 bps. Depending on how global bonds are being used in asset allocation, the impact of withholding tax on optimal asset location may become less relevant – if the unrecoverable withholding tax consequences for holding assets in the RRSP are similar for stocks and bonds then it becomes a non-issue in the decision.

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<sup>2</sup> Following the methodology explained in Justin Bender and Dan Bortolotti's 2016 paper [Foreign Withholding Taxes: How to estimate the hidden tax drag on US and International equity ETFs](#).

## 8 Practical Applications

We have examined pre-tax and after-tax asset allocation and seen that investment outcomes are affected more by after-tax asset allocation than they are by optimal location. We have also seen that while it is possible to generate a risk-free payoff by shifting certain types of assets out of the RRSP and into the taxable account, it is the asset with the highest yield that should be favoured in the RRSP. At the time of writing, it is not obvious that bonds have higher yields than stocks<sup>3</sup> which calls into question the wisdom of locating bonds in the RRSP. The optimality of holding all bonds in the RRSP ends up being a bet on the spread between future interest rates and dividend yields.

A major practical takeaway from this work is that it is not universally optimal to hold bonds in the RRSP account when we control for after-tax asset allocation. Without controlling for after-tax asset allocation, bonds will be directed to the RRSP resulting in a more aggressive portfolio, and a correspondingly higher expected return. However, tricking ourselves into a more aggressive portfolio by locating bonds in the RRSP leads to an inefficient outcome. It would be more ex ante efficient to target a desired after-tax asset allocation and locate the highest yielding asset in the RRSP account.

This approach is not without its flaws: it results in a more aggressive pre-tax asset allocation, which is what you see when you look at your account. There is a meaningful behavioural component to this point – can you handle the swings of a more aggressive pre-tax asset allocation? Even though your ultimate result is driven by after-tax wealth, you have to watch the pre-tax values in your account day-to-day. In other words, there is a difference between *what you see* and *what you get*.

In Table 6 we can see three different location strategies, all with a 75/25 after-tax asset allocation. We have used the optimal location strategy for pre-tax asset allocation as the benchmark to measure value-added from alternative location strategies. For this example, we assume an equity drawdown of -50% accompanied by a flat 0% fixed income return for the time period under examination.

<sup>3</sup>Bonds have lower yields to maturity and in some cases higher coupons compared to the dividend yield on International and Emerging Markets stocks. Higher coupons might favour bonds in the RRSP at this moment, but coupons should tend toward the yield to maturity over time.

## Table 6 - Wealth Impact and Behavioural Risk of Optimal Asset Location

Location Strategy	Estimated Value Added (bps/year)	Pre-tax Drawdown (what you see)	After-tax Drawdown (what you get)
Pre-tax Optimal (Table 1)	0 bps (baseline)	-30.00%	-37.50%
Balanced (Table 3)	9 bps	-37.50%	-37.50%
After-tax Optimal (Table 4)	12 bps	-40.00%	-37.50%

Source: PWL Capital Inc.

It should be obvious from Table 6 that while the after-tax drawdown – which is what you get – is identical across the strategies, there is a meaningful difference in the pre-tax drawdown – which is what you see. For the badly behaved (human) investor, this difference in pre-tax drawdown could make a more aggressive portfolio palatable. There is a behavioural argument that leaving an estimated 12 bps from optimal location on the table is a reasonable trade-off if it facilitates better behaviour due to what appears to be less volatility in the portfolio value.

## 9 Conclusion

The optimal location of asset classes across account types seems like it should be a reliable approach to increasing expected after-tax wealth. One of the typical approaches to optimal asset location directs fixed income to the RRSP account. We argue that the increase in expected wealth from this approach stems from a more aggressive after-tax asset allocation. Once after-tax asset allocation is controlled, the optimal location of asset classes becomes less obvious. As explained in Dammon, Spatt, and Zhang (2004), the asset with the highest yield belongs in the tax-deferred account.

From a behavioural perspective, it is possible that the sub-optimal approach of holding bonds in the RRSP account makes a more aggressive portfolio feel better to own. This “trick” may allow investors to achieve higher expected returns without having to watch the same pre-tax swings as an investor with a truly ex ante optimal asset location strategy.

Our preferred approach in practice continues to be intentionally holding the same risk-appropriate asset mix across all account types. This approach produces a better expected outcome than holding all bonds in the RRSP when after-tax allocation is controlled; it also bypasses the requirement to predict future asset class yields, and removes the complexity of managing pre and after-tax asset allocation decisions.

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