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Financial Planning Assumptions

(Factor Tilted Portfolio)

Data Update
Year end 2022

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1. Introduction

This guide is intended to provide Canadian financial planners with our best estimates of future asset class returns and volatilities to produce financial projections for their clients. This document assumes that investors hold a broadly diversified portfolio of publicly-traded Canadian fixed-income securities and global equity, including both developed and emerging markets. These estimates are valid uniquely in the context of an investor who purposely avoids concentration in one or a few securities or sectors. Our investment horizon is 30 years. For users of the NaviPlan financial planning software, key inputs are highlighted in green. We have added an appendix to provide users of NaviPlan with data presented in a more compatible format.

We have created this report specifically to help financial advisors investing with mutual funds from Dimensional Fund Advisors Canada. The asset class expected returns, standard deviations, correlations, and distribution yields are designed to replicate the characteristics of the DFA Global Allocation funds. Importantly, these characteristics take into account the exposure of these funds to the Fama-French factors.

2. Q1 2023 Improvements to Methodology

We have made three major improvements to our methodology.

1. In the previous edition of the Financial Planning Assumptions for Factor-Tilted Portfolios ("FPAFTP"), we provided a factor-adjusted expected return only for equity. In the present report, **we adjust our factor-tilted fixed income expected return estimate to account for the shorter duration and higher credit risk exposure of the DFA Global Fixed Income Fund compared to the FTSE Canada Universe Bond Index.** Our methodology for the factor-tilted fixed-income expected return is explained in appendix 2.
2. While in the previous FPAFTP, we subtracted product fees only for the portfolio's equity component; we now have extended this measure to all asset classes. As a result, the MERs of F-class DFA mutual funds were subtracted from all asset-class expected returns.
3. Finally, a last significant change is **to estimate the total volatility of personal residences, accounting for idiosyncratic risk.** In the past, we have used the Teranet-National Bank House Price Index, which underestimates the actual volatility of individual homes because it accounts only for the general market risk of Canadian homes. We found some research that helps correct this flaw.

3. Expected Inflation

Our estimate for long-run Canadian inflation is the average of 30-year Government of Canada bond breakeven inflation, Canadian historical inflation from 1900 to 2022, and the Bank of Canada's inflation target. These figures are 2.1%, 3.0%, and 2.0%, respectively, for an inflation expectation of 2.4%.

In November 2022, Canada's Ministry of Finance announced it would stop issuing real-return bonds. Thus, we will review our methodology for estimating expected inflation to account for this new development in a future edition of the Financial Planning Assumptions.

Table 1: Expected inflation composition

1/3 x (Breakeven Inflation) Plus	1/3 x (Historical Inflation) Plus	1/3 x (Bank of Canada Target Inflation)	Equals Expected Inflation
2.1%	3.0%	2.0%	2.4%

Source: PWL Capital; Data Sources: Elroy Dimson, Paul Marsh and Mike Staunton, Triumph of Optimists: 101 Years of Global Investment Returns, Princeton University Press, 2002; Elroy Dimson, Paul Marsh and Mike Staunton, Credit Suisse Global Returns Yearbook and Sourcebook, 2018, Zurich: Credit Suisse Research Institute, 2021, Bank of Canada

4. Primary Residence

We estimate the expected real capital return for personal residences at 1% annually. The carrying costs of real estate, including maintenance, insurance, and property taxes, must also be captured. We estimate a 1% annual cost for maintenance and insurance. As property taxes vary greatly, we do not attempt to prescribe a figure here, but users should be sure to include them based on their circumstances. For example, a 1% real return less maintenance and property taxes (not to mention the opportunity cost of home equity) may make housing look like a poor investment. However, it is essential to remember that the owner receives imputed rent as a benefit.

To estimate the volatility of returns on residences, we found two studies documenting the total volatility of individual homes in the US. Thus, our first step was determining whether US data could provide sound evidence in a Canadian context. We looked at the S&P Case/Shiller and the Teranet/National Bank indices for insight. Although these two indices are only moderately correlated (0.55 from March 1999 to November 2022), their volatilities are similar: 3.5% per annum for the Canadian Index compared to 3.0% for the US Index. Based on this evidence, we assume the idiosyncratic volatility of Canadian and US homes will be similar.

Haurin & Zhou (2010) documents the idiosyncratic volatility of individual homes from 1985 to 2003, and Peng & Thibodeau (2016) cover the periods from 1996 to 2000, 2001 to 2007, and 2007 to 2012. We calculate an average from these studies and add it to the general Canadian market volatility to obtain an estimate of 14.1% for the volatility of Canadian homes, as documented in table 2 below.

Table 2 – Canadian Individual Home Volatility Estimate

Title	Title	Title
Canadian Market Volatility Estimate (3/1999-12/2022)		3.5%
Plus: Idiosyncratic Volatility:		
Haurin & Zhou (1985-2003)[1]	13.1%	
Peng & Thibodeau (1996-2000)	9.4%	
Peng & Thibodeau (2001-2007)	7.9%	
Peng & Thibodeau (2007-2012)	11.5%	
Average	10.6%	10.6%
Total Volatility		14.1%

Source: PWL Capital; Data Sources: Haurin and Zhou, Peng and Thibodeau, Federal Reserve Bank of Saint-Louis, Teranet/National Bank

[1]Haurin & Zhou provide an estimate for the total volatility of US homes (15%) from which we subtract the volatility of the S&P Case/Shiller Index for 1987-2003 (1.9%).

5. Asset Class Expected Returns

We estimate asset class expected returns with a weighted average of the Market-Based Expected Return (MBER) and the Equilibrium Cost of Capital (ECOC). The MBER is an estimate of expected returns based on current market conditions. The ECOC estimates expected returns based on more than 120 years of global asset class return historical data. The weighting of each component is derived from the statistical explanatory power of the MBER documented in Felix, Kerzérho, and Warwick (2021). Empirical evidence suggests that the MBER has a high explanatory power for fixed income and a relatively low explanatory power for equity.

We attribute a weight "W1" to the MBER and the balance of the attribution "W2" to the ECOC to obtain gross asset class returns. We then subtract product MERs to obtain the net nominal expected return. We use DFA F-class mutual fund MERs as our product fee assumption to factor-tilted portfolios. The underlying funds to each asset class are outlined in the section "Composition of Asset Class Returns."

Table 3 – Asset Class Expected Returns

Asset Class	W1	Nominal MBER	W2	Nominal ECOC	Nominal Expected Return Gross of fees	MER	Nominal Expected Return Net of fees
Cash	75%	4.26%	25%	3.07%	3.96%	0.00%	3.96%
Fixed Income Factor-Tilted	75%	4.58%	25%	3.94%	4.42%	0.31%	4.09%
Canadian Equity Factor-Tilted	25%	7.23%	75%	7.54%	7.46%	0.28%	7.16%
US Equity - Factor-Tilted	25%	6.31%	75%	7.75%	7.39%	0.27%	7.10%
International Equity (DV+EM) Factor-Tilted*	25%	10.44%	75%	8.07%	8.67%	0.45%	8.17%
Global Equity - Factor-Tilted[2]	25%	7.67%	75%	7.76%	7.74%	0.34%	7.37%

Source: PWL Capital; Data Sources: Bloomberg, Morningstar, Robert Shiller, Elroy Dimson, Paul Marsh and Mike Staunton, Triumph of the Optimists: 101 Years of Global Investment Returns, Princeton University Press, 2002; Elroy Dimson, Paul Marsh and Mike Staunton, Credit Suisse Global Returns Yearbook and Sourcebook, 2018, Zurich: Credit Suisse Research Institute, 2021

6. Expected Standard Deviations

Asset class standard deviations are estimated using a simple average of the 5-year and 20-year historical standard deviations.

Table 4 - Estimated Volatility of Major Asset Classes

Asset Class	Five-year Standard Deviation	20-year Standard Deviation	Estimated Standard Deviation
Fixed Income - Factor-Tilted	3.52%	3.78%	3.65%
Canadian Equity - Factor Tilted	19.69%	16.11%	17.90%
US Equity - Factor Tilted	17.20%	14.39%	15.79%
International Equity - Factor Tilted	13.90%	14.56%	14.23%

Source: PWL Capital; Data Source: Morningstar

[2] "Global Equity – Factor-tilted" is made of 1/3 Canadian equity, with the balance being allocated on a market cap weighted basis to U.S. and international equity. The weightings of the DFA Global Equity Fund are used as a guide.

7. Expected Correlations

Asset class correlations are estimated using a simple average of the 5-year and 20-year historical data.

Table 5 - Correlation Estimates

	Fixed Income - Factor-Tilted	Cdn Equity - Factor-Tilted	US Equity - Factor-Tilted	Int. Equity - Factor-Tilted
Fixed Income - Factor-Tilted	1.00	-0.21	0.04	0.04
Canadian Equity - Factor-Tilted	-0.21	1.00	0.75	0.77
US Equity - Factor-Tilted	0.04	0.75	1.00	0.80
International Equity - Factor-Tilted	0.04	0.77	0.80	1.00

Source: PWL Capital; Data Source: Morningstar

8. Composition of Asset Class Returns

The composition of returns, primarily consisting of the mix between capital appreciation, interest income and dividends, is essential for financial planning. The tax liability in taxable and non-taxable accounts (due to foreign withholding tax) will hinge on the portion of returns assumed to be coming from interest, Canadian and foreign dividends, and realized and unrealized capital gains.

To determine the composition of asset class returns, we proceed as follows:

- Establish one or more mutual funds or ETFs representing the passive benchmark for each asset class.
- For fixed income, the average distribution yield is assumed to be the lowest of the underlying fund's current yield and the asset class expected return. Distributions are assumed to be 100% interest income.
- For Canadian equity, distributions are assumed to be 100% Canadian dividends.
- For US and international equity, distributions are assumed to be 100% foreign dividends.
- The balance of expected returns (net of distribution yields) is treated as capital gains.
- We assume a 50%/50% split between unrealized and realized capital gains.

We use the following funds to estimate the composition of asset class returns:

Fixed income: 100% DFA Global Fixed Income F (DFA916)

Canadian equity: 70% DFA Canadian Core Equity F (DFA256) and 30% DFA Canadian Vector Equity F (DFA600)

US Equity: 70% DFA US Core Equity F (DFA293) and 30% DFA US Vector Equity F (DFA223)

International Equity: 70% DFA International Core Equity F (DFA295) and 30% DFA International Vector Equity F (DFA227)

Our estimates for the composition of expected returns are illustrated in Table 6. This data is reproduced in a Naviplan-compatible format in Appendix 1.

Table 6 - Composition of Expected Asset Class Returns

Asset Class	Expected Return	Current Yield	Interest & Foreign Dividends	Canadian Dividends	Realized Capital Gains	Unrealized Capital Gains
Fixed Income	4.09%	2.04%	2.04%	0.00%	1.03%	1.03%
Canadian Equity	7.16%	3.34%	0.00%	3.34%	1.91%	1.91%
US Equity	7.10%	1.47%	1.47%	0.00%	2.81%	2.81%
International equity DV + EM	8.17%	3.20%	3.20%	0.00%	2.49%	2.49%

Source: PWL Capital; Data Sources: Bloomberg, Morningstar, Robert Shiller, Elroy Dimson, Paul Marsh and Mike Staunton, Triumph of the Optimists: 101 Years of Global Investment Returns, Princeton University Press, 2002; Elroy Dimson, Paul Marsh and Mike Staunton, Credit Suisse Global Returns Yearbook and Sourcebook, 2018, Zurich: Credit Suisse Research Institute, 2021

9. Portfolio Expected Returns

To simplify the practical application of the information presented in this paper, table 7 shows portfolios consisting of various mixes between stocks and bonds.

Table 7 - Composition of Expected Asset Class Returns

			ESTIMATED RETURN COMPOSITION			
Asset Mix (Equity/Bond)	Expected Return	Expected Standard Deviation	Interest & Foreign Dividends	Canadian Dividends	Realized Capital Gains	Unrealized Capital Gains
0/100	4.09%	3.65%	2.04%	0.00%	1.03%	1.03%
5/95	4.25%	3.53%	2.01%	0.06%	1.09%	1.09%
10/90	4.42%	3.58%	1.98%	0.11%	1.16%	1.16%
15/85	4.59%	3.72%	1.95%	0.17%	1.24%	1.24%
20/80	4.76%	4.06%	1.92%	0.22%	1.31%	1.31%
25/75	4.92%	4.52%	1.89%	0.28%	1.38%	1.38%
30/70	5.07%	4.98%	1.86%	0.33%	1.44%	1.44%
35/65	5.23%	5.56%	1.82%	0.39%	1.51%	1.51%
40/60	5.41%	6.25%	1.79%	0.44%	1.59%	1.59%
45/55	5.55%	6.82%	1.76%	0.50%	1.65%	1.65%
50/50	5.72%	7.51%	1.73%	0.56%	1.72%	1.72%
55/45	5.88%	8.20%	1.70%	0.61%	1.79%	1.79%
60/40	6.04%	8.89%	1.67%	0.67%	1.85%	1.85%
65/35	6.23%	9.69%	1.64%	0.72%	1.93%	1.93%
70/30	6.38%	10.38%	1.61%	0.78%	2.00%	2.00%
75/25	6.54%	11.07%	1.58%	0.83%	2.06%	2.06%
80/20	6.72%	11.87%	1.55%	0.89%	2.14%	2.14%
85/15	6.87%	12.56%	1.52%	0.95%	2.20%	2.20%
90/10	7.04%	13.37%	1.49%	1.00%	2.28%	2.28%
95/5	7.19%	14.06%	1.45%	1.06%	2.34%	2.34%
100/0	7.37%	14.86%	1.42%	1.11%	2.42%	2.42%

Source: PWL Capital; Data Sources: Bloomberg, Morningstar, Robert Shiller, Elroy Dimson, Paul Marsh and Mike Staunton, Triumph of the Optimists: 101 Years of Global Investment Returns, Princeton University Press, 2002; Elroy Dimson, Paul Marsh and Mike Staunton, Credit Suisse Global Returns Yearbook and Sourcebook, 2018, Zurich: Credit Suisse Research Institute, 2021

Appendix: Financial Planning Assumptions – Naviplan Input Format

Table 8 - Composition of Asset Class Returns

Asset Class	Interest	Dividends	Capital Gains	Deferred Growth	Total	Standard Deviation
Fixed Income -Factor-Tilted	2.04%		1.03%	1.03%	4.09%	3.65%
Canadian Equity - Factor-Tilted		3.34%	1.91%	1.91%	7.16%	17.90%
U.S. Equity - Factor Tilted	1.47%		2.81%	2.81%	7.10%	15.79%
International Equity - Factor Tilted	3.20%		2.49%	2.49%	8.17%	14.23%
Fixed Income - STD	2.87%		0.64%	0.64%	4.15%	4.96%
Canadian Equity - STD		3.10%	1.92%	1.92%	6.95%	15.50%
U.S. Equity - STD	1.21%		2.67%	2.67%	6.56%	14.99%
International Equity - STD	2.94%		2.24%	2.24%	7.41%	13.12%

Source: PWL Capital; Data Sources: Bloomberg, Morningstar, Robert Shiller, Elroy Dimson, Paul Marsh and Mike Staunton, Triumph of the Optimists: 101 Years of Global Investment Returns, Princeton University Press, 2002; Elroy Dimson, Paul Marsh and Mike Staunton, Credit Suisse Global Returns Yearbook and Sourcebook, 2018, Zurich: Credit Suisse Research Institute, 2021

Table 9 - Correlations

	Fixed Income - Factor Tilted	Canadian Equity - Factor Tilted	US Equity - Factor Tilted	Int Equity - Factor Tilted	Fixed Income - STD	Canadian Equity - STD	US Equity - STD	Int Equity - Factor Tilted
Fixed Income Factor Tilted	1.00	-0.21	0.04	0.04	0.80	-0.13	0.15	0.07
Canadian Equity Factor Tilted	-0.21	1.00	0.75	0.77	0.19	0.97	0.68	0.72
US Equity - Factor Tilted	0.04	0.75	1.00	0.80	0.26	0.78	0.97	0.78
International Equity Factor Tilted	0.04	0.77	0.80	1.00	0.32	0.76	0.76	0.98
Fixed Income - STD	0.80	0.19	0.26	0.32	1.00	0.27	0.35	0.34
Canadian Equity - STD	-0.13	0.97	0.78	0.76	0.27	1.00	0.73	0.73
US Equity - STD	0.15	0.68	0.97	0.76	0.35	0.73	1.00	0.77
International Equity - STD	0.07	0.72	0.78	0.98	0.34	0.73	0.77	1.00

Source: PWL Capital; Data Sources: Bloomberg, Morningstar, Robert Shiller, Elroy Dimson, Paul Marsh and Mike Staunton, Triumph of the Optimists: 101 Years of Global Investment Returns, Princeton University Press, 2002; Elroy Dimson, Paul Marsh and Mike Staunton, Credit Suisse Global Returns Yearbook and Sourcebook, 2018, Zurich: Credit Suisse Research Institute, 2021

Table 10 - Portfolio Asset Mixes

Asset Mix (Equity/Bond)	Fixed Income	Canadian Equity	US Equity	International Equity
0/100	100.00%	0.00%	0.00%	0.00%
5/95	95.00%	1.67%	2.05%	1.28%
10/90	90.00%	3.33%	4.11%	2.56%
15/85	85.00%	5.00%	6.16%	3.84%
20/80	80.00%	6.67%	8.21%	5.12%
25/75	75.00%	8.33%	10.27%	6.40%
30/70	70.00%	10.00%	12.32%	7.68%
35/65	65.00%	11.67%	14.37%	8.96%
40/60	60.00%	13.33%	16.43%	10.24%
45/55	55.00%	15.00%	18.48%	11.52%
50/50	50.00%	16.67%	20.53%	12.80%
55/45	45.00%	18.33%	22.59%	14.08%
60/40	40.00%	20.00%	24.64%	15.36%
65/35	35.00%	21.66%	26.69%	16.64%
70/30	30.00%	23.33%	28.75%	17.92%
75/25	25.00%	25.00%	30.80%	19.20%
80/20	20.00%	26.66%	32.85%	20.48%
85/15	15.00%	28.33%	34.91%	21.76%
90/10	10.00%	30.00%	36.96%	23.04%
95/5	5.00%	31.66%	39.01%	24.32%
100/0	0.00%	33.33%	41.07%	25.60%

Source: PWL Capital; Data Sources: Bloomberg, Morningstar, Robert Shiller, Elroy Dimson, Paul Marsh and Mike Staunton, Triumph of the Optimists: 101 Years of Global Investment Returns, Princeton University Press, 2002; Elroy Dimson, Paul Marsh and Mike Staunton, Credit Suisse Global Returns Yearbook and Sourcebook, 2018, Zurich: Credit Suisse Research Institute, 2021

Appendix 2: Estimating Factor-Tilted Fixed-Income Expected Return

This document provides guidance for financial planners working with DFA Global Allocations funds. These funds can be approximately decomposed into the DFA Global Fixed Income Portfolio and the DFA Global Equity Portfolio. In the first edition of the Financial Planning Assumptions for Factor-Tilted Portfolios, we calculated a factor-tilted estimate for the portfolio's equity component, and we assumed the fixed-income component had a similar profile to the FTSE Canada Universe Bond Index. This appendix describes the procedure to better estimate the expected return of the factor-tilted fixed-income portfolio.

Before we look at how we estimate the expected return of the factor-tilted fixed-income portfolio, we must address two critical issues. First, we only have data about the yield-to-maturity of Canadian bond indices. The DFA Global Fixed Income Portfolio consists of Canadian dollar-hedged global bonds. We solve this problem by assuming global bonds with Canadian dollar hedging have a similar expected return as the Canadian bond market in the long run. The second problem is that the DFA Global Fixed Income Fund uses variable maturity and variable credit strategies, for which we cannot easily estimate an expected premium. We solve this problem by assuming the factor-tilted fixed-income portfolio has an expected return that mimics an appropriate mix of the FTSE Canada Short Bond Index, the FTSE Canada Short Corporate Bond Index, and the FTSE Canada Universe Bond Index. This procedure adjusts the factor-tilted fixed-income portfolio's expected return according to its duration and credit characteristics and attributes a premium of zero for the variable maturity and variable credit strategies.

DFA Global Fixed Income Portfolio Composition

The DFA Global Fixed Income Portfolio is a fund-of-fund made of three components: the DFA Five-Year Global Fixed Income Fund, the DFA Global Targeted Credit Fund, and the DFA Global Investment Grade Fixed Income Fund. Table 11 outlines the weightings of all component funds and the proxy indices in use.

Table 11 – Structure of the Factor-Tilted Fixed-Income portfolio

Fund	FundServ Code	Proxy Index	Weight
Five-Year Global Fixed Income Fund (F)	DFA231	FTSE Canada Short Bond Index	40%
Global Targeted Credit Fund (F)	DFA857	FTSE Canada Short Corporate Bond Index	25%
Global Investment Grade Fixed Income Fund (F)	DFA449	FTSE Canada Universe Bond Index	35%
Global Fixed Income Portfolio (F)	DFA916	Factor-Tilted Fixed-Income portfolio	100%

Source: PWL Capital; Data Source: DFA

Market-Based Expected Return

The MBER for factor-tilted fixed income will be a weighted average of the yield-to-maturity of the proxy market indices that mimic the underlying funds to the DFA Global Fixed Income Portfolio. The details are outlined in table 12. By our calculations, the gross MBER of the factor-tilted fixed-income portfolio equals 4.58%.

Table 12 – Nominal Gross MBER

Proxy Index	Weight	Yield-to-maturity (as of 12|31|2022)
FTSE Canada Short Bond Index	40%	4.40%
FTSE Canada Short Corporate Bond Index	25%	5.28%
FTSE Canada Universe Bond Index	35%	4.28%
Factor-Tilted Fixed-Income Portfolio Gross MBER		**4.58%**

Source: PWL Capital; Data Source: BMO, DFA

Equilibrium Cost of Capital

The base for estimating the ECOC of the factor-tilted fixed-income portfolio is the FTSE Canada Bond Universe Index, which we adjust for the difference in duration and credit exposure of the component funds. The process is detailed in table 13.

We estimate the ECOC of the FTSE Canada Universe with the DMS historical real return for global bonds in US dollars from 1900 to 2022, which equals 1.75%.

The discount for the shorter maturities of the DFA231 and the DFA857 compared to the FTSE Canada Universe Index is estimated from the average yield difference between the FTSE Canada Short-Term Bond Index and the FTSE Canada Universe Bond Index from December 1985 to December 2022. This so-called “maturity discount” equals -0.55%.

The premium to account for the greater exposure of the DFA857 to credit risk compared to the FTSE Canada Universe Index is estimated from the average yield difference between the FTSE Canada Short-Term Corporate Bond Index and the FTSE Canada Short-Term Bond Index from December 1985 to December 2022. This so-called “credit premium” equals 0.58%.

The weighted average of the component funds results in a real ECOC estimate of 1.53%. Once adding our expected inflation estimate (2.40%), we obtain a nominal gross ECOC estimate of 3.94%.

Table 13 - Nominal Gross ECOC

Underlying fund	Index	Weight	Bond Universe Real ECOC	Minus: maturity discount	Plus: credit premium	Total
DFA 231	FTSE Canada Short Term	40%	1.75%	-0.55%	NA	1.20%
DFA 857	FTSE Canada Short Term Corporates	25%	1.75%	-0.55%	0.58%	1.78%
DFA 449	FTSE Canada Universe	35%	1.75%	NA	NA	1.75%
Real ECOC						1.53%
Plus:	Expected Inflation					2.40%
Factor-Tilted Fixed-Income Portfolio Gross ECOC						3.94%

Source: PWL Capital; Data Source: Dimson, Marsh and Staunton, BMO, Bloomberg

Bringing it all Together: Expected Return

As described in table 14, for fixed-income securities, we attribute a weight of 75% to the MBER and 25% to the ECOC, which results in a gross expected return for the factor-tiled portfolio of 4.42%, to which we subtract 0.31% for the MER of the DFA Global Fixed Income Portfolio. We estimate the net expected return for the factor-tilted fixed-income portfolio to be 4.09%.

Table 14 – Expected Return

	Weight	Gross Expected Return	MER	Net Expected Return
MBER	75%	4.58%	0.31%	4.26%
ECOC	25%	3.94%	0.31%	3.62%
Expected Return		4.42%		4.09%

Source: PWL Capital; Data Source: Dimson, Marsh and Staunton, BMO, Bloomberg

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