TD Global Investment Solutions

Investor Knowledge 20 Minutes

TD Asset Management Long-Term Asset Class Assumptions

In the following pages we outline TD Asset Management Inc.'s (TDAM) long-term capital markets assumption methodology for stocks, bonds and alternative investments, used to inform strategic asset mix decisions.

Philosophy

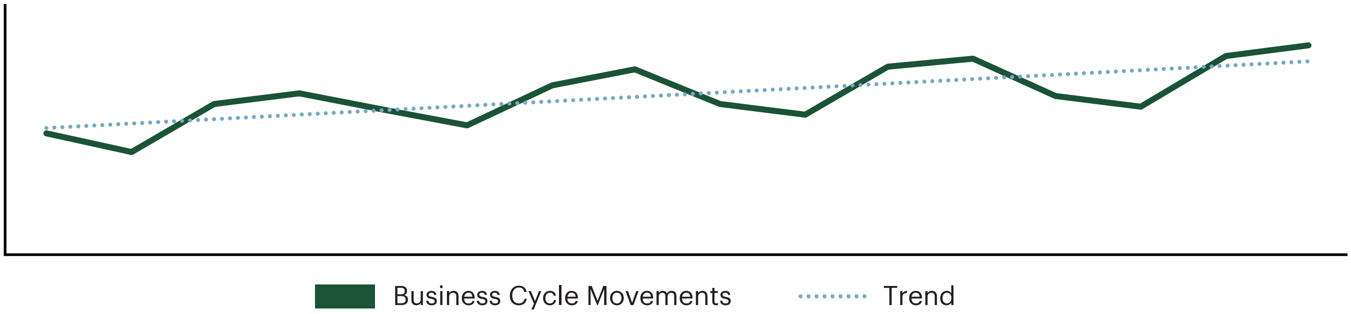
Defining forward-looking return expectations shines a light on investor challenges and ultimately how to address them.

Strategic asset mix decisions require an objective approach to long-term asset class return expectations. Below are examples where TDAM and our clients utilize asset class assumptions:

- Strategic Asset Allocation Optimization (assessing best risk-adjusted return)
- Tactical asset allocations
- Multi-Asset/Balanced/Target Date Fund Design
- Market Commentary and Outlook

TDAM's asset class assumptions are long-term in nature, reflecting average annual expectations over 7 to 10 year horizons. The methodology assumes long- run historical relationships are fairly constant and that most asset classes will trend according to structural macro-economic factors over time. This allows strategic asset mix decisions to rely on intermediate and long-term trends rather than attempting to time the business cycle itself. The utility of this philosophy is depicted by the more predictable long-term trend line compared to the more volatile business cycle movements in **Figure 1**:

Figure 1: Trend Versus Business Cycle Movements



Source: TDAM. For illustrative purposes.

Asset class assumptions fall under three categories:

Returns

long-term expected return
for each asset class

Risk

standard deviation of
asset class returns

Correlation

correlation across
asset class returns

The remaining sections of this paper outline the methodology for setting each category and TDAM’s resulting assumptions for commonly used asset classes.

Expected Returns

TDAM utilizes a forward-looking building block approach to set asset class return assumptions. This methodology builds on the Grinold and Kroner forecasting approach. The return assumptions encapsulate three financial and economic parameters: expected real Gross Domestic Product (“GDP”) growth, expected inflation, and yield. The formula used for average annual expected return assumptions is listed directly below:

Average Annual Expected Return = Forecast Real GDP Growth + Forecast Inflation + Yield

Global

Different asset classes incorporate different financial and economic parameters into their return expectations. For instance, equities include all three parameters, while nominal bonds only incorporate yield.

Below is a breakdown of the separate building blocks used to forecast each asset class return.

Figure 2: Building Block Approach

Real GDP

Exposed Asset Classes:

- Equities
- Infrastructure

+

Inflation

Exposed Asset Classes:

- Equities
- Real Estate
- Infrastructure
- Real Return Bonds[1]

+

Yield

Exposed Asset Classes:

- Equities
- Real Estate
- Infrastructure
- Real Return Bonds[1]
- Nominal Bonds
- Money Market
- Commercial Mortgages
- Private Debt

[1] The yield for fixed income assets illustrates geometric expected returns. Geometric returns will be lower than arithmetic returns for any asset that has volatility, or the risk of negative returns. We convert the fixed income geometric expected returns into arithmetic using the following formula: Arithmetic Average = Geometric Average + $(\sigma)^{\wedge 2}/2$. Source: TDAM.

Forecasting Economic Growth & Inflation

TDAM's model incorporates economic forecast from third party sources — International Monetary Fund (IMF) and Bloomberg — to facilitate objectivity and eliminate bias. IMF, founded in 1944, is a renowned organization created to foster international economic cooperation. In its World Economic Outlook database, it publishes economic forecasts for 190 countries every year. Bloomberg polls a wide breadth of economists and derive a consensus forecast based on the poll results.

Incorporating TD Asset Management's Outlook

The asset class return model requires an overlay of professional judgement to create rational assumptions. Our Asset Allocation Team sometimes adjust the forecasted returns based on the firm's outlook. Below are some considerations that will affect each factor (GDP, CPI & Yield).

Figure 3: Incorporating Fundamental Outlook

Real GDP

- Different firm view from consensus
- Adjust for forecast error

+

Inflation

- Different firm view from consensus
- Adjust for forecast error

+

Yield

- Default risk in fixed income
- Expected increase/decrease in dividend payout ratios or share buybacks
- Curve Steepness

Source: TDAM.

Below we describe the nuances of each asset class and how they are accounted for within TDAM's forecasting methodology.

Fixed Income

The following fixed income asset classes represent common exposures for Canadian investors. Additionally, the methodology can be extended to reflect broader private debt and global fixed income sectors.

Figure 4

Fixed Income	Assumed 7-10 Yr. Annual Expected Return (%)[2,3]
Canadian Money Market	2.2
Canadian Short-Term Bonds	4.2
Canadian Real Return Bonds	4.0
Canadian Government Bonds	3.9
Canadian Long Government Bonds	4.3
Canadian Universe Bonds	4.2
Canadian Long Bonds	4.5
Canadian Corporate Bonds	5.3

Fixed Income	Assumed 7-10 Yr. Annual Expected Return (%)[2,3]
High Yield	6.8
U.S. Fixed Income	4.8
U.S. Treasury Bonds	4.2
U.S. Corporate Bonds	5.9
Global Bonds	3.7
Private Commercial Mortgages	5.0
Private Debt	5.9
Long Private Debt	5.9

[2] No assurance that expected returns will be achieved.

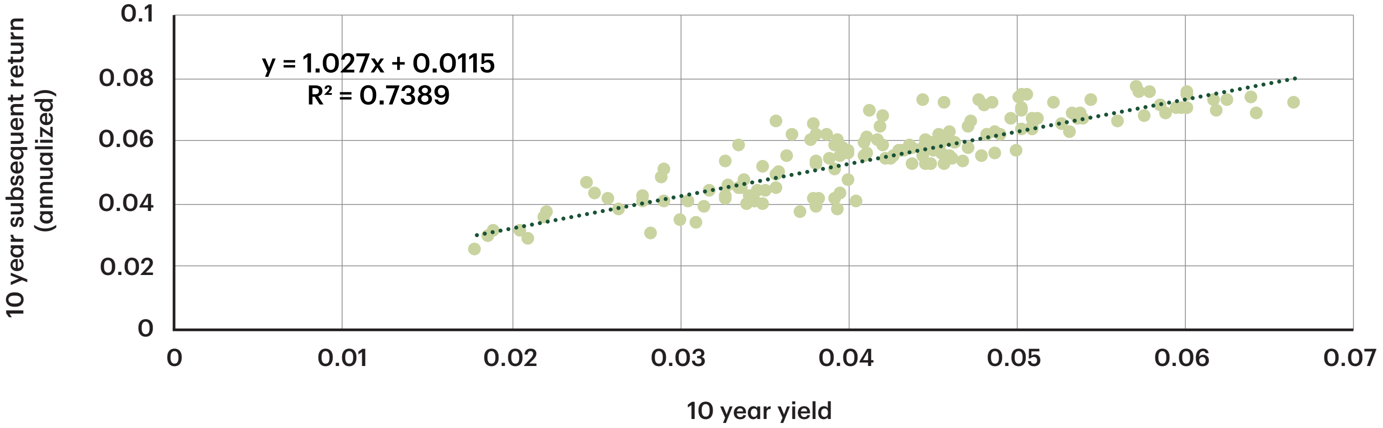
[3] We convert the fixed income geometric expected returns (i.e. yield) into arithmetic returns using the following formula: Arithmetic Average = Geometric Average + $(\sigma)^{\wedge 2}/2$.

Source: TDAM. As at October 2022.

For fixed income, yield is the only factor contributing to returns in the methodology, as nominal bonds do not reward investors for increases in real economic growth or inflation expectations. While curve movements affect the mark-to-market return, passively held fixed income securities will theoretically return the yield as the investment horizon approaches maturity. We can use the same methodology for any other fixed income sector such as Emerging Market Debt and Mortgage- Backed Securities that are not listed here.

The efficacy of using the yield of a bond at purchase to forecast its subsequent long-term return is illustrated in **Figure 5** where we regressed the starting yield of 10-year Government of Canada bonds dating back to 1989 to their subsequent 10-year annualized returns. A positive linear relationship and high correlation indicates that long-term fixed income performance is extremely dependent on the beginning yield. This means that if an investor bought a 10-year Canadian bond today, the nominal annualized return over the next 10 years has a high likelihood of being approximate to today's yield.

Figure 5: Canadian Government Bond Returns Driven by Starting Yields



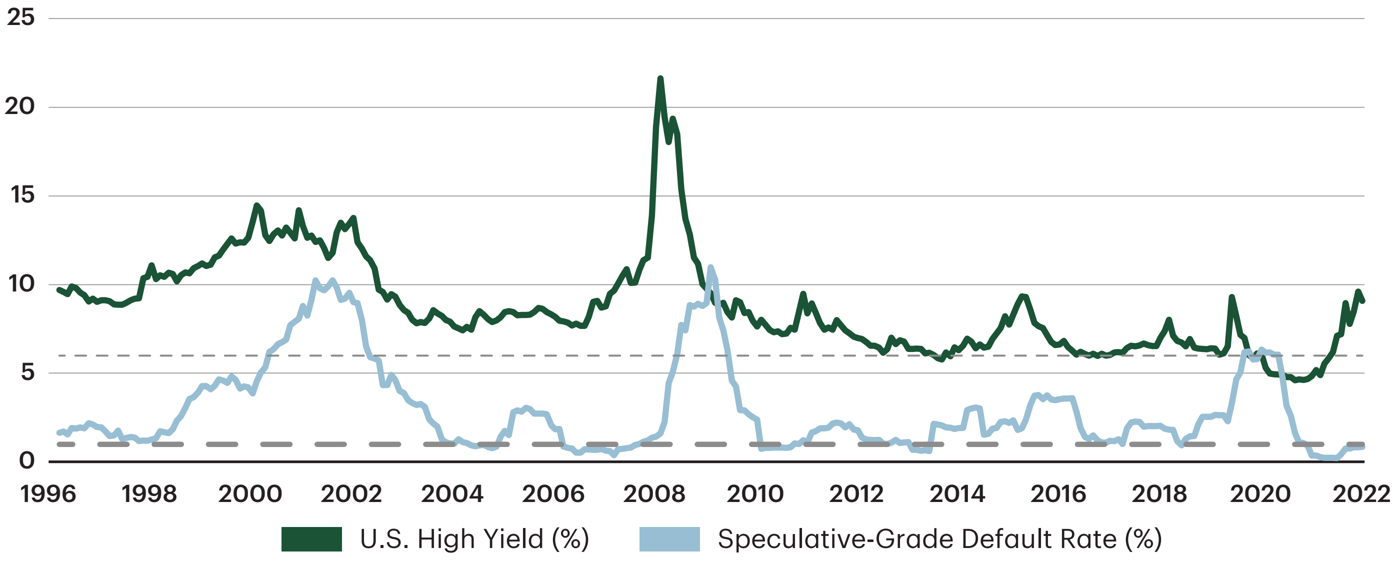
Source: Bloomberg L.P., TDAM. Data from 1989-2022.

We recognize that fixed income instruments with average terms greater or less than a 10-year horizon will be impacted by future movements in interest rates. We leave that forecast and determination to users of the assumptions, who believe modification is prudent.

Incorporating Credit Loss Rates

The yield at purchase is insufficient in forecasting returns if risk of credit loss is significant. High yield bond investors have historically experienced losses because of credit events. To account for this, our methodology applies a market-weighted probability of loss against the beginning yield when calculating expected returns. The expected impact of credit events can be derived through the relationship between historical loss rates of non-investment grade bonds and high yield credit spreads. As depicted in **Figure 6**, when credit spreads move higher, subsequent loss rates tend to move higher as well. For example, loss rates spiked higher in 2009 following the increase in credit spreads of 2008. Considering recent low credit spread levels, TDAM assumes loss rates near the low end of the historical range and applies credit loss rates of between 1-2% for high yield bonds.

Figure 6: Global High Yield vs. Historical Implied Loss Rate



Source: S&P Global Corporate Default Rate. Moody's Unsecured Bond Recovery Rates. Bloomberg Barclays High Yield. Does not account for transitions.

Private Debt and Private Commercial Mortgages

High-quality private debt sectors function in a similar manner to public fixed income, and as a result, the yield is the only factor contributing to expected returns. Due to the limited availability of data on private debt, we rely on information from TDAM's internal strategies. Applying our methodology for fixed income expected returns, the assumed return for private debt and private commercial mortgages reflects the yield of the TD Emerald Private Debt Pooled Fund Trust and the TD Greystone Mortgage Fund. Due to low historical credit loss rates of the strategies, TDAM does not deduct any loss rates from the yield.

Public Equities

All three building blocks are applied to forecasting equity returns as we believe real earnings growth broadly reflects real growth in the economy. Stocks also compensate for inflation through pricing power and provide a dividend yield (**Figure 7**).

Figure 7: Annualized Equity Expected Returns

Asset Class	Growth (%)	Inflation (%)	Yield (%)	Small Cap Premium (%)	Growth Discount (%)	Expected Return (%)
Canadian Equities	1.8	2.3	3.4	–	–	7.4
Canadian Small Cap Equities	1.8	2.3	3.4	1.0	–	8.4
U.S. Equities	1.7	2.2	1.8	–	–	5.8
International Equities	1.4	2.1	3.6	–	–	7.1
Global Equities	1.6	2.2	2.4	–	–	6.2
Global Small Cap Equities	1.6	2.2	2.4	1.0	–	7.2
Low Volatility ACWI Equities	1.8	2.2	2.5	–	0.5	6.0
Emerging Market Equities	3.5	2.4	3.4	–	–	9.4
Chinese Equities	4.6	2.0	2.3	–	–	8.9

Source: IMF, TDAM. As at October 2022.

Users of the capital assumptions may wish to modify the total expected return to account for their view on the growth rates.

Equities

Small Cap vs. Large Cap

TDAM attributes a 1% premium to small cap equities expected return versus their large cap counterparts. The additional 1% is the incremental compensation that investors require for taking on the additional risk that small cap stocks contain versus large cap stocks.

The small cap premium is shown by **Figure 8** where a historical return premium of 0.83% was calculated dating back to 1926 for small cap versus large cap stocks.

Figure 8: Summary Statistics- 1926-2018 (Returns in U.S. dollars)

	Number of periods	Arithmetic Mean (%)
IA SBBI US Small Stock Premium[4]	370 Quarters	0.83

[4] Ibbotson Associates Index that captures the differential return between U.S. large and small cap. Source: TDAM.

We round this premium to 1% and use it for all regions as the U.S. market is considered sufficient representation of the small cap premium due to its depth of history and diversification.

Dividend and Low Volatility Equities

In accordance with the Modigliani-Miller Theorem (1991), investors are indifferent towards returns in the form of capital gains or dividends. Therefore, we do not distinguish between dividend and growth focused strategies in terms of expected returns.

We also apply the market expected return to low volatility equities. We make an adjustment to the Low Volatility ACWI equities expected return to account for a low volatility growth discount observed in the data. Over the past 10 years, the revenue growth of low volatility equities tended to lag GDP growth by 0.5%.

Expected returns may differ by style once accounting for value added potential above benchmarks.

Bottom-up Crosscheck for Equities

The Top-down methodology is our main approach for forecasting return for equities, as it is broadly consistent with the approach taken for other asset classes. But this approach is also very reliant on GDP and Inflation forecasts and some implicit assumptions, e.g. the assumptions that global central banks will eventually rein in inflation. **The other shortcomings of the top-down approach are:**

1. By construction, it ignores impact of the equity valuation even when it is at extreme. Given it is a very long-term return forecast, typically valuation impact would be small when spread across a 10-year time horizon. But when valuation is extreme, it could significantly affect the long-term expected return. A good example is the Dotcom bubble.
2. It fails to address the composition of the market.

A notable trend in the U.S. market in recent years is that a few high-growth companies account for an increasingly larger weight of major indices. Their revenue and earnings trend growth are much higher than nominal GDP growth. If we use macro data for forecasting, it tends to underestimate their growth.

To address these weaknesses, we designed the bottom-up crosscheck as a complement to our top- down approach.

The bottom-up approach takes the following inputs:

1. Analysts' forecast of revenue/earning/cash flow growth for each stock in the index for the next 3 years
2. Median valuation of each stock over the past few years
3. Index weight of each stock
4. Average analyst forecast bias

We assume that at the end of the 3-year time horizon, valuation will revert to historical median. This effectively addresses the valuation weakness in the top-down approach. Then based on 1) and 2), we can calculate an Internal Rate of Return (IRR) for each stock. In calculating the IRR, we noticed that most appropriate valuation measures for stocks across different sectors and growth profiles tend to be very different. For example, Price to Earnings might be more appropriate for traditional mature companies, Price to Sales might be less volatile and more suitable for fast growing software companies, and Price to Funds from Operations might be the favored measure when trading REITs. We take that into account by assigning a reasonable valuation measure for each stock. Further combining with stock's weight in index, we can aggregate the IRRs to the index level for an expected return forecast. Finally, we deduct average analyst forecast bias from this IRR to get an unbiased estimate.

The results of the bottom-up crosscheck are shown in the following table.

Growth

Figure 9

As of October 2022	Ann. Capital IRR (%)	Dividend Yield (%)	Ann. Total Return (%)	Bias Adjustment (%)	Expected Return (%)
Canadian Core	6.3	3.4	9.6	-1.4	8.2
U.S. Core	8.5	1.8	10.3	-1.4	8.9
MSCI Europe	6.1	3.9	10.1	-1.4	8.7
CSI 300	13.0	3.4	16.4	-6.0	10.4

Source: TDAM. As at October 2022.

Note that the bottom-up cross check produces much stronger returns for U.S. and Chinese equities versus the top-down approach. It mainly reflects the fact that the valuations for these two markets have corrected significantly, but the long-term earnings growth is still robust, therefore producing healthy IRRs. The results provide food for thought for practitioners.

Commodities

Exposure to commodities can be achieved through investment in future contracts and the total return from the Commodity Index can be attributed to three sources:

- **Spot return:** attempts to capture the price movements of the value of the commodity as a real asset. It can be further broken down to real spot return and a long-term inflation component.
- **Roll return:** reflects the return from rolling the futures positions to keep exposure as they approach the expiry date.
- **Collateral return:** is meant to capture the return from the yield earned on the collateral while trading commodity futures.

We use the building block approach to calculate the expected return for commodities. For roll and real spot returns we use their long-term historical averages as proxies for future expected returns. We then add on our expectations for long-term cash returns and global inflation to arrive at the commodities total expected return.

Figure 10

Asset Class	Inflation (%)	Roll + Spot (%)	T-Bill (%)	Expected Return (%)
Global Commodities	2.2	0.3	2.5	5.0

Source: Bloomberg LP, TDAM. As at October 2022.

Commodities

Private Real Assets

The expected returns for private real assets are difficult to forecast due to a lack of publicly available data and low beta risk exposure. For this reason, we take asset specific approaches while further validating through our building block approach if necessary.

Canadian Commercial Real Estate

Real Estate provides potential inflation protection and income. Rising inflation may be compensated through CPI[5] linked rental escalation agreements while higher building costs (e.g. labor, materials, etc.) typically demands increased real estate pricing. The expected cash yield for investors is the market capitalization rate[6] less 1%[7] for capital expenditures.

Capital expenditures include replacement components of a building (e.g. roofing, asphalt, elevators, etc.), repairs or expenditures that improve the functionality and/or marketability of the building.

Figure 11

Asset Class	MSCI/REALPAC Canada Annual Property Index Capitalization Rate (%)	Capital Expenditures (%)	Forecasted Canadian CPI (%)	Expected Return (%)
Canadian Real Estate	3.9	-1.0	2.1	5.2

Source: Bloomberg LP, MSCI, TDAM. As at October 2022.

Global Commercial Real Estate

Expected returns for global real estate follow the same approach as Canadian real estate, as depicted in **Figure 12**.

Figure 12

Asset Class	MSCI Global Quarterly Property Fund Index Capitalization (%)	Capital Expenditures (%)	Forecasted Global CPI (%)	Expected Return (%)
Global Real Estate	3.8	-1.0	2.2	5.0

Source: Bloomberg LP, MSCI, TDAM. As at October 2022.

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[5] Consumer Price Index – weighted average of prices for goods and services.

[6] The Net Operating Income (NOI) of the properties over previous year divided by the total market value of the properties.

[7] The 1% capital expenditure was deduced from a sample properties by TDAM where the difference in NOI and Cash Flow from Operations was approximately 1%.

Global Infrastructure

It is difficult to estimate future return expectations for global infrastructure based on financial and economic parameters due to the asset-specific nature of infrastructure investments and the lack of publicly available data.

Fundamentally, global infrastructure may provide real GDP exposure, inflation protection and income. The expected cash yield for Global Infrastructure is the market capitalization rate for listed strategies less 2% capital expenditure. It's a challenge to come up with a precise capital expenditure figure due to the diversity of infrastructure assets. In general, we assume a 1.5% to 3% range for capital expenditure. This represents the rate of investment to keep the asset active for the holding time horizon and we can assume the reinvestment cost is equivalent to the depreciation cost if it maintains value.

A 1% private market premium is added to the listed market yield reflecting higher rates generally available in private deals.

Figure 13 depicts the building block approach and implies an expected annualized return of 7.2%.

Figure 13

Asset Class	MSCI Global Infrastructure Yield (%)	Infrastructure Depreciation (%)	Forecasted Global real GDP (%)	Forecasted Global CPI (%)	Infrastructure Private Market Yield Premium (%)	Expected Return (%)
Infrastructure	4.4	-2.0	1.6	2.2	1.0	7.2

Source: Bloomberg LP, IMF, MSCI, TDAM. As at October 2022.

Expected Risk: Setting Standard Deviation

The TDAM approach uses historical returns dating back to December 31, 1998 for each asset class to set expected standard deviations. For most asset classes, prevailing benchmarks have been sourced.

De-Smoothing Alternative Asset Volatility

Volatility metrics for illiquid assets can be artificially low due to the "smoothing" effect of appraisal- based returns coupled with infrequent trading. This can underestimate the level of asset class risk if not accounted for.

Reported private investment returns differ from those of public financial assets in that they rely on periodic (i.e. quarterly or semi-annual) valuations to measure capital growth and income return. Appraisers often use historical transaction data as an anchor in the valuation appraisal of illiquid assets, which creates an appraisal bias. The appraisal bias couples with the timing of valuations to create an appraisal lag, where valuations, and hence returns, lag the actual state of the market. The combined effects of these elements result in serial correlation and the smoothing of the reported returns, which contributes to reduced volatility and lower correlations with other asset classes. To capture the true risk and return of the underlying illiquid assets, the returns need to be de-smoothed, in essence grossing up volatility.

TDAM first tests for first-order serial correlation and, if significant, applies an autoregressive model to correct for it. This process is outlined for Canadian commercial real estate below.

Real Estate

Utilizing quarterly historical MSCI data to estimate private market real estate volatility could be subject to a smoothing effect within the returns, understating true volatility. To test if the smoothing effect has statistical significance, we examine the first order serial correlation in the return series, measured by the Q-statistic[8] (**Figure 14**). If no serial correlation were present, then the Q-statistic would be zero. Therefore, the higher the Q-statistic, the greater the likelihood that serial correlation is present and producing a smoothing effect that is artificially suppressing risk measurements.

We test the significance of the Q-statistic by calculating the P-Value.[9]

Figure 14: Testing for First Order Serial Correlation in Quarterly Canadian Real Estate Returns, January 1, 1985 – September 30, 2021

Number of lagged quarters	Q-Statistic	P-Value	Significance (at the 5% confidence level; p-value<0.05)
One	34.28	0.00	Yes
Four	142.48	0.00	Yes

Source: Bloomberg LP, MSCI, TDAM. As at September 2021.

For comparison, one quarter lagged Q-Statistic measurements of large cap U.S. equities and Canadian government bonds over the same period and were materially lower at 1.65 and 2.11, respectively with P-values greater than 0.05 (demonstrating no significance).

To de-smooth the return time series, we apply the Fisher-Geltner-Webb methodology and compute the following for each quarterly return:

$$r_t' = \frac{r_t - A_1 r_{t-1}}{1 - A_1}$$

rt' = de-smoothed return observation at time t

rt = return observation at time t

A_1 = regression coefficient

Real Estate

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[8] The Ljung-Box Q Statistic looks at the accumulated autocorrelations within a data series for any time period lag, m. The test statistic is calculated as:

$$Q(m) = n(n+2)\sum \frac{r_j^2}{n-j}$$

where n = number of data points, rj is the autocorrelation of the data series with lag j.

[9] P-Value reflects the probability that the null hypothesis is not true. In this case, the null hypothesis is that "no serial correlation exists". By demonstrating a p-value that is lower than the significance level (5%), we have rejected the null hypothesis and can conclude that serial correlation exists.

The regression coefficient is determined using the slope of MSCI/REALPAC returns versus four quarter lagged MSCI/REALPAC returns. Higher slopes imply higher autocorrelation, resulting in a higher regression coefficient and increased de-smoothed volatility relative to the uncorrected volatility.

The de-smoothed volatility metrics are used in our asset allocation models and are compared to the actual volatility measurements in **Figure 15** below.

Figure 15

Alternatives	Experienced Volatility (%)	De-smoothed Volatility (%)
Canadian Real Estate	3.4	8.2
Global Real Estate	4.4	7.3
Global Infrastructure	4.9	7.6

Source: MSCI/REALPAC Canada Annual Property Index, MSCI Global Annual Property Index, TDAM estimate.
January 1, 1985 – September 30, 2021.

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Correlation

Correlation for public assets is calculated from historical returns of respective market indices for each asset class from December 31, 1998 to September 30, 2022. In order to capture different market regimes, correlation with commodities is derived from series going back further, depending on the data availability. Correlations with private assets are derived from series as far back as we could source.

To correct for appraisal biases within real estate and infrastructure in the correlation matrix, TDAM utilizes de-smoothed returns to calculate the correlation where alternative assets are involved. The table below illustrates cross-asset correlations for commonly used asset classes.

Figure 16

Alternatives	Cmdty	Cash	Cdn FI	Cdn Long Bonds	Cdn Corp Bonds	U.S. FI	Global Bonds	Mtgs	Cdn Equity[10]	U.S. Equity[10]	Intl Equity[10]	Chinese Equity	Low Vol	Private Debt	Cdn Real Estate	Global Real Estate	Global Infra
Global Commodities	1.00																
Cash	0.04	1.00															
Canadian Fixed Income	-0.14	0.16	1.00														
Canadian Long Bonds	-0.14	0.08	0.97	1.00													
Canadian Corporate Bonds	0.00	0.07	0.92	0.90	1.00												
U.S. Fixed Income	-0.13	0.18	0.81	0.77	0.74	1.00											
Global Bonds	-0.11	0.17	0.84	0.80	0.77	0.95	1.00										
Mortgages	-0.01	0.24	0.95	0.84	0.86	0.79	0.81	1.00									
Canadian Equity	0.15	-0.09	0.10	0.16	0.28	0.07	0.04	0.00	1.00								
U.S. Equitiy	-0.02	-0.17	0.13	0.17	0.21	-0.02	0.00	0.04	0.61	1.00							
International Equity	0.06	-0.11	0.18	0.21	0.29	0.06	0.05	0.13	0.66	0.79	1.00						
Chinese Equity	0.08	0.04	0.01	0.02	0.06	-0.02	-0.02	-0.01	0.13	0.14	0.17	1.00					
All Country Low Volatility Equity	0.13	-0.09	0.35	0.38	0.35	0.15	0.20	0.28	0.38	0.75	0.72	0.10	1.00				
Universe Private Debt	0.00	0.08	0.92	0.89	0.96	0.72	0.76	0.86	0.24	0.20	0.27	0.05	0.34	1.00			
Canadian Real Estate	0.12	0.02	-0.12	-0.03	-0.11	-0.15	-0.17	-0.20	0.09	0.08	0.03	-0.01	0.10	-0.09	1.00		
Global Real Estate	0.20	-0.07	-0.22	-0.13	-0.20	-0.20	-0.23	-0.28	0.20	0.18	0.14	0.02	0.19	-0.20	0.71	1.00	
Global Infrastructure	0.04	-0.03	0.01	0.03	0.02	-0.04	-0.04	-0.01	0.02	-0.01	0.04	0.20	0.08	0.01	0.31	0.29	1.00

[10] Unhedged returns in Canadian dollars

Source: FTSE Canada 91 Day T-bill Index, FTSE Canada Universe Bond Index, FTSE Canada Long Term Overall Index, FTSE Canada All Corporate Bond Index, Bloomberg Barclays US Aggregate Index C$, Barclays Global Aggregate Bond Index C$,40% FTSE Canada Mid Term Overall Bond Index + 60% FTSE Short Term Overall Bond Index + 0.5% per annum, S&P/TSX Composite Index, MSCI World C$, S&P 500 C$, MSCI EAFE C$, CSI 300 C$, MSCI ACWI, FTSE Universe Corporate Bond + 110 bps p.a. to Dec 2017; TD Emerald Private Debt Pooled Fund Trust returns thereafter, MSCI/REALPAC Canada Annual Property Index, MSCI Global Annual Property Index, BCOM total return index, TDAM estimate. Practitioners may choose to use their discretion to override certain correlation pairs to better reflect their belief.

Correlation for public assets is calculated from historical monthly returns of respective market indices for each asset class from December 31, 1998 to September 30, 2022. Correlation factors between public and private markets are calculated from historical quarterly returns of respective market indices for each asset class.

The starting date for correlation factors for commodities varies based on the history available for each asset. Refer to the table below for starting dates:

Cash	1972	U.S. Fixed Income	1976	U.S. Equity	1972	Private Debt	1991
Canadian Fixed Income	1980	Global Bonds	1990	International Equity	1972	Canadian Real Estate	1985
Canadian Long Bonds	1972	Mortgages	1998	Chinese Equity	1997	Global Real Estate	1986
Canadian Corporate Bond	1990	Canadian Equity	1972	Low Volatility	1994	Global Infrastructure	1995

Appendix

Table A1 contains TDAM's long-term asset class assumptions and corresponding historical volatility using our building block approach.

Table A1: Expected Return and Expected Volatility Assumptions

Fixed Income

Asset Class	Risk Proxies	Assumed 7-10 Yr. Annual Expected Return (%)[11]	Historic Volatility (%)[12]
Canadian Money Market	FTSE Canada 91 Day T-bill Index	2.2	0.5
Canadian Short-Term Bonds	FTSE Canada Short Term Overall Bond Index	4.2	2.0
Canadian Real Return Bond	FTSE Canada Real Return Bond Index	4.0	7.3
Canadian Government Bonds	FTSE Canada All Government Bond Index	3.9	4.4
Canadian Long Government Bonds	FTSE Canada Long Term Government Bond Index	4.3	8.0
Canadian Universe Bonds	FTSE Canada Universe Bond Index	4.2	4.1
Canadian Long Bonds	FTSE Canada Long Term Overall Bond Index	4.5	7.7
Canadian Corporate Bonds	FTSE Canada All Corporate Bond Index	5.3	3.9
Global Bonds	Barclays Global Aggregate Index	3.7	3.1
High Yield	50% ML US HY Master II Trust Hedge to CAD + 50% ML CAD and USD HY Canadian Issuers	6.8	9.5
U.S. Fixed Income	Bloomberg Barclays US Aggregate Index	4.8	3.8
U.S. Treasury Bonds	Bloomberg US Treasury Index	4.2	4.5
U.S. Corporate Bonds	Bloomberg Barclays US Corporate Bond Index	5.9	5.9

Equities[13]

Asset Class	Risk Proxies	Assumed 7-10 Yr. Annual Expected Return (%)[11]	Historic Volatility (%)[12]
Canadian Equities	S&P/TSX Composite	7.4	14.1
Canadian Dividend	MSCI Canada High Dividend Yield	7.4	12.5
Canadian Small Cap	NBSC Price Return to May 1999; S&P TSX Small Cap thereafter	8.4	19.2
Canadian Low-Volatility	S&P/TSX Composite Low Volatility	7.4	9.8

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[11] No assurance that expected returns will be achieved.

[12] Historical volatility is calculated using respective benchmarks. From December 1998 until September 2022.

[13] Unhedged returns in Canadian Dollars.

Asset Class	Risk Proxies	Assumed 7-10 Yr. Annual Expected Return (%)[11]	Historic Volatility (%)[12]
U.S. Equities	S&P 500	5.8	12.6
U.S. Dividend	MSCI USA High Dividend Yield	5.8	12.0
International Equities	MSCI EAFE	7.1	12.8
International Dividend	MSCI EAFE High Dividend Yield	7.1	13.4
Global Equities	MSCI World	6.2	12.2
Global Dividend	MSCI World High Dividend Yield	6.2	11.4
Global Small Cap	MSCI World Small Cap	7.2	14.5
Chinese Equities	CSI 300	8.9	24.8
Emerging Market Equities	MSCI Emerging Markets	9.4	17.1
All Country Low Volatility Equities	MSCI ACWI	6.0	8.8

Alternatives

Asset Class	Risk Proxies	Assumed 7-10 Yr. Annual Expected Return (%)[11]	Historic Volatility (%)[12]
Private Commercial Mortgages[14]	40% FTSE Canada Mid Term Overall Bond Index + 60% FTSE Short Term Overall Bond Index + 0.5% per annum	5.0	2.9
Private Debt[14]	FTSE Universe Corporate Bond + 110 bps p.a. to Dec 2017; TD Emerald Private Debt Pooled Fund Trust returns thereafter	5.9	4.2
Long Private Debt	FTSE Long Corporate Bond + 80 bps p.a. to Dec 2017; TD Emerald Long Private Debt Pooled Fund Trust returns thereafter	5.9	10.3
Canadian Real Estate	MSCI/REALPAC Canada Annual Property Index	5.2	8.5
Global Real Estate[15]	MSCI Global Annual Property Index	5.0	6.9
Global Infrastructure[15]	TD Asset Management Estimate	7.2	7.1
Global Commodities[15,16]	BCOM Total Return Index	5.0	16.0

[14] The TD Greystone Mortgage Fund is composed of 40-80% conventional mortgages and 20-60% of conventional plus mortgages. For Private Debt, strategies that utilize non-Canadian opportunity sets may be more accurately reflected through foreign credit proxies.

[15] Please note that the experienced volatility was 3.4%, 4.3%, and 5.0% for Real Estate, Global Real Estate, and Infrastructure. Infrequently measured assets like Real Estate and Infrastructure exhibit significant serial correlation and failure to correct can grossly understate actual volatility for their asset classes. For this reason, we have de-smoothed the return stream of Real Estate and Infrastructure and the results of our analysis reflect this de-smoothing approach.

[16] Commodity's volatility is calculated based on data from December 1972.

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We utilize a de-smoothing technique on the historical quarterly returns of real estate and infrastructure. Correlations: For public asset classes, correlation factors are calculated from the monthly return experience of respective market indices from Dec 31, 1998 to Sep 30, 2022. Correlation factors that involve Canadian Real Estate, Global Real Estate or Global Infrastructure are calculated using quarterly de-smoothed return data to Sep 30, 2022. Indices & Benchmarks: Index returns include reinvestment of dividends, if applicable, but not the deduction of any fees or expenses, which would reduce returns. Indexes used in TDAM reporting are copyrighted by and used with the permission of their respective providers. Index use will vary by TDAM client and not all indexes or index providers may be cited in this report. 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