



PORTFOLIO CONSTRUCTION USING CANADIAN FARMLAND ALLOCATIONS

ABSTRACT:

A review of the Canadian farmland market over the last 30 years reveals: a farmland holding would have improved the financial performance of typical investor portfolios; a realized volatility that was lower than stocks; a realized return that was greater than bonds; a low correlation to traditional financial asset returns; and domestic institutional investors are under-invested relative to efficient frontier analysis.

KEYWORDS:

Farmland, equities, bonds, efficient investment, investment portfolio, portfolio performance, pension plan, institutional investment, commercial real estate

INTRODUCTION:

In the current zero interest rate policy "ZIRP" environment, institutional investors are increasingly looking to less traditional asset classes to generate returns. One such asset class that has been the beneficiary of this push into alternatives in the last decade is farmland. We believe this is warranted as our research supports the conclusion that farmland investments materially improve portfolio performance and institutional investors are under-invested in this asset class relative to other portfolio allocations. The following is a survey of abstracts from relevant research papers in the area:

Lins, Kowalski, and Hoffman (1992) Abstract:

Farmland equates to approximately 5% of the market capital of assets in the United States but is a de minimis allocation in institutional portfolios. The financial performance of U.S. portfolios that included U.S. stocks, bonds, and commercial real estate, could be improved by adding U.S. farmland.

Shiha and Chavas (1995) Abstract:

"In this paper we present and test a segmented capital market equilibrium. We extend the traditional CAPM by explicitly considering barriers to the flow of external equity capital into farm real estate markets. The empirical results provide a plausible explanation as to why the traditional arbitrage-based pricing models fail to explain equity pricing in farmland markets."

Lence and Miller (1999) Abstract:

"The present study investigates whether the farmland 'constant-discount-rate present-value-model (CDR-PVM) puzzle' is due to transaction costs. The theoretical implications of transaction costs for the CDR-PVM of farmland are discussed, and two bootstrap tests of such implications are introduced and applied to Iowa farmland prices and rents. Empirical results regarding the validity of the CDR-PVM in the presence of typical transaction costs are ambiguous. Econometric tests indicate that the CDR-PVM is consistent with typical transaction costs assuming a one-period holding horizon, but not when an infinite-holding horizon is hypothesized."

Painter (2002) Abstract:

"Farmland has been a good investment over the past 30 years, as part of an internationally diversified medium-risk portfolio. For average or medium levels of risk, farmland can enhance the financial performance of an investment portfolio. Investors who choose to maintain a low-risk portfolio will not include farmland and, similarly, the gains at the high-risk level are also very minimal. The financial gains from farmland are a result of its negatively correlated returns with other equity markets. When added to an equity portfolio, the risk is reduced while maintaining the same rate of return on investment. This is especially true of the medium-risk portfolios. Farmland investment has associated problems including illiquidity, poor marketability and asset lumpiness. A potential solution to these problems is to allow the organization of a Saskatchewan (or Canadian) farmland mutual fund."

Painter (2010) Abstract:

"This study shows that for the period 1990-2007, international portfolio investment performance was significantly improved with the addition of Canadian farmland. Farmland in Canada is considered relatively low risk, enters the efficient portfolios at low risk levels and adds the most financial improvement to low and medium risk portfolios. Compared with T-bills and long bonds, farmland has higher risk and yield, but lower risk than stocks. Compared with stocks, farmland has income yields and risk that are similar to or better than dividend yields and risk on stocks while farmland has capital gain yields and risk that are usually lower, on average, than stocks. The low and negative correlation of farmland yields with stocks and bonds make it a good candidate for portfolio diversification benefits."

Painter (2015) Abstract:

In recent years, as North American farmland prices have continued to rise, a number of North American public farmland investment trusts have been formed to offer investors a liquid and marketable farmland investment vehicle. How risky are these farmland REITs?

This paper compares the investment risk with other popular investment options such as bonds, stocks, gold, oil and real estate using several well-known and accepted methods of risk analysis, including overall yield variance, CAPM, Value at Risk (VAR), and Drawdown. North American Farmland REIT has less risk than gold, oil, REITs and stock markets.

DISCUSSION OF RESULTS:

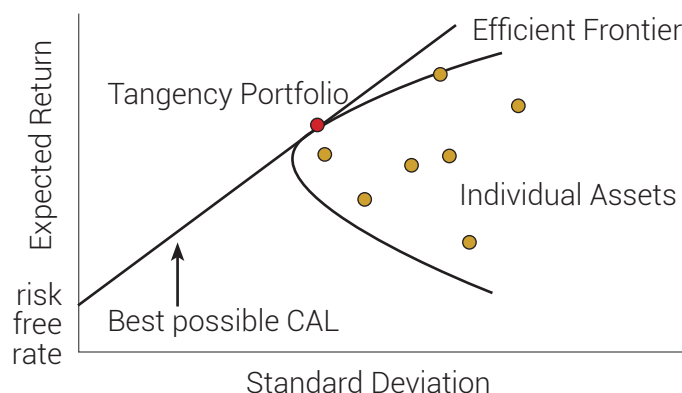
This paper analyzes the efficient frontier effects of the addition of farmland to the three portfolio configurations over multiple time series. In summary farmland consistently demonstrates:

1. Competitive returns: Canadian farmland investments generated an average return of 14.8% from 2012 to 2016 and 12.4% in the last 10 years (2007 – 2016). This is higher than the five-year average return of 14.0% and the 10-year average return of 7.8% for the S&P 500 index. Based on the Sharpe ratio, farmland investments have given a superior return for the same amount of risk compared to most asset classes.
2. Portfolio diversification: Farmland as an asset class has had low/negative correlation with other investment classes, which provides diversification benefits to its investors.
3. Inflation hedging: Farmland returns demonstrate a positive correlation with inflation, making farmland an effective tool for hedging this risk (farmland, which produces food, has inelastic demand and can produce better returns during inflationary periods). During periods of very high inflation Veripath believes this hedging quality to be even more pronounced. In the 1970s, western Canadian farmland increased from around \$100/acre to over \$500/acre in a decade - significantly outperforming equities.
4. Generation of income: Farmland investments help in generating income for investors either from rental payments (collected from lease-

hold farmers), or as a percentage of harvest revenue as a part of a crop sharing arrangement, which is basically a joint-venture between the landowner and the farm operator. Farmland enjoys almost 100% tenant occupancy rates as rental demand is consistently high, ensuring that farmland investment incomes tendency to remain stable irrespective of most market conditions, further reducing return volatility within a diversified investment portfolio.

From the period data, we generated efficient frontiers adding a 50/50 allocation of Alberta and Saskatchewan farmland.

"The efficient frontier (or portfolio frontier) is a concept in modern portfolio theory introduced by Harry Markowitz in 1952. It refers to investment portfolios which occupy the 'efficient' parts of the risk-return spectrum. Formally, it is the set of portfolios which satisfy the condition that no other portfolio exists with a higher expected return but with the same standard deviation of return. A combination of assets, i.e. a portfolio, is referred to as "efficient" if it has the best possible expected level of return for its level of risk (which is represented by the standard deviation of the portfolio's return). Here, every possible combination of risky assets can be plotted in risk-expected return space, and the collection of all such possible portfolios defines a region in this space. In the absence of the opportunity to hold a risk-free asset, this region is the opportunity set (the feasible



set). The positively sloped (upward-sloped) top boundary of this region is a portion of a parabola and is called the "efficient frontier."

If a risk-free asset is also available, the opportunity set is larger, and its upper boundary, the efficient frontier, is a straight-line segment emanating from the vertical axis at the value of the risk-free asset's return and tangent to the risky-assets-only opportunity set. All portfolios between the risk-free asset and the tangency portfolio are portfolios composed of risk-free assets and the tangency portfolio, while all portfolios on the linear frontier above and to the right of the tangency portfolio

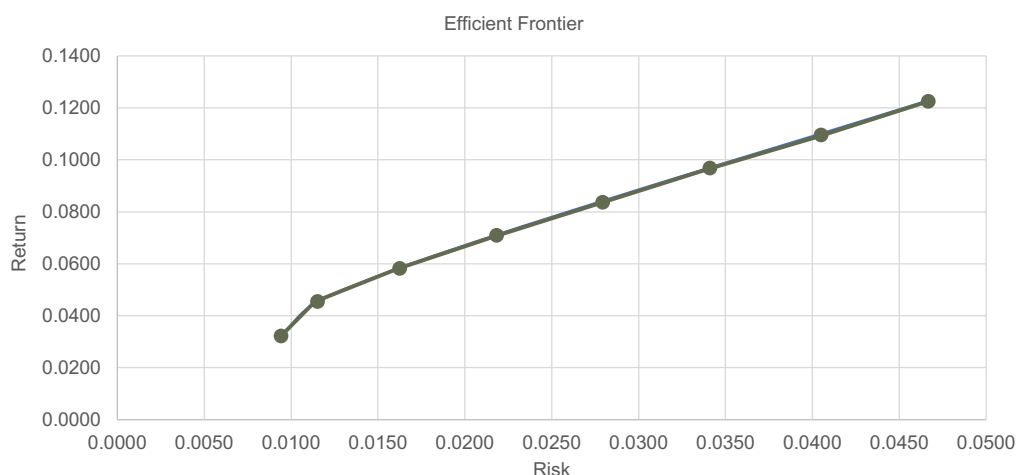
are generated by borrowing at the risk-free rate and investing the proceeds into the tangency portfolio." Source Wikipedia

The time series we utilized are 32, 30, 20 and 10 years. We measured multiple periods with a view to exposing potential shifts in risk/return profiles over time. We used three portfolio configurations to represent distinct investor risk profiles, with "Medium" risk being a typical 40/60 bond/public equity allocation:

- Low Risk – 100% bonds
- Medium Risk – 40/60 bonds/listed equities
- High Risk – 100% listed equities

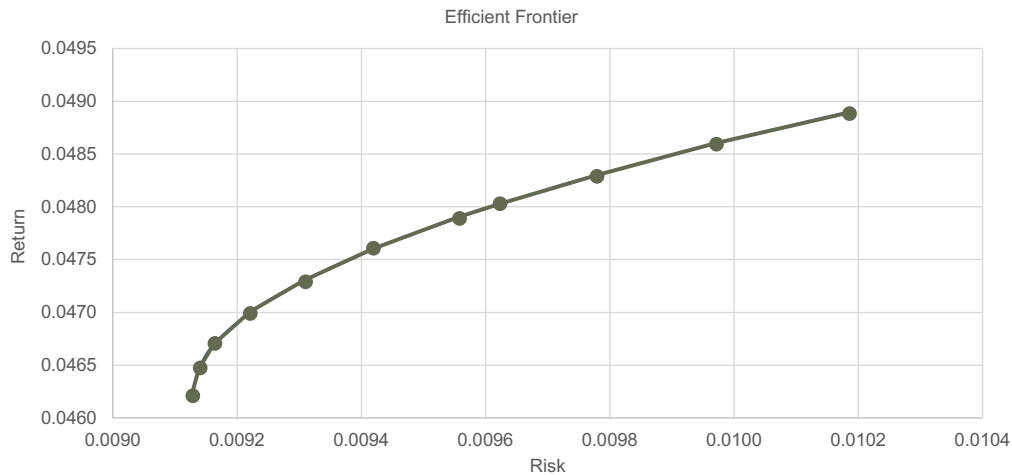
SOURCE DATA AND ANALYSIS:

1. Efficient Frontiers for Low Risk Portfolio – 100% Bonds – with allocation of 50/50 Alberta and Saskatchewan Farmland: 10-Yrs (2007-2016)



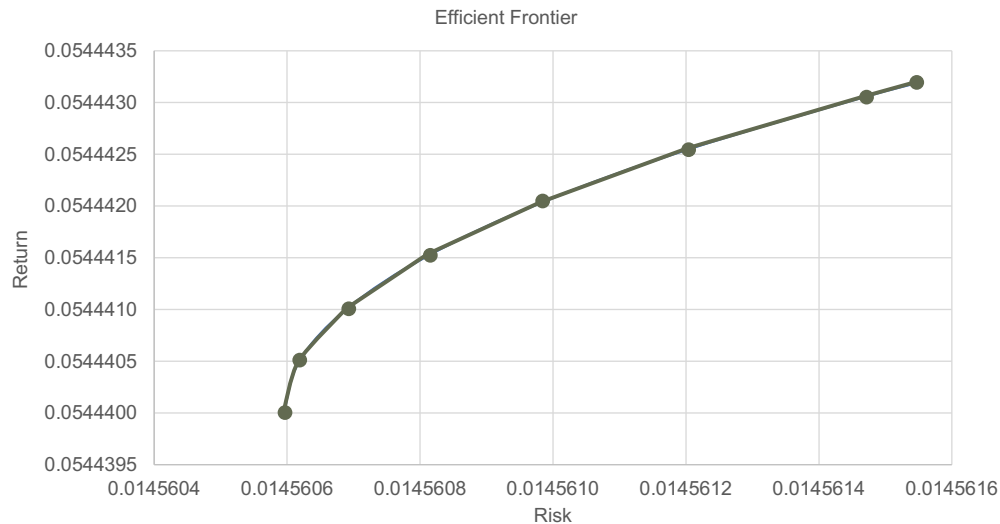
	Min. Risk							Max. Sharpe			
Mean	0.0322	0.0451	0.0581	0.0710	0.0840	0.0969	0.1099	0.12285	0.1228	0.1228	0.1228
St. Dev.	0.0094	0.0115	0.0161	0.0218	0.0278	0.0341	0.0404	0.0467	0.0467	0.0467	0.0467
Sharpe	0.2298	1.3160	1.7421	1.8864	1.9431	1.9687	1.9815	1.9882	1.9882	1.9882	1.9882
F	0.06	0.20	0.33	0.47	0.60	0.73	0.87	1.00	1.00	1.00	1.00
P	0.94	0.80	0.67	0.53	0.40	0.27	0.13	0.00	0.00	0.00	0.00

Efficient Frontiers for Low Risk Portfolio – 100% Bonds – with allocation of 50/50 Alberta and Saskatchewan Farmland: 20-Yrs (1997-2016)



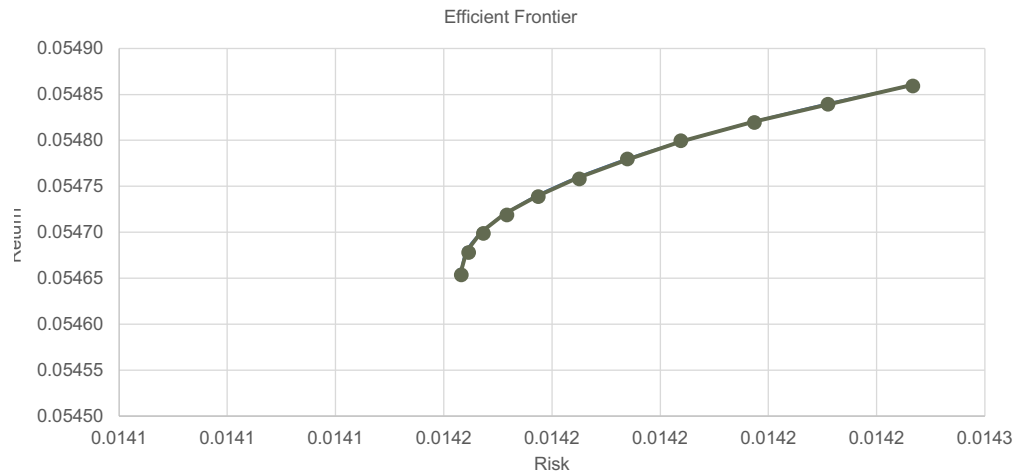
	Min. Risk							Max. Sharpe			
Mean	0.0462	0.0465	0.0467	0.0470	0.0473	0.0476	0.0479	0.04803	0.0483	0.0486	0.0489
St. Dev.	0.0091	0.0091	0.0092	0.0092	0.0093	0.0094	0.0096	0.0096	0.0098	0.0100	0.0102
Sharpe	1.7769	1.8053	1.8225	1.8434	1.8587	1.8684	1.8729	1.8734	1.8715	1.8655	1.8557
F	0.18	0.19	0.19	0.20	0.21	0.21	0.22	0.23	0.23	0.24	0.25
P	0.82	0.81	0.81	0.80	0.79	0.79	0.78	0.77	0.77	0.76	0.75

Efficient Frontiers for Low Risk Portfolio – 100% Bonds – with allocation of 50/50 Alberta and Saskatchewan Farmland: 30-Yrs (1987-2016)



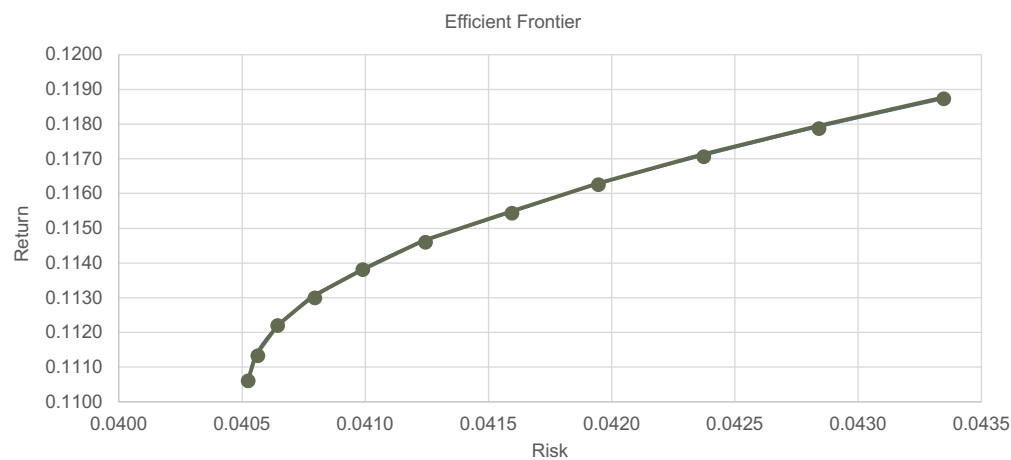
	Min. Risk							Max. Sharpe		
Mean	0.0544400	0.0544405	0.0544410	0.0544415	0.0544420	0.0544425	0.0544431	0.0544432	0.0544399	0.0544404
St. Dev.	0.0145606	0.0145606	0.0145607	0.0145608	0.0145610	0.0145612	0.0145615	0.0145615	0.0145606	0.0145606
Sharpe	1.678502	1.678535	1.678561	1.678582	1.678598	1.678608	1.678612	1.678612	1.678499	1.678531
F	0.232732	0.232453	0.232174	0.231896	0.231617	0.231338	0.231059	0.230988	0.232762	0.232483
P	0.767268	0.767547	0.767826	0.768104	0.768383	0.768662	0.768941	0.769012	0.767238	0.767517

Efficient Frontiers for Low Risk Portfolio – 100% Bonds – with allocation of 50/50 Alberta and Saskatchewan Farmland: 32-Yrs (1985-2016)



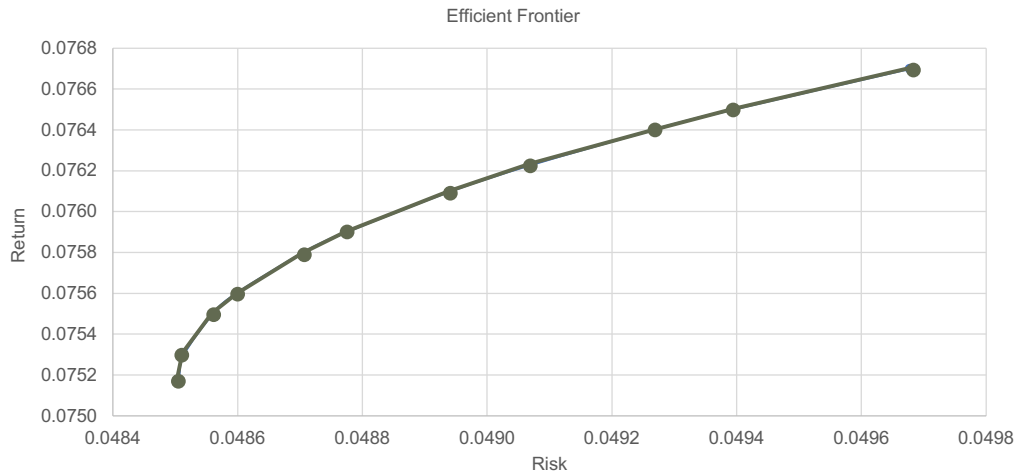
	Min. Risk							Max. Sharpe			
Mean	0.05466	0.05468	0.05470	0.05472	0.05474	0.05476	0.05478	0.05480	0.05482	0.05484	0.05486
St. Dev.	0.0142	0.0142	0.0142	0.0142	0.0142	0.0142	0.0142	0.0142	0.0142	0.0142	0.0142
Sharpe	1.7409	1.7424	1.7435	1.7444	1.7450	1.7455	1.7458	1.7459	1.7458	1.7455	1.7450
F	0.24	0.24	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.22	0.22
P	0.76	0.76	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.78	0.78

2. Efficient Frontiers for Medium Risk Portfolio – 60/40 Equities and Bonds – with added allocation of 50/50 Alberta and Saskatchewan Farmland: 10-Yrs (2007-2016)



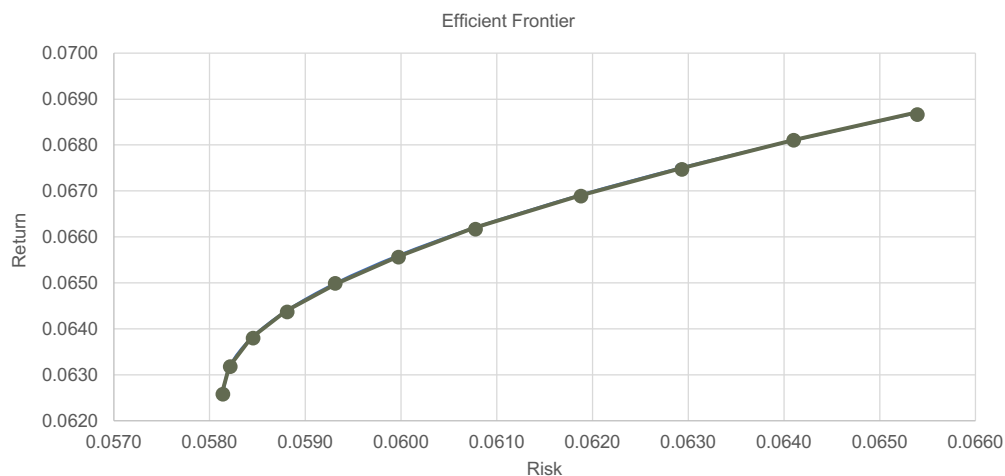
	Min. Risk							Max. Sharpe			
Mean	0.1105	0.1114	0.1122	0.1130	0.1138	0.1146	0.1155	0.11628	0.1171	0.1179	0.1187
St. Dev.	0.0405	0.0406	0.0406	0.0408	0.0410	0.0412	0.0416	0.0419	0.0424	0.0428	0.0433
Sharpe	1.9875	2.0071	2.0224	2.0349	2.0445	2.0514	2.0558	2.0570	2.0557	2.0521	2.0463
F	0.81	0.83	0.84	0.85	0.86	0.87	0.89	0.90	0.91	0.92	0.94
P	0.19	0.17	0.16	0.15	0.14	0.13	0.11	0.10	0.09	0.08	0.06

Efficient Frontiers for Medium Risk Portfolio – 60/40 Equities and Bonds – with added allocation of 50/50 Alberta and Saskatchewan Farmland: 20-Yrs (1997-2016)



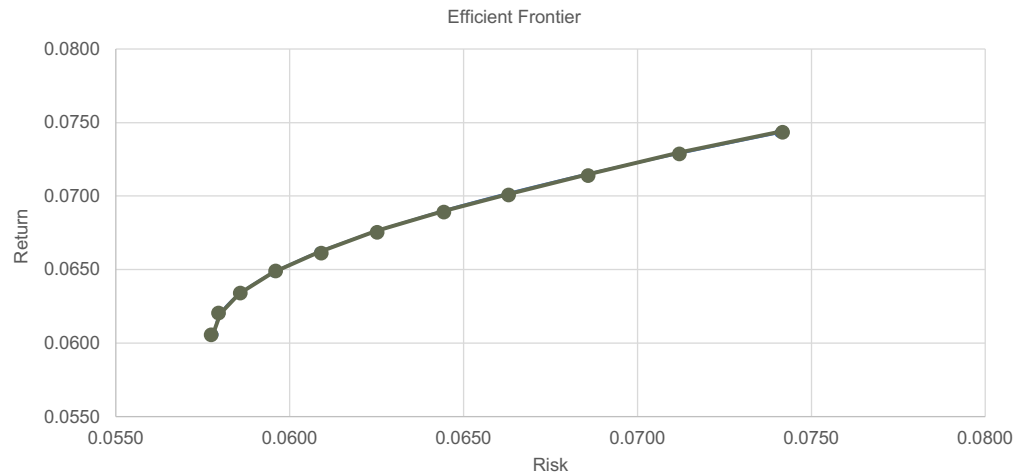
	Min. Risk							Max. Sharpe			
Mean	0.0752	0.0753	0.0755	0.0756	0.0758	0.0759	0.0761	0.07623	0.0764	0.0765	0.0767
St. Dev.	0.0485	0.0485	0.0486	0.0486	0.0487	0.0488	0.0489	0.0491	0.0493	0.0494	0.0497
Sharpe	0.9312	0.9338	0.9370	0.9383	0.9403	0.9411	0.9419	0.9421	0.9418	0.9414	0.9401
F	0.76	0.77	0.78	0.79	0.80	0.81	0.82	0.82	0.83	0.84	0.85
P	0.24	0.23	0.22	0.21	0.20	0.19	0.18	0.18	0.17	0.16	0.15

Efficient Frontiers for Medium Risk Portfolio – 60/40 Equities and Bonds – with added allocation of 50/50 Alberta and Saskatchewan Farmland: 30-Yrs (1987-2016)



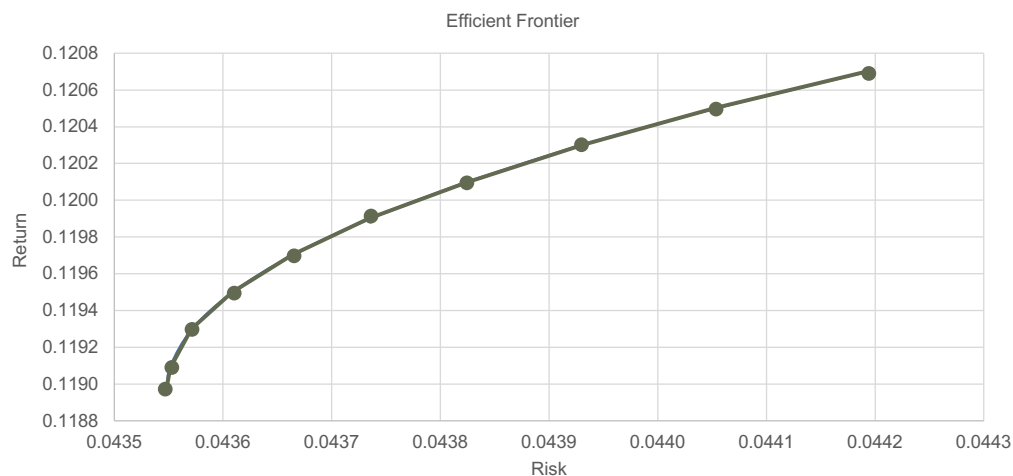
	Min. Risk							Max. Sharpe			
Mean	0.0626	0.0632	0.0638	0.0644	0.0650	0.0656	0.0662	0.06691	0.0675	0.0681	0.0687
St. Dev.	0.0581	0.0582	0.0584	0.0588	0.0593	0.0600	0.0608	0.0619	0.0629	0.0641	0.0654
Sharpe	0.5607	0.5703	0.5784	0.5850	0.5900	0.5936	0.5958	0.5966	0.5961	0.5944	0.5919
F	0.63	0.61	0.59	0.56	0.54	0.52	0.50	0.47	0.45	0.42	0.40
P	0.37	0.39	0.41	0.44	0.46	0.48	0.50	0.53	0.55	0.58	0.60

Efficient Frontiers for Medium Risk Portfolio – 60/40 Equities and Bonds – with added allocation of 50/50 Alberta and Saskatchewan Farmland: 32-Yrs (1985-2016)



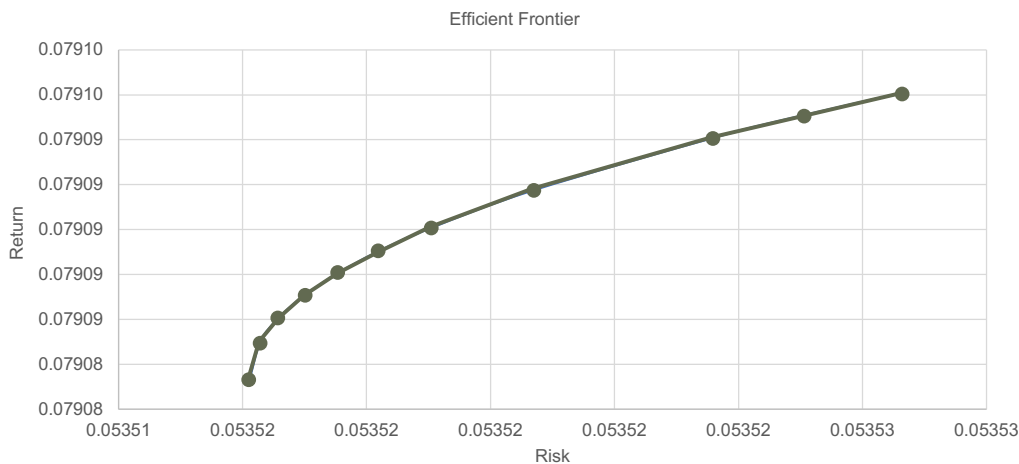
	Min. Risk							Max. Sharpe			
Mean	0.0606	0.0620	0.0634	0.0648	0.0662	0.0676	0.0690	0.07017	0.0715	0.0729	0.0743
St. Dev.	0.0578	0.0580	0.0586	0.0595	0.0608	0.0625	0.0644	0.0663	0.0686	0.0712	0.0741
Sharpe	0.5291	0.5516	0.5701	0.5845	0.5950	0.6018	0.6054	0.6063	0.6053	0.6024	0.5981
F	0.59	0.56	0.52	0.49	0.45	0.42	0.38	0.36	0.32	0.29	0.25
P	0.41	0.44	0.48	0.51	0.55	0.58	0.62	0.64	0.68	0.71	0.75

3. Efficient Frontiers for High Risk Portfolio – 100% Equities – with added allocation of 50/50 Alberta and Saskatchewan Farmland: 10-Yrs (2007-2016)

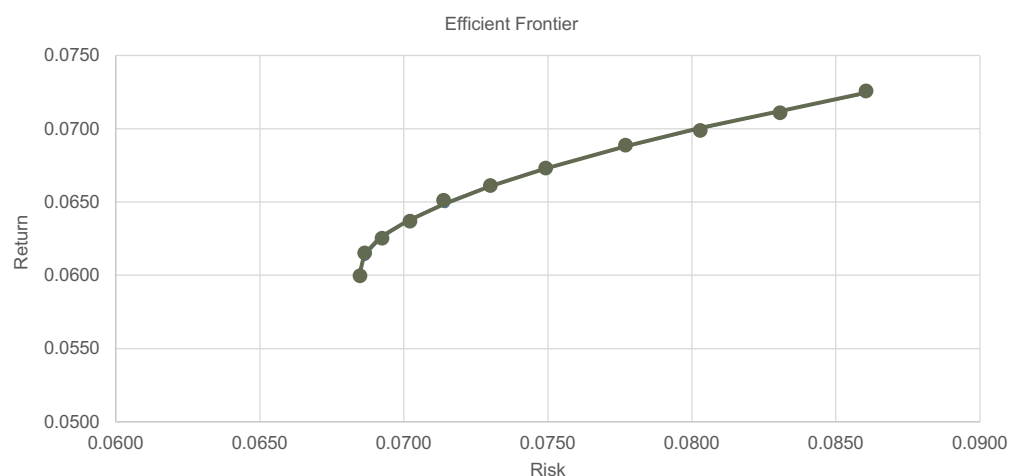


	Min. Risk							Max. Sharpe			
Mean	0.1190	0.1191	0.1193	0.1195	0.1197	0.1199	0.1201	0.12010	0.1203	0.1205	0.1207
St. Dev.	0.0435	0.0436	0.0436	0.0436	0.0437	0.0437	0.0438	0.0438	0.0439	0.0441	0.0442
Sharpe	2.0430	2.0458	2.0495	2.0523	2.0543	2.0555	2.0559	2.0559	2.0555	2.0543	2.0524
F	0.91	0.92	0.92	0.93	0.93	0.93	0.94	0.94	0.94	0.95	0.95
P	0.09	0.08	0.08	0.07	0.07	0.07	0.06	0.06	0.06	0.05	0.05

Efficient Frontiers for High Risk Portfolio – 100% Equities – with added allocation of 50/50 Alberta and Saskatchewan Farmland: 20-Yrs (1997-2016)

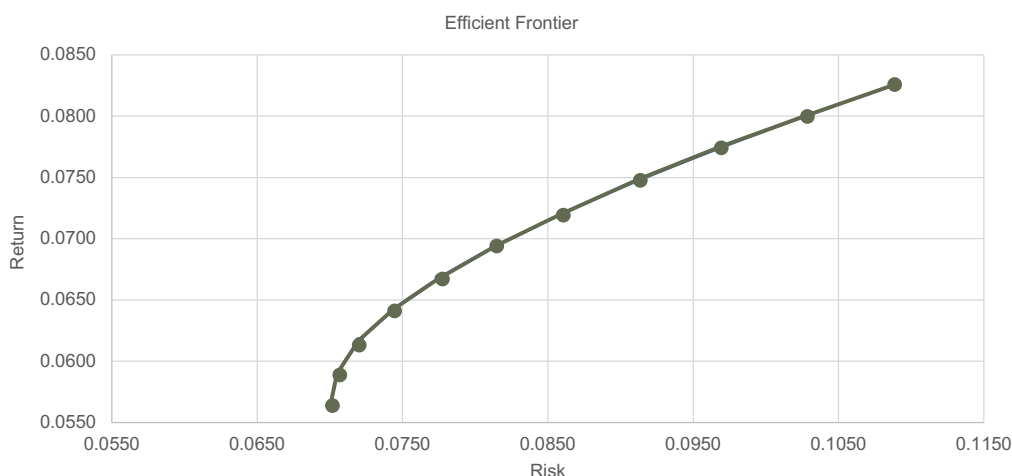
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Efficient Frontiers for High Risk Portfolio – 100% Equities – with added allocation of 50/50 Alberta and Saskatchewan Farmland: 30-Yrs (1987-2016)



	Min. Risk							Max. Sharpe			
Mean	0.0601	0.0613	0.0625	0.0637	0.0649	0.0661	0.0673	0.06880	0.0700	0.0712	0.0724
St. Dev.	0.0685	0.0687	0.0692	0.0701	0.0714	0.0730	0.0749	0.0777	0.0803	0.0830	0.0860
Sharpe	0.4395	0.4559	0.4695	0.4804	0.4886	0.4943	0.4977	0.4991	0.4983	0.4962	0.4930
F	0.83	0.80	0.78	0.75	0.72	0.69	0.66	0.63	0.60	0.57	0.54
P	0.17	0.20	0.22	0.25	0.28	0.31	0.34	0.37	0.40	0.43	0.46

Efficient Frontiers for High Risk Portfolio – 100% Equities – with added allocation of 50/50 Alberta and Saskatchewan Farmland: 32-Yrs (1985-2016)



	Min. Risk							Max. Sharpe			
Mean	0.0564	0.0590	0.0616	0.0642	0.0668	0.0694	0.0720	0.07480	0.0774	0.0800	0.0826
St. Dev.	0.0701	0.0706	0.0720	0.0744	0.0775	0.0814	0.0859	0.0914	0.0969	0.1027	0.1089
Sharpe	0.3761	0.4109	0.4387	0.4599	0.4746	0.4840	0.4889	0.4904	0.4894	0.4867	0.4829
F	0.79	0.75	0.70	0.66	0.61	0.57	0.52	0.47	0.43	0.38	0.34
P	0.21	0.25	0.30	0.34	0.39	0.43	0.48	0.53	0.57	0.62	0.66

CONCLUSIONS:

Canadian farmland has been a good investment over multiple time periods both short and long term. For a medium risk portfolio represented by equity/bond holdings of 60/40 weighting, farmland enhanced financial performance and a material allocation is supportable.

NOTES:

The data used to derive the data series in this paper come from multiple sources listed below:

Farmland price change	Farm Credit Canada
CPI	StatsCan
Oil	http://www.macrotrends.net/1369/crude-oil-price-history-chart
Natgas	https://www.eia.gov/dnav/ng/hist/n9190us3a.htm
Gold	http://onlygold.com/Info/Historical-Gold-Prices.asp
GDP	https://tradingeconomics.com/canada/gdp
Residential properties	https://tradingeconomics.com/canada/housing-index
Bond - 10yr sovereign	https://tradingeconomics.com/canada/government-bond-yield
exchange rate	https://tradingeconomics.com/canada/currency
S&P 500	http://finance.yahoo.com/echarts?s=%5Egspc+interactive

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SOURCE DATA:

	Canada	BC	AB	SK	MB	ON	QC	NB	NS	PEI	NL	CPI	Oil	Natgas	Gold	GDP	Resident	Bond	S&P
1985	-8.8%	-13.7%	-8.3%	-10.3%	-7.3%	-9.4%	-1.0%	1.0%	-4.3%	-11.4%	0.0%	4.0%	3.4%	-5.6%	6.2%	2.8%	0.0%	11.0%	26.3%
1986	-6.9%	-6.6%	-8.2%	-8.3%	-4.9%	-4.8%	1.4%	-2.1%	1.7%	-7.9%	0.0%	4.1%	-32.8%	-22.7%	19.9%	3.3%	5.3%	9.7%	14.7%
1987	-10.2%	-11.3%	-7.4%	-15.3%	-6.8%	-3.9%	0.2%	0.6%	2.1%	-7.9%	0.0%	4.4%	-12.2%	-13.9%	24.9%	14.3%	12.9%	8.8%	2.1%
1988	-7.3%	-1.3%	-8.2%	-10.6%	-11.3%	11.4%	1.0%	-0.1%	2.6%	1.0%	0.0%	3.9%	-2.8%	1.2%	-15.7%	17.6%	8.9%	10.0%	12.1%
1989	4.9%	3.8%	5.7%	0.4%	6.1%	23.8%	4.3%	1.8%	13.1%	6.4%	0.0%	5.1%	20.0%	0.0%	-2.2%	11.4%	16.3%	10.0%	27.4%
1990	-2.7%	3.0%	-1.1%	-6.9%	3.9%	0.8%	4.1%	5.9%	1.3%	0.0%	0.0%	4.6%	-4.8%	1.2%	-3.7%	5.0%	8.8%	9.9%	-2.9%
1991	-5.4%	3.6%	-4.6%	-9.1%	-2.8%	1.1%	2.7%	3.8%	-1.3%	0.0%	6.1%	5.6%	-15.0%	-4.1%	-8.6%	2.9%	-9.7%	9.9%	21.2%
1992	-2.1%	7.9%	-3.2%	-3.8%	2.4%	0.6%	1.2%	0.0%	0.0%	5.2%	-2.0%	1.4%	0.0%	6.1%	-5.7%	-3.0%	-0.4%	8.4%	5.3%
1993	2.0%	14.7%	1.9%	1.6%	2.6%	1.0%	2.9%	0.0%	0.0%	0.0%	-2.0%	1.9%	-32.4%	17.2%	17.6%	-2.9%	0.7%	8.0%	9.8%
1994	8.9%	10.3%	10.1%	9.9%	5.1%	3.4%	6.0%	3.6%	0.0%	21.3%	0.0%	0.1%	26.1%	-9.3%	-1.2%	0.9%	1.4%	6.9%	-9.8%
1995	10.0%	13.6%	9.6%	11.9%	5.6%	6.9%	9.8%	24.1%	8.9%	8.9%	0.0%	2.2%	6.9%	-16.2%	1.0%	4.9%	-0.4%	9.0%	35.3%
1996	11.3%	9.8%	9.9%	11.0%	10.9%	12.9%	23.7%	16.3%	4.0%	0.0%	0.0%	1.9%	29.0%	40.0%	-4.7%	4.1%	-2.3%	7.0%	23.6%
1997	8.0%	10.9%	7.8%	5.9%	11.7%	12.3%	10.9%	7.3%	6.9%	5.8%	2.6%	1.7%	-35.0%	6.9%	-22.2%	3.8%	-0.9%	6.0%	24.7%
1998	2.7%	-5.3%	5.1%	0.9%	3.4%	4.7%	9.2%	6.7%	0.8%	3.9%	1.7%	1.0%	-30.8%	-15.9%	0.6%	-3.2%	1.8%	5.9%	30.6%
1999	0.2%	0.4%	5.7%	-4.8%	0.7%	2.1%	12.9%	15.4%	5.7%	10.4%	2.3%	1.8%	105.6%	11.7%	0.9%	7.0%	0.9%	5.0%	8.9%
2000	1.9%	4.4%	4.3%	-2.2%	0.6%	8.9%	11.6%	8.9%	2.9%	2.7%	3.6%	2.7%	8.1%	68.0%	-6.1%	9.8%	0.9%	6.2%	-2.0%
2001	1.4%	0.9%	4.2%	-1.9%	0.3%	4.8%	10.0%	1.0%	2.1%	0.8%	2.3%	2.9%	-30.0%	8.7%	1.4%	-0.8%	3.9%	5.3%	-17.3%
2002	5.3%	4.6%	6.4%	3.9%	6.4%	6.3%	8.2%	1.2%	0.0%	0.8%	0.0%	2.2%	50.0%	-26.3%	24.0%	3.0%	3.4%	5.4%	-22.1%
2003	3.8%	4.6%	4.2%	3.1%	3.2%	7.2%	3.3%	4.8%	2.4%	1.9%	0.0%	2.8%	2.4%	65.4%	21.7%	17.7%	4.9%	5.0%	28.9%
2004	4.6%	9.4%	9.0%	1.9%	3.7%	6.9%	3.1%	2.6%	0.0%	3.8%	3.8%	1.8%	30.2%	11.9%	4.4%	14.7%	4.7%	4.7%	4.4%
2005	3.1%	17.2%	6.1%	1.3%	1.8%	5.7%	0.4%	-0.3%	0.4%	0.0%	3.0%	2.2%	35.7%	34.2%	17.8%	14.3%	4.9%	4.7%	8.4%
2006	4.7%	19.3%	8.9%	2.1%	5.8%	3.8%	1.9%	2.9%	2.7%	0.0%	5.8%	2.0%	-2.6%	-12.8%	23.9%	12.9%	7.1%	4.0%	12.3%
2007	11.6%	18.7%	17.4%	11.0%	9.1%	3.9%	4.8%	-1.4%	3.1%	-1.4%	3.0%	2.2%	51.4%	-2.2%	31.6%	11.4%	10.7%	4.1%	-4.2%
2008	11.7%	5.4%	9.1%	14.9%	10.7%	6.6%	11.7%	6.0%	9.7%	-2.4%	4.0%	2.3%	-53.6%	27.9%	4.0%	4.8%	4.0%	-40.1%	1.1%
2009	6.6%	-0.7%	4.8%	6.9%	11.7%	6.2%	5.7%	8.2%	5.7%	-1.4%	2.8%	0.3%	73.1%	-54.0%	25.0%	-11.9%	-1.1%	2.7%	30.0%
2010	5.2%	-0.9%	4.4%	5.7%	4.7%	6.8%	3.2%	2.4%	3.7%	3.2%	0.7%	1.8%	13.3%	22.1%	30.6%	17.7%	1.2%	3.4%	19.7%
2011	14.8%	0.2%	8.7%	22.9%	4.4%	14.3%	8.9%	1.3%	6.2%	1.9%	0.0%	2.9%	4.9%	-11.8%	7.8%	10.9%	2.3%	3.0%	2.0%
2012	19.9%	0.1%	13.3%	19.7%	25.6%	30.1%	0.0%	0.0%	9.8%	9.0%	0.0%	1.9%	-32.7%	8.7%	2.0%	2.2%	2.0%	14.2%	1.7%
2013	22.1%	3.0%	12.9%	28.9%	25.6%	24.7%	7.2%	7.2%	1.9%	4.4%	0.0%	0.9%	-40.2%	-27.6%	-2.7%	1.0%	2.2%	23.4%	1.1%
2014	14.3%	4.2%	8.8%	18.7%	12.2%	12.4%	15.7%	8.0%	7.0%	9.3%	0.0%	2.0%	-45.6%	17.2%	-0.4%	-2.7%	1.1%	2.7%	11.1%
2015	10.1%	6.9%	11.6%	9.4%	12.4%	6.6%	9.6%	4.6%	6.3%	8.9%	7.7%	1.1%	-30.4%	-40.0%	-11.6%	-13.4%	1.8%	1.2%	10.4%
2016	7.9%	8.2%	9.9%	7.9%	8.1%	4.4%	7.7%	1.9%	9.1%	13.4%	1.4%	38.9%	37.0%	8.1%	1.4%	1.3%	1.3%	11.1%	1.1%
1985-2016	4.8%	4.9%	4.9%	3.9%	5.2%	7.1%	8.1%	4.7%	3.6%	2.7%	1.9%	2.4%	5.2%	4.7%	5.3%	5.2%	3.1%	5.8%	10.2%
St. dev	7.8%	7.8%	6.7%	10.3%	7.9%	9.1%	8.1%	6.0%	4.1%	6.3%	2.3%	1.4%	35.1%	27.9%	15.0%	8.0%	4.8%	2.9%	16.4%
sharpe ratio (RF=3%)	0.23	0.19	0.29	0.09	0.27	0.45	0.64	0.28	0.14	(0.05)	(0.65)	(0.45)	0.05	0.05	0.15	0.27	0.02	0.97	0.44
Kurtosis	(0.12)	0.28	(0.09)	(0.04)	1.60	0.89	0.92	4.71	0.18	1.75	0.54	0.09	0.92	0.23	(0.48)	(0.12)	2.09	(1.10)	1.70
30-yr 1987-2016	5.6%	5.9%	5.8%	4.8%	5.9%	8.6%	8.9%	5.2%	4.1%	3.9%	1.6%	2.3%	6.6%	5.9%	4.8%	5.3%	3.1%	5.9%	9.9%
St. dev	7.3%	6.9%	5.9%	10.0%	7.6%	8.3%	8.0%	6.0%	3.8%	5.6%	2.4%	1.3%	35.6%	28.3%	15.3%	8.2%	4.9%	2.7%	16.7%
sharpe ratio (RF=3%)	0.36	0.36	0.47	0.18	0.38	0.67	0.74	0.36	0.28	0.09	(0.60)	(0.55)	0.10	0.10	0.11	0.28	0.02	0.92	0.39
Kurtosis	0.26	0.33	0.64	0.16	2.15	1.28	0.71	4.56	(0.06)	2.41	0.33	0.80	0.82	0.19	(0.52)	(0.26)	1.97	(1.01)	1.54
20-yr 1997-2016	8.0%	5.6%	8.1%	7.8%	8.1%	11.4%	12.3%	4.8%	5.7%	3.9%	2.3%	1.9%	9.1%	7.8%	7.1%	5.2%	2.9%	3.9%	7.7%
St. dev	6.1%	6.7%	3.6%	9.0%	7.2%	7.8%	8.0%	3.1%	2.9%	4.9%	2.2%	0.7%	41.6%	32.9%	16.9%	9.0%	2.7%	1.6%	18.2%
sharpe ratio (RF=3%)	0.81	0.38	1.42	0.53	0.71	1.08	1.16	0.57	0.95	0.11	(0.33)	(1.67)	0.15	0.15	0.25	0.25	(0.05)	0.57	0.26
Kurtosis	0.21	0.18	0.79	0.05	1.81	3.36	0.29	(1.77)	(0.41)	(0.41)	0.61	0.11	(0.09)	(0.40)	(0.26)	(0.29)	2.28	(1.07)	1.25
10-yr 2007-2016	12.4%	4.9%	10.1%	14.9%	12.9%	12.1%	12.9%	4.2%	6.2%	4.4%	2.1%	1.6%	4.8%	0.3%	7.6%	2.3%	2.6%	2.6%	7.8%
St. dev	5.4%	5.9%	3.9%	7.7%	7.9%	8.4%	8.9%	3.3%	2.6%	5.4%	2.7%	0.9%	41.4%	33.8%	18.9%	10.4%	3.2%	1.0%	19.9%
sharpe ratio (RF=3%)	1.73	0.26	1.79	1.50	1.26	1.08	1.11	0.37	1.24	0.26	(0.39)	(1.75)	0.04	(0.08)	0.25	(0.06)	(0.11)	(0.37)	0.24
Kurtosis	(0.41)	3.42	0.12	(0.80)	0.39	2.75	(0.74)	(1.95)	(0.18)	(1.77)	1.38	(0.01)	(0.80)	(1.36)	0.05	(0.80)	5.01	(1.28)	4.12