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Gold, black gold, and farmland: should they all be part of your investment portfolio?

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ABSTRACT

Can traditional investors improve financial performance by adding a farmland real estate investment trust (F-REIT), gold and oil to their investment portfolios? This study shows that for the period 1972–2011, financial performance was significantly improved with the addition of F-REIT, gold and oil to a portfolio of traditional investments of T-bills, bonds, stocks and REITs. A Canadian F-REIT is considered relatively low risk, enters the efficient portfolios at low to medium risk levels and adds the most financial improvement to medium risk portfolios. Gold and Oil are higher risk assets with no dividend yield but because of their low correlations with other assets, they are able to reduce portfolio risk and add significant financial improvement in all portfolios.

KEYWORDS: investment portfolio performance; farmland real estate investment trust

1. Introduction

In response to the worldwide recession of 2008, many governments, including those in the United States and the European Union, chose to borrow and spend in order to spur the economy. Many industrialized countries by 2012 had reached debt levels that were potentially unsustainable. Some countries in Europe, such as Greece, Spain, Portugal and Ireland were at risk of defaulting on their debts, which has started another economic panic similar to 2008. The United States was similarly spending far more than its annual revenues and its government debt was also becoming perilously large. In summer 2011, Standard and Poor's, a world-renowned bond rating agency, lowered the US debt rating from AAA (the top rating, which US held for over 100 years) to AA+. This sent shock waves to the financial markets around the world. In one week, stock markets had lost approximately 10% of their value based on fears of another world recession. The US Federal Reserve chairman announced that interest rates would be at near-zero levels likely until 2013. In 2012, the debt fears remained, with the European Union threatening to expel Greece (and possibly others) if it did not agree to austerity measures. Unemployment levels in Spain reached 25% and the banking system was near collapse. The new government challenge in industrialized countries is to lower expenditures and move towards balanced budgets, which could have a further dampening effect on economies and stock markets. The economic fear and worry has led investors to seek alternative investments to the traditional bonds and stocks that have been staples for so many years.

In the US, because of the 2008 housing crisis, real estate investment is still very risky as no one can predict when the industry might again be sustainably on the rise. Rather, there has been a flight to safety. Many investors have chosen government treasury bills (T-bills, which are discounted government short term bonds) and long-term bonds, even though interest rates are very low. Many investors who are willing to accept some risk have moved to commodities such as precious metals (gold, for safety) and energy (oil), as world demand for commodities has been growing. There is also growing interest in the food industry as worldwide population and food demand continues to grow. One way to invest in the food industry is by investing directly in food commodities; another is through farmland ownership. However, it is difficult and time-consuming for the average investor to purchase and manage farmland. To add liquidity and marketability to the farmland market, a number of farmland real estate investment trusts (F-REITs) have come onto the market in recent years. In general, the trust buys farmland using investor equity and bank debt and then leases the farmland to farmer operators (mix of cash and crop share rents). The F-REIT charges administrative and management fees, similar to a mutual fund that charges an MER (management expense ratio). The F-REIT can earn an operating profit based on the lease income, net of expenses, but the expected larger profit or return is from land value appreciation.

There are a number of North American F-REITs such as Hancock Agricultural Investment Group[2]

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[2] http://haig.jhancock.com/

(division of Manulife Financial Canada, a publicly traded company), which is a US $1.6 billion[3] farmland investment fund, managing 108,000 hectares in US, 400 hectares in Canada and 2,500 hectares in Australia. Bonnefield Canadian Farmland Fund[4], located in Ottawa, Ontario, launched LPI with a public offering in April, 2010 and holds a diversified Canadian farmland portfolio worth approximately $20 million (they have recently launched LPII). Agcapita[5] is a Canadian farmland fund based in Calgary, Alberta with $100 million in assets under management and has now launched its third fund. Assiniboia Capital Corporation[6], located in Regina, Saskatchewan, is a limited partnership publicly available for investment, was founded in 2005 and now manages approximately 45,000 hectares of Canadian farmland. Sprott Resources[7] is a publicly traded Canadian company that is targeting over 800,000 hectares in western Canada. HCI Ventures[8] and Prairie Merchant Corp.[9], both private, have also been investing in farmland.

As average farm size grows, farmers need more sources of equity financing as not all growth can be financed with debt. Over 50% of farmland in Canada and the United States is now leased by farm operators and the demand for leased land is growing as average farm size continues to increase, which points to a growing demand for farmland equity investment. The average investor needs to know whether an F-REIT is a good mix in their investment portfolios and whether it provides the investment qualities they are looking for, especially given current world-wide economic turbulence. Therefore, the main question in this paper is: Can Traditional investors improve financial performance by adding a farmland real estate investment trust (F-REIT), gold and oil to their investment portfolios? The research sub-questions are (a) what are the risk-return characteristics of F-REITs compared with financial assets, REITs, gold, and oil; (b) what is the impact on portfolio performance when an F-REIT, gold and oil are added to the portfolio, and; (c) is F-REIT a better diversifier than gold or oil? A diversified Canadian F-REIT along with bonds, stocks, REITs, gold and oil are assessed to determine their impact on the financial performance of a well-diversified international investment portfolio.

2. Background

Efficient investment is the basis for all portfolio decisions, considering the trade-off between risk and return for an individual investor. Markowitz (1959) developed the idea of efficient investment, which sought to combine the right assets into a portfolio such that it would dominate any other investment or portfolio for that given risk level. The result was an efficient frontier of dominant or efficient portfolios spanning the risk spectrum. The most important aspect of efficient investment is that the total risk of a portfolio will almost always be less than the sum of the risks of the individual assets held. Tobin (1958) and Treynor (1961) added to this with the two-fund separation theorem by including the risk-free asset in the mix, producing the Capital Market Line (CML). This very important contribution improved and simplified the investment decision because it showed that all efficient portfolios were some combination of the tangency portfolio (market portfolio) and the risk-free asset. Now investors only needed to choose what percentage they wanted invested in safe risk-free assets and what percentage in the risky market portfolio. This led to the development of the Capital Asset Pricing Model (CAPM) by Sharpe (1964), which applied efficient investment theory to individual asset pricing. Since all investors would only hold efficient portfolios, they should only be concerned about that portion of an asset's risk that is added to the total risk of a well-diversified portfolio, called systematic risk, as opposed to the portion of the asset's risk that is diversified away when included in the portfolio. An asset could have a high total risk level, but if most of that risk is diversified away within an efficient portfolio, then it would add little risk to the overall portfolio and would be considered a low-risk asset.

Figure 1 illustrates the concept of efficient investment. The efficient frontier (Markowitz) represents all those investments that dominate on a risk-return basis when the risk-free asset is not included in the mix. When the risk-free asset is added to the choice set, the Capital Market Line (Tobin and Treynor) becomes the efficient set of investment opportunities, where every investment on the CML is a combination of the risk-free asset and the tangency portfolio. Each investor mixes the risk-free asset and the market (tangency) portfolio to achieve the desired level of risk, which maximizes the expected return for that chosen level of risk. In Figure 1, the borrowing rate for investors is also added, which means there are two tangency portfolios, making the efficiency frontier ABCD. Selection of a portfolio on this frontier would be the result of an individual investor's risk-return preferences. A portfolio between B and C is a standard diversified portfolio of bonds, stocks and REITs without borrowing or lending (usually considered the market portfolio). Between A and B is where the investor reduces the amount invested in the market portfolio and transfers some funds into a risk-free investment (T-bills). Between C and D, the investor expands the market portfolio investment by borrowing.

A number of past studies have assessed farmland investment efficiency. Peter Barry (1980) applied the CAPM to farmland in eleven different regions in the United States and found that farmland added very little risk to a diversified portfolio of stocks and bonds because most of farmland risk is diversifiable (unsystematic risk). Kaplan (1985) found that farm real estate had two favourable attributes: high total return and low correlation with other assets, which meant that including farmland in a portfolio added a high return asset with very little risk added. Moss, Featherstone and Baker (1987) as well as Lins, Kowalski and Hoffman (1992) and Ruebens and Webb (1995), assessed efficient portfolios using US financial assets and farmland and concluded that the addition of farmland to stock and bond portfolios improved portfolio performance. Brown (1999) showed that farm returns are comparable

[3] In early January 2013, US $1 was approximately equal to GB £0.62, and €0.77.
[4] http://bonnefield.com/index.php
[5] http://www.farmlandinvestmentpartnership.com/
[6] http://www.assiniboiacapital.com/
[7] http://www.sprottresource.com/
[8] http://www.hciventures.ca/
[9] http://www.wbrettwilson.ca/pmc/contactUs.html

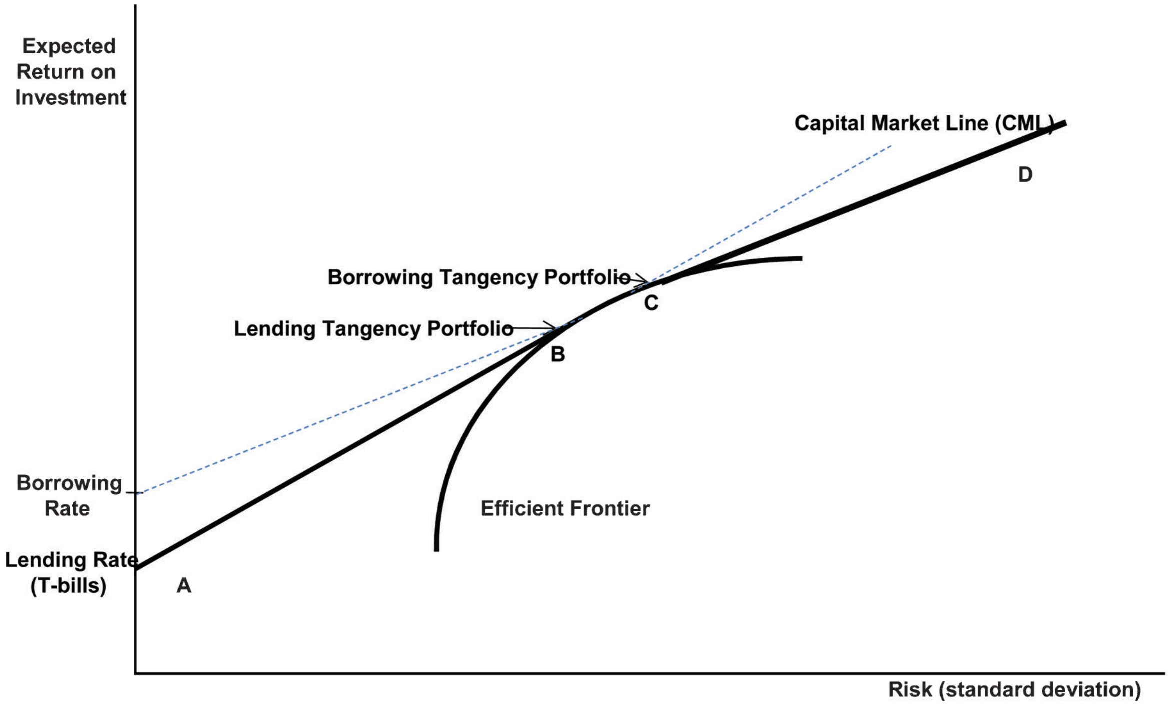

Figure 1: Efficient investment and the capital market line (CML)

to returns for stocks and bonds and correlations are low between farmland and financial assets, indicating the potential for efficient diversification by adding farmland to the investment mix. Bigge and Langemeier (2004) found that Kansas farmland's low level of systematic risk meant that farmers could improve overall portfolio performance with investment in the stock market. Libbin, Kohler and Hawkes (2004a and 2004b) suggest that farmers could improve financial performance by investing in financial assets and/or paying down their debt liabilities. Hardin and Cheng (2005) used a Markowitz semi-variance model to evaluate US farmland in a mixed-asset portfolio and found that farmland did not need to be a substantial part of an optimal portfolio; however, they suggested that more studies were needed using additional farmland data to fully assess direct investment in agricultural land. Shadbolt and Gardner (2006) found that returns to farming business investors are highly variable compared to the returns to farmland ownership based on rental agreements. Oltmans (2007) explains that with an appreciating asset like farmland, the capital gain return means that the asset itself need produce less operating income to make it economically desirable. This in part explains why farmers continue to purchase farmland even when it cannot cash flow itself because the operating return is only part of the total return; capital gain (expected growth) is the other part and needs to be addressed in the valuation assessment as well. Painter and Eves (2008) assessed farmland investments in United States, Canada, New Zealand and Australia and found that the low and negative correlation of farmland yields with stocks and bonds made it a good candidate for portfolio diversification. Waggle and Johnson (2009) added farmland and timberland to the choice set of assets. They employed a Markowitz portfolio optimization model and found widely varying allocations with farmland entering the optimal portfolios only at low risk levels and timberland at higher risk levels. Painter (2011) found that a Canadian Farmland Real Estate Investment Trust fared well in an efficient international investment portfolio and provided better diversification performance than gold, in medium risk portfolios. Noland *et al.* (2011) used the University of Illinois farmland portfolio and found that it frequently dominated the efficient asset allocation when other financial assets were included in the choice set. This paper can add to the literature in three ways; 1) by adding gold and oil to the asset mix, we can address the question as to whether we really need farmland as a diversifier, if it turns out that other assets, which are easier to invest in, can provide the diversification benefits we seek; 2) this paper is assessing the portfolio benefits of Canadian farmland whereas most previous research has been about US farmland; and 3) this is research that brings Canadian farmland portfolio assessment up to date by including 2011 market information.

3. The expected value-variance (E-V) model

An E-V model is used to assess whether an F-REIT would improve the financial performance of a diversified portfolio of financial assets, including REITs, gold and oil and to determine whether F-REIT is as good or a better diversifier than gold or oil. The E-V model is used to derive the efficient set of portfolios at all risk levels, by minimizing risk for various expected return constraints. The mapping of the minimum risk and corresponding return combinations provides the efficient set or frontier. The E-V model is as follows:

$$\text{Minimize } X' QX \quad (1)$$

X

subject to:

Rp=C' X

1.0=1' X

where:

X= vector of the wealth share invested in each asset, xi being the proportion of total wealth invested in asset i

Q= variance-covariance matrix of asset returns, Cov(ri, rj)

Rp= portfolio return on investment

C= Nx1 vector of expected return on investment for N choice assets

4. Calculating F-REIT, REIT, gold, oil and financial asset returns

Financial returns are calculated for each of the choice assets for the study period 1972-2011. The choice set of assets includes T-bills, long term bonds, F-REIT, gold, oil, United States REITs, and stock markets in Australia, Canada, Japan, United States, Europe, Hong Kong, and the MSCI World Stock Market Portfolio. For T-bills and bonds, average annual Canadian yields are calculated while for stock markets, average annual dividend, capital gain and total yields are calculated, using Morgan Stanley International stock market data. Average annual income and capital gain yields are calculated for REITs (FTSE NAREIT US Real Estate Index Series) and a Canadian F-REIT. Average annual gold and oil prices in USD were used to calculate annual investment yields for each.

Calculating income and capital gain yields for a Canadian F-REIT

The total return to an F-REIT is divided into two parts; income return and capital gain return. The income return is based on the net lease revenue obtained from renting the farmland in the trust to farm operators. The capital gain return is the change from year to year in the market value of the land. Canadian F-REIT returns are an average of the farmland ownership returns in the five major agriculture producing provinces: Alberta, Saskatchewan, Manitoba, Ontario and Quebec. A standard crop share approach is used where the F-REIT receives a percentage of the gross revenues produced (17.5% is a common crop share arrangement in North America, which compares closely with cash rents that are usually in the 5% - 7% of land values range). The F-REIT is then responsible for paying property taxes and building depreciation to arrive at a net lease amount or income return to the F-REIT. Hence, the annual income return per hectare to farmland ownership in a Canadian F-REIT is calculated as follows;

$$IR_t = LR_t - PT_t - BD_t \quad (2)$$

Where,

IR_t= \$ income return to farmland per hectare in year t;

LR_t=gross lease revenue per hectare in year t (17.5% of Gross Farm Revenues);

PT_t=property taxes per hectare in year t;

BD_t=building depreciation per hectare in year t;

The annual income and capital gain yields for a Canadian F-REIT are calculated as follows:

$$IY_t = \frac{IR_t}{V_{t-1}} \quad (3)$$

Where;

IY_t =% income yield per hectare in year t;

IR_t=\$ income return to farmland per hectare in year t;

V_{t-1}=average farmland value per hectare in year t-1.

$$CGY_t = \frac{V_t - V_{t-1}}{V_{t-1}} \quad (4)$$

Where;

CGY_t =% capital gain yield per hectare in year t;

V_t, V_{t-1}=average farmland values per hectare in years t and t-1, respectively.

The annual total investment yield for the F-REIT is the sum of the income and capital gain yields, calculated as follows

$$ROI_t = \frac{IR_t}{V_{t-1}} + \frac{V_t - V_{t-1}}{V_{t-1}} \quad (5)$$

Tax and Management Expense Adjustments to F-REIT and Bond Investment Yields

Before an efficient frontier of investments can be assessed, it must be recognized that there are tax differences between various financial assets and F-REITs and adjustments must be made to account for these differences. Also, an F-REIT requires management so a Management Expense Ratio (MER) must be included to account for management costs.

The first tax adjustment is to the F-REIT income return (net lease revenue earned). The F-REIT must pay corporate taxes on net lease income before any distributions to unit holders can be made, just as a stock market company must pay corporate taxes before distributing dividends. An average Canadian corporate tax rate of 27% is used to adjust the income return in the F-REIT (After Tax Income Return=Income Return x .73). The second tax adjustment is to T-bill and Long Bond yields. In Canada, the average personal tax rate on interest is significantly higher than on dividends or capital gains, which means that to an average investor, a 5% pre-tax dividend or capital gain yield is significantly better than a 5% pre-tax bond yield. Since the study is using before-tax average yields, a discount must be applied to T-bills and Long Bonds to adjust for the higher rates of taxation. This is not an adjustment for risk but recognizes that interest is taxed significantly higher and thus has less value to an investor on an after-tax basis. The average tax adjustment factor is calculated as follows:

$$T = \frac{1 - t_{interest}}{1 - t_{Dividend,CG}} \quad (6)$$

Where:

T= the tax adjustment factor for average T-bill and Long Bond yields;

$t_{interest}$= the average personal tax rate on interest income;

$t_{Dividend,CG}$= the average personal tax rate on dividend and capital gain income.

Using average 2012 personal tax rates in Canada, the adjustment factor T is 72%. Therefore, average T-bill and Long Bond yields are discounted to 72% of their calculated values to adjust for the fact that interest income is taxed higher than dividend and capital gain income.

An MER of 4% has been subtracted from the calculated F-REIT average yield to account for management expenses. A typical Canadian MER for equity funds such as Templeton Franklin, AIM Trimark, Investors Group and others is between 2% and 3% while segregated funds are up to 4%. Bonnefield states a 1.25% MER on their webpage, however it is unclear whether that includes all associated management expenses. Since an F-REIT would require active management, the upper end (4%) was chosen as a reasonable estimate.

5. Discussion of results

Table 1 provides average annual investment yields for the choice set of assets. The total yield results include all the tax adjustments and the F-REIT MER deduction. The borrowing rate is the average prime rate plus 2%, adjusted by the interest tax factor of 72%. The investment attraction of F-REIT appears to be reasonable investment yield with relatively low risk, as indicated by the lower coefficient of variation (standard deviation/yield=risk per unit of return) on F-REIT than on stocks, gold oil and REITs.

The important risk and return characteristics can be summarized as follows:

- FREIT total yields fall between long term bonds and REITS, Oil, Gold and Stocks.
- FREIT has a relatively low coefficient of variation at 1.31.
- The total REIT yield is almost entirely an income yield. When comparing coefficients of variation, REIT is higher than FREIT, but lower than Gold, Oil and most of the stock markets.
- Gold and Oil yields are the opposite of REIT yields in that there is no income yield at all; the yield is entirely from price movements. Gold and Oil yields are higher than F-REITs but the risk for each is almost three times that of an F-REIT, making gold and oil risk similar to stock market risk. Gold and Oil coefficients of variation are similar to stock markets.

The other attraction of F-REIT is its low and/or negative correlation with bonds, stocks, and REITs, which gives it significant diversification advantages for an investment portfolio. Table 2 illustrates the correlation coefficients between the choice assets. Some important implications are as follows:

- F-REIT is negatively correlated with REITs as well as with every stock market and has very low correlation with T-bills and bonds;
- Gold is negatively correlated with both T-bills and bonds, REITs and a number of stock markets, giving it diversification benefits;
- Oil is negatively correlated with REITs, every stock market, bonds and has a zero correlation with T-bills, which suggests that it will be an important diversifier in an efficient portfolio;
- F-REIT has high positive correlation with both gold and oil, implying that F-REIT, gold and oil may be interchangeable as diversifying agents in portfolios;
- F-REIT has been a better hedge against inflation than either gold or oil and almost as good as T-bills and bonds, as indicated by the positive correlation with inflation;
- F-REIT has been referred to as 'Gold with yield' because it has similar properties to gold such as safety of principal and inflationary hedge, but also offers a steady income yield;
- Simply diversifying across international stock markets may have worked for risk management at one time but with globalization, that is no longer a very good diversification strategy in itself, as can be seen by the high positive correlations amongst stock

Table 1: Average annual investment yields for T-bills, long bonds, F-REIT, gold, oil, REITs and stock markets (1972–2011)

	Income/Div Yield		Cap Gain Yield		Total Yield		Coefficient Of Variation
	Avg Yield	Std Dev	Avg Yield	Std Dev	Avg Yield	Std Dev	
T-bills	N/A	N/A	N/A	N/A	4.8%	0.0%	N/A
Long Bonds	N/A	N/A	N/A	N/A	5.8%	3.0%	0.52
Borrowing	N/A	N/A	N/A	N/A	7.4%	0.0%	N/A
Real Estate:							
F-REIT	3.9%	0.7%	7.3%	8.8%	7.0%	9.2%	1.31
REITs	8.7%	2.8%	0.8%	20.1%	9.5%	21.4%	2.25
Gold	0.0%	0.0%	9.6%	26.1%	9.6%	26.1%	2.72
Oil	0.0%	0.0%	8.3%	29.4%	8.3%	29.4%	3.54
Stock Markets:							
Canada	2.5%	1.0%	6.7%	22.2%	9.2%	22.5%	2.44
Australia	3.4%	1.2%	6.0%	26.2%	9.3%	27.1%	2.91
US	2.4%	1.1%	6.2%	17.8%	8.5%	18.2%	2.14
Japan	1.3%	0.8%	7.4%	33.0%	8.6%	33.5%	3.90
Europe	3.0%	1.0%	6.4%	21.8%	9.4%	22.4%	2.38
World	2.4%	1.1%	6.2%	18.1%	8.5%	18.5%	2.18
Hong Kong	4.2%	1.7%	10.7%	45.6%	13.2%	46.8%	3.55

Table 2: Correlation matrix for the choice set of assets (1972–2011)

	T-b	LTB	F-REIT	Gold	Oil	REIT	Can	Aus	US	Japan	Eur	World	HK	Inflation
T-b	1.0	.94	**.12**	–.13	.00	.02	–.12	–.13	.10	.07	.02	.06	–.01	.72
LTB		1.0	**.05**	–.13	–.10	.10	–.13	–.10	.13	.16	.06	.12	.03	.69
F-REIT			**1.0**	**.51**	**.55**	**–.12**	**–.06**	**–.10**	**–.15**	**–.17**	**–.22**	**–.23**	**–.02**	**.60**
Gold				1.0	.51	–.18	.10	.22	–.25	.09	–.13	–.11	.11	.26
Oil					1.0	–.21	–.03	–.25	–.35	–.29	–.36	–.41	–.14	.30
REIT						1.0	.47	.51	.57	.17	.39	.51	.43	.02
Can							1.0	.79	.66	.44	.64	.74	.60	–.13
Aus								1.0	.60	.45	.70	.77	.64	–.12
US									1.0	.35	.76	.88	.53	–.09
Japan										1.0	.47	.66	.59	.07
Europe											1.0	.89	.53	–.12
World												1.0	.64	–.08
HK													1.0	–.03

markets. REITs are also significantly positively correlated with stock markets.

FREIT appears to be an attractive investment, with similar diversification qualities displayed by gold and oil, but if gold and oil are available and easy to invest in, do investors need FREIT? The E-V model was applied to assess and compare performance of the following portfolios:

1. T-bills, long bonds, F-REIT (traditional farmer portfolio)
2. T-bills, long bonds, REITs, stocks (traditional investor portfolio)
3. T-bills, long bonds, gold, oil, REITs, stocks (traditional plus gold and oil)
4. T-bills, long bonds, F-REIT, gold, oil, REITs, stocks (all assets)
5. T-bills, long bonds, F-REIT, REITs, stocks (traditional plus F-REIT)

Figure 2 illustrates the kinked CML's for portfolios 1, 2 and 4. It shows that the traditional farmer and the traditional investor portfolios could both be significantly improved by adding FREIT, Gold and Oil.

This next section addresses the question of whether the portfolio improvement is from adding gold, oil or F-REIT, or all to the portfolio. Tables 3, 4, and 5 provide a comparison the five different portfolios. Table 3 compares performance in the low risk category (6% investment yield), Table 4 the medium risk (8% investment yield), and Table 5 the high risk (10% investment yield). The main performance measure is the coefficient of variation, which assesses the amount of risk in the portfolio for the chosen investment yield–the lower the coefficient of variation, the better the yield per unit of risk taken.

In Table 3 (low risk efficient portfolios), portfolio 1 (bonds and farmland only) is the weakest. This implies that farmers who put all their wealth into farmland and bonds could improve financial performance by considering other assets such as stocks, gold and REITs (this implies owning less farmland and leasing more, hence a greater need for F-REITs). Portfolio 2 (bonds, stocks, REITs–most non-farmer investors) did not perform much better. Portfolio 3 (bonds, stocks, REITs, gold, oil) and portfolio 4 (bonds, stocks, REITs, F-REIT, gold, oil) performed best. The improvement in financial performance in portfolios 3 and 4 can be mainly attributed to the inclusion of oil, as F-REIT enters the portfolio at a weight of 1.7% only. However, in portfolio 5 (bonds, stocks, REIT and F-REIT) when oil and gold are not available, F-REIT enters at a higher weighting (15.4%) to provide some of the diversification benefit lost by excluding gold and oil. Therefore, it appears that in low risk portfolios, oil is the best diversifier with F-REIT coming in a close second. Those investors who prefer dividends will likely choose F-REIT over oil or gold for a low risk portfolio. However, it is important to note that the low risk efficient portfolios are dominated by bonds.

Table 4 shows medium risk efficient portfolios. Portfolio 1 does not earn a high enough yield to achieve the desired 8%, even if 100% of the portfolio is F-REIT, and portfolio 2 does not perform well with only bonds, stocks and REITs available. Portfolios 3 and 4 have

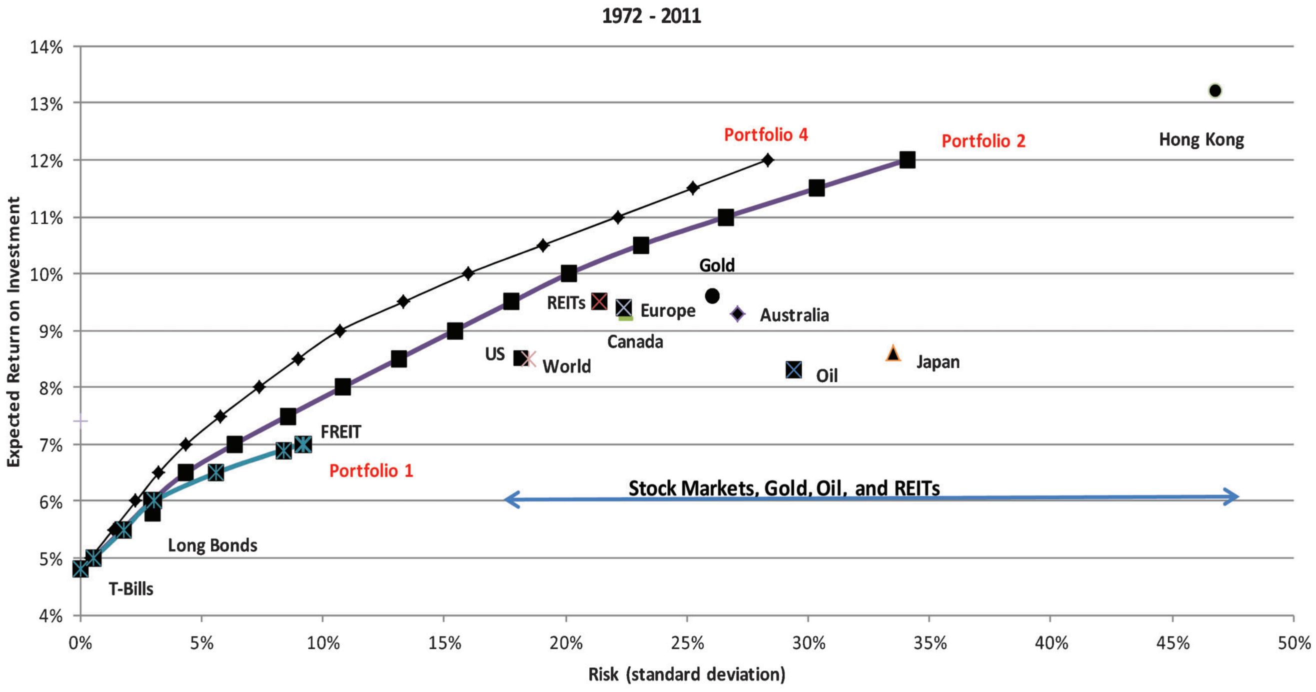

Figure 2: The capital market line for portfolios 1, 2 and 4 (1972–2011)

almost identical performance and when compared, it appears that if F-REIT is available, as in portfolio 4, it will replace bonds and oil but not to a large degree. Portfolio 5 shows that if oil and gold are not available, F-REIT enters the portfolio in a significant way, completely replacing bonds (compare portfolios 5 and 2). Therefore, it appears that in medium risk portfolios, F-REIT can add little value over an oil investment but significant value for investors averse to gold or oil. Again, those investors who prefer regular dividends may choose F-REIT over oil, but they lose some performance in the process.

In Table 5 (high risk efficient portfolios), F-REIT does not play an important role unless gold and oil are not available for investment. In portfolio 4 when F-REIT, gold and oil are in the choice set, F-REIT is not chosen at all. Indeed, portfolios 3 and 4 are identical efficient portfolios because adding F-REIT to the choice set added no improvement, mainly because F-REIT does not offer a high enough yield. Notice that gold has

Table 3: Investment performance of low risk portfolios (1972-2011)

Portfolio #:	1	2	3	4	5
Investment Yield	6%	6%	6%	6%	6%
Risk (std deviation)	3.07%	2.95%	2.31%	2.31%	2.47%
Coef of Variation	**.51**	**.49**	**.39**	**.39**	**.41**
Portfolio Weights:					
T-bills and Bonds	80.2%	90.2%	81.8%	81.0%	76.2%
F-REIT	19.8%	0.0%	0.0%	1.7%	15.4%
Gold	0.0%	0.0%	0.0%	0.0%	0.0%
Oil	0.0%	0.0%	8.7%	8.1%	0.0%
REITs	0.0%	3.0%	3.6%	3.6%	2.9%
Stocks	0.0%	6.8%	5.9%	5.6%	5.5%

Table 4: Investment performance of medium risk portfolios (1972-2011)

Portfolio #:	1	2	3	4	5
Investment Yield	7.0%	8%	8%	8%	8%
Risk (std deviation)	9.19%	10.82%	7.37%	7.36%	8.16%
Coef of Variation	**n/a**	**1.35**	**.92**	**.92**	**1.02**
Portfolio Weights:					
T-bills and Bonds	0.0%	44.7%	26.8%	23.6%	0.0%
F-REIT	100.0%	0.0%	0.0%	6.5%	60.7%
Gold	0.0%	0.0%	0.0%	0.0%	0.0%
Oil	0.0%	0.0%	31.7%	29.0%	0.0%
REITs	0.0%	25.8%	17.1%	17.2%	18.6%
Stocks	0.0%	29.5%	24.4%	23.7%	20.7%

Table 5: Investment performance of high risk portfolios (1972-2011)

Portfolio #:	1	2	3	4	5
Investment Yield	n/a	10%	10%	10%	10%
Risk (std deviation)	n/a	20.15%	15.98%	15.98%	19.68%
Coef of Variation	**n/a**	**2.01**	**1.60**	**1.60**	**1.97**
Portfolio Weights:					
T-bills and Bonds	n/a	0.0%	0.0%	0.0%	0.0%
F-REIT	n/a	0.0%	0.0%	0.0%	14.5%
Gold	n/a	0.0%	36.5%	36.5%	0.0%
Oil	n/a	0.0%	0.0%	0.0%	0.0%
REITs	n/a	51.5%	31.3%	31.3%	46.1%
Stocks	n/a	51.5%	31.3%	31.3%	46.1%
Borrowing	n/a	0.0%	-1.2%	-1.2%	0.0%

replaced oil as the efficient diversifier for this level of required investment yield, mainly due to gold's higher yield. Once again, if gold and oil are not available, as in portfolio 5, F-REIT is chosen but overall performance of portfolio 5 in only slightly better than portfolio 2, where only bonds, stocks and REITs are included.

F-REIT has significant investment advantages, including low risk, low to negative correlation in yields with other assets, excellent inflation hedge, and offers a dividend yield. However, when both gold and oil are included in the choice set of assets, oil seems to outperform F-REIT and gold in the low and medium risk portfolios and gold outperforms F-REIT and oil in the high risk portfolios. While F-REIT is valuable in the low and medium risk portfolios, it does not appear to dominate. These results are consistent with many of the other studies completed such as Barry (1980), Kaplan (1985), Moss *et al.* (1987), Lins *et al.* (1992), Ruebens and Webb (1995), Bigge and Langemeier (2004), Libbin *et al.* (2004a and 2004b) and Noland (2011). However, there are some inconsistencies with Waggle and Johnson (2009) who found farmland provided an advantage only at low levels of risk, and with Hardin and Cheng (2005) who found no significant advantage to adding farmland to a portfolio.

6. Conclusions

Can traditional investors improve financial performance by adding a farmland real estate investment trust, gold and oil to their investment portfolios? This study shows that for the period 1972–2011, financial performance was significantly improved with the addition of F-REIT, gold and oil to a portfolio of traditional investments of T-bills, bonds, stocks and REITs. A Canadian F-REIT is considered relatively low risk, enters the efficient portfolios at low to medium risk levels and adds the most financial improvement to medium risk portfolios. Gold and Oil are higher risk assets with no dividend yield but because of their low correlations with other assets, they are able to reduce portfolio risk and add significant financial improvement in all portfolios.

What are the implications for investors? For current farmland investors, including farmers, it implies that they should own bonds, stocks, oil, and REITs to complement their farmland investment holdings, and possibly gold if they want a higher risk portfolio (most farmers do not). Farmers might consider leasing instead of buying more farmland when they expand their farm operations. As the number and size of F-REITs expands, retiring farmers will have additional potential buyers for their farmland. Institutional investors and large pension funds can consider the diversification benefits of holding F-REITs as part of their portfolios. The main benefits for the agricultural market is that F-REITs inject new equity by purchasing land from retiring farmers and leasing to farmers who want to expand. The main benefit for the non-farmer investor and institutional investors is another asset choice with excellent diversification and inflation hedge benefits offering a dividend yield.

What are the implications for farm businesses? The demand for F-REITs by the farm business sector depends, at least partially, on the speed at which average farm size is expected to grow. If cropping and machinery technological changes continue to replace labour with machines and larger farm sizes are needed to achieve economies of scale associated with those technological investments, the internal equity generated by farmers may not be sufficient to finance those farm expansions. In this scenario, there will be even larger farms, fewer farm managers, and more external farm equity investment needed, implying a greater need for F-REITs. On the other hand, if technological changes come at a pace where farmers are able to generate sufficient internal equity financing needed to grow, the farmer demand for F-REITs may not materialize. Farmland may continue to be traded and leased predominantly between farmers, as it is currently. Of course there are other questions to consider associated with F-REITs. For example, what are the cultural and social implications for the farm community of having much of the land owned by investment trusts? Some Canadians believe that farmland should be owned by farmers only. Would Canadians be comfortable with a significant amount of farmland being owned by foreigners or would F-REIT's be restricted to Canadian investors? Would there still be a sufficient supply of farm management skills available to efficiently and sustainably manage the farmland? These and many other questions still need to be addressed.

In summary, F-REITs can offer value to a portfolio comparable to gold and oil, in terms of being a hedge against inflation, diversifier and stabilizer, and providing safety of principal. It is better than gold and oil in some respects, including lower overall risk, less risk of price fluctuation, shorter price cycle, and provides an annual dividend. However, in terms of efficient portfolio risk-return trade-off, F-REIT does not outperform gold or oil.

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Appendix A: Calculating Average Asset Returns, Risk, Correlations and Capital Market Lines

Average Returns, risk and correlations are calculated using 1972-2011 time series data for the following asset set: Canadian government treasury bills (90 day T-bills), long term Canadian government bonds (10 years to maturity), Canadian farmland real estate investment trust, gold, oil, US real estate investment trusts, and stock markets for Canada, Australia, United States, Japan, Europe, MSCI world portfolio, and Hong Kong. For each of these, the data used and calculation method is described.

Canadian government 90 day Treasury Bills: Statistics Canada provides average annual T-bill rates. A geometric average over the time series is calculated to provide the average annual compounded rate of return that could have been earned by continuously investing in 90 day T-bills. Data Source: http://www.statcan.gc.ca/start-debut-eng.html

Long Term Government of Canada Bonds: similar to T-bills, Statistics Canada provides average annual long term bond yields over the time series. A geometric average is calculated to provide the average return on investment that could have been earned. The standard deviation is calculated and represents the risk (same source as T-bills).

Canadian Farmland Real Estate Investment Trust: The general approach to calculating F-REIT returns is provided in the body of the paper but more detail is provided here. The data is provided by Statistics Canada as aggregate farmland financial information, by province, by year. The data needed to calculate average annual farmland ownership returns by province includes (Statistics Canada Cansim table numbers in bracket) Value per acre Farmland and Buildings (002-0003), Value of Farm Capital (002-0007), Farm Debt outstanding (002-0008), Farm Cash Receipts (002-0001), Farm Operating Expenses (002-0005), and Farm Income in Kind (002-0012). Total farm cash receipts by province are used to estimate the average income return per hectare for a land owner by applying a crop-share lease percentage.

From this, property taxes and building depreciation are deducted to arrive at the net lease or income return to the landowner, per year. This represents part of the overall farmland ownership return, which is referred to here as the income return (comes from the operating revenues of the farm). The other part of the return is the land value appreciation or depreciation each year–if farmland values increases there is a capital gain and if it decreases, there is a capital loss. This is measured each year and called the capital gain yield. Each year, for each province, the income return is added to the capital gain yield to arrive at the total yield for the year. The geometric average of total yields over the time series is the average annual return on farmland investment for that province. The standard deviation is the measure of risk for the farmland investment. The annual Canadian F-REIT return on investment is the non-weighted arithmetic average of the five provincial annual returns for that year (cross-sectional). The time-series geometric average and standard deviation are then calculated for the F-REIT over the 1972-2011 time period and the tax and management expense adjustments are made to arrive at a net F-REIT return on investment, which is then used in the EV analysis.

Gold: historic gold prices, in US dollars, were used to calculate an average annual compounded return for investing in gold. Source: http://www.nma.org/pdf/gold/his_gold_prices.pdf

Oil: historic oil prices were used to calculate the average annual compounded return for investing in oil. Source: http://www.fintrend.com/inflation/inflation_rate/Historical_Oil_Prices_Table.asp

United States Real Estate Investment Trusts: Annual average returns are provided by FTSE NAREIT US Real estate Index Services. Source: http://www.reit.com/DataAndResearch/IndexData/FNUS-Historical-Data.aspx

Stock Market Returns: all stock market returns are calculated from the Morgan Stanley world stock market indices site, which is update daily. All indexes are for countries or regions and are an average of the stock markets within that country or region. Indices are provided for both dividends and capital gains so geometric averages are calculated for both and added together to produce a total stock market return, per year, per country or region. The standard deviation for the time series is used as the risk measure. Source:
http://www.mscibarra.com/legal/index_data_additional_terms_of_use.html?/products/indices/international_equity_indices/gimi/stdindex/performance.html

Table A1: Summary of Average Returns and Risk (1972–2011)

Asset	Std Dev	E[R]
T-Bills	0.0%	4.8%
Long Bonds	3.0%	5.8%
FREIT	9.2%	7.0%
Gold	26.1%	9.6%
Oil	29.4%	8.3%
REITs	21.4%	9.5%
Canada	22.5%	9.2%
Australia	27.1%	9.3%
US	18.2%	8.5%
Japan	33.5%	8.6%
Europe	22.4%	9.4%
World	18.5%	8.5%
Hong Kong	46.8%	13.2%

At this point in the study, the data set shown in Table A1 has been produced:

The next step is to use the time series annual returns to calculate the Variance Co-Variance matrix and from that derive the Correlation matrix, as illustrated in the paper. The average returns for the time series, along with the variance co-variance matrix are required inputs for the EV model. When the EV analysis is applied to the data, a table of portfolio results is produced, as follows, which represents the Markowitz set of Efficient Portfolios, when the risk-free asset is included.

Applying this methodology to five different scenarios allows for a comparison of financial performance (risk and return) when various assets are included or not. This allows us to see whether any particular assets, such as F-REIT, Gold, or Oil make a difference in overall performance.

Appendix B: The Expected Value - Variance Model and the Capital Market Line

The E-V Model

The expected value-variance model (E-V model) has long been the fundamental approach in showing how the efficient set of portfolio investments is derived. The usual method of deriving the efficient set of investments is to minimize risk for various expected return constraints. The mapping of the minimum risk levels provides the feasible set, of which the dominant assets or portfolios represent the efficient frontier.

The efficient frontier is derived by minimizing investment risk (variance), subject to expected return and wealth constraints.

$$\text{Minimize } X'QX \tag{B.1}$$

subject to:

$Rp = C'X$

$W = e'X$

where:

X=vector of wealth invested in each asset, xi being the dollar amount invested in asset i

Q=variance-covariance matrix of asset returns, Cov(ri, rj)

Rp=portfolio return on investment

C=Nx1 vector of return on investment for N choice assets

W=the investor's total wealth

e=Nx1 vector of 1's.

Table A2: The Capital Market Line (Farmland Included in Choice Set)

Portfolio Return	Standard Deviation	T-Bills	Long Bonds	FREIT	Gold	Oil	REITs	Canada	Australia	US	Japan	Europe	World	Hong Kong	Borrowing
		Portfolio Weights for Choice Set of Assets													
12.00%	28.32%	0.0%	0.0%	0.0%	64.6%	0.0%	59.1%	0.0%	0.0%	0.0%	0.0%	31.9%	0.0%	23.5%	-79.2%
11.50%	25.24%	0.0%	0.0%	0.0%	57.6%	0.0%	52.7%	0.0%	0.0%	0.0%	0.0%	28.5%	0.0%	20.9%	-59.7%
11.00%	22.15%	0.0%	0.0%	0.0%	50.5%	0.0%	46.3%	0.0%	0.0%	0.0%	0.0%	25.0%	0.0%	18.4%	-40.2%
10.50%	19.07%	0.0%	0.0%	0.0%	43.5%	0.0%	39.8%	0.0%	0.0%	0.0%	0.0%	21.5%	0.0%	15.8%	-20.6%
10.00%	15.98%	0.0%	0.0%	0.0%	36.5%	0.0%	33.4%	0.0%	0.0%	0.0%	0.0%	18.0%	0.0%	13.3%	-1.1%
9.50%	13.32%	0.0%	0.0%	0.0%	18.3%	19.3%	31.7%	0.0%	0.0%	0.0%	0.0%	23.6%	0.0%	7.2%	0.0%
9.00%	10.72%	0.0%	0.0%	0.0%	0.0%	41.9%	27.0%	0.0%	0.0%	3.2%	0.0%	25.7%	0.0%	2.2%	0.0%
8.50%	8.97%	0.0%	6.6%	8.1%	0.0%	35.0%	21.2%	0.0%	0.0%	8.6%	1.1%	19.5%	0.0%	0.0%	0.0%
8.00%	7.36%	0.0%	23.6%	6.5%	0.0%	29.0%	17.2%	0.0%	0.0%	7.0%	0.6%	16.1%	0.0%	0.0%	0.0%
7.50%	5.81%	0.0%	40.8%	4.5%	0.0%	23.3%	13.0%	0.0%	0.0%	5.5%	0.2%	12.6%	0.0%	0.0%	0.0%
7.00%	4.39%	0.0%	57.5%	3.3%	0.0%	17.2%	9.0%	0.0%	0.0%	3.8%	0.0%	9.1%	0.0%	0.0%	0.0%
6.50%	3.25%	2.8%	70.5%	2.4%	0.0%	11.3%	5.1%	0.0%	0.0%	2.2%	0.0%	5.7%	0.0%	0.0%	0.0%
6.00%	2.31%	30.8%	50.2%	1.7%	0.0%	8.1%	3.6%	0.0%	0.0%	1.5%	0.0%	4.1%	0.0%	0.0%	0.0%
5.50%	1.37%	58.9%	29.8%	1.0%	0.0%	4.8%	2.2%	0.0%	0.0%	0.9%	0.0%	2.4%	0.0%	0.0%	0.0%
5.00%	0.43%	87.0%	9.4%	0.3%	0.0%	1.5%	0.7%	0.0%	0.0%	0.3%	0.0%	0.8%	0.0%	0.0%	0.0%
4.80%	0.00%	100.0-%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

The resulting Lagrangian equation is:

$$\text{Minimize } L = X'QX + l1(Rp - C'X) + l2(W - e'X) \quad \text{(B.2)}$$

X, l1, l2
where:
l1=the incremental risk (variance) due to an increase in portfolio return, Rp.
l2=the change in risk given an increase in wealth.
The first order conditions are:

$$\frac{\partial L}{\partial Xi} = 2X'Q\text{-ri } l1\text{-}l2 = 0$$
$$\frac{\partial L}{\partial l1} = Rp\text{-}C'X = 0 \quad \text{(B.3)}$$
$$\frac{\partial L}{\partial l2} = W\text{-}e'X = 0$$

where: ri, rj=expected returns on assets i and j
The first order conditions provide the optimum values of X, l1, and l2:

$$X^* = Q\text{-}1[Ce]\begin{bmatrix} l1 \\ l2 \end{bmatrix} \quad \text{(B.4)}$$

Premultiplying (B.4) by [Ce]' and rearranging provides:

$$\begin{bmatrix} l1 \\ l2 \end{bmatrix} = A\text{-}1[Ce]'X^* \quad \text{(B.5)}$$

A is a 2x2 matrix called the 'fundamental matrix of information' since it contains all the information about the asset means, variances, and covariances. The A matrix consists of:

$$A = \begin{bmatrix} C'Q-1C & C'Q-1e \\ e'Q-1C & e'Q-1e \end{bmatrix} = \begin{bmatrix} a & b \\ b & c \end{bmatrix} \quad \text{(B.6)}$$

The scalar elements of A are called the 'efficient set constants'. By substituting (B.5) into (B.4) and rearranging, the optimal solution vector X* is derived at given levels of expected return and risk.

$$X^* = Q\text{-}1[Ce]A\text{-}1\begin{bmatrix} Rp \\ W \end{bmatrix} \quad \text{(B.7)}$$

The variance of returns for the optimal portfolio X* can be found by substituting (B.7) into the following equation for variance of the portfolio:

$$s_p^2 * = X^*QX^* = \frac{1}{ac-b2}\left[R_p^2 c - 2RpWb + W2a\right] \quad \text{(B.8)}$$

Equations (B.7) and (B.8) determine the E-V efficient portfolio and variance for a given level of expected return. By varying Rp over a reasonable range, the efficient frontier can be mapped in expected return-standard deviation space.

The Capital Market Line

The E-V model is based on a concave investment opportunity surface. However, the introduction of a risk-free asset changes the nature of the efficient set. The two-fund separation theorem suggests that investors can maximize their utility by choosing a portfolio which is some combination of the market portfolio (tangency portfolio) and the risk-free asset. All optimal portfolios would then fall on the Capital Market Line (CML), which represents the linear efficient set of portfolios for investors. The linear efficient set is a combination of N risky assets and one riskless asset:

$$\bar{X}^* = \bar{Q}\text{-}1[\bar{C}\bar{e}]A\text{-}1\begin{bmatrix} Rp \\ W \end{bmatrix} \quad \text{(B.9)}$$

where the hats (^) indicate that the risk-free asset has been included. The variance-covariance matrix , becomes:

$$\hat{Q} = \begin{bmatrix} Q & f \\ f' & e \end{bmatrix} \quad (B.10)$$

where: f=an Nx1 null vector
e=a very small number, which represents the variance of the risk-free asset. Setting e to some number other than zero allows $\hat{Q}$ to be inverted.
$\hat{Q}$ = an (N + 1) x (N + 1) variance-covariance matrix, which includes the risk-free asset.
The CML then becomes a linear combination of the risk-free asset and the point of tangency with the investment opportunities surface.

Appendix C: Alternative Risk Measurement Approaches

Capital Asset Pricing Model (CAPM)

The most common alternative risk measurement approach has been the Capital Asset Pricing Model, developed by Sharpe (1964). The Capital Asset Pricing Model (CAPM) is derived from the E-V model and is predicated on investors maximizing utility by choosing portfolios from the linear efficient frontier. The CAPM, as developed by Sharpe, assumes:

1. Markets are perfect in that there are no taxes or transaction costs, there is perfect liquidity and marketability, and assets are priced efficiently.
2. Investors are risk averse and asset returns are normally distributed, which implies that utility is maximized by investing on the CML.
3. There is unlimited borrowing and lending at the risk-free rate of return.

The major characteristic of the CAPM is the assumption that the returns of various securities are related only through common relationships with some basic underlying factor. Sharpe suggested that the return for asset i is determined solely by the outside element plus a random set of factors:

$$Ri = Ai + BiI + Ci \quad (C.1)$$

where:
Ri=the return on asset i
Ai, Bi=parameters
Ci=a random variable where E(Ci)=0 and V(Ci)=Qi
I=the level of some index which may be a stock market index, GNP, some price index, or any other factor that is the most important influence on the return on assets.
Then, with estimates of Ai, Bi, and E(I), E(Ri) could be estimated:
E(Ri)=Ai + Bi E(I)
with variance:

$$V(Ri) = B_i^2 V(i) + Qi$$

The variance equation illustrates the two components of total risk; systematic and unsystematic risk. The term $B_i^2 V(I)$ represents that portion of total risk that is a function of the variance of the common outside element, namely the systematic risk. Since this part of the risk is due to an element common to all assets, it cannot be diversified away simply by combining different assets in a portfolio. The term Qi represents the variance of the random elements associated with asset i. Because these elements are random for each asset i, this part of the risk, called unsystematic risk, can be diversified away simply by holding many different assets together in a portfolio. In attempting to solve Markowitz's problem in a simpler fashion, Sharpe laid out the groundwork for the CAPM by deriving his CAPM model.
The CAPM equation states explicitly the expected return for an asset, based on the systematic risk of the asset, and implicitly the price of the asset.

$$E(Ri) = rf + [E(Rm)\text{-}rf] \frac{sim}{s_m^2} \quad (C.2)$$

where:
E(Ri)=the expected return on asset i
rf=the risk-free rate of return
E(Rm)=the expected return on the market portfolio
sim=the covariance between Ri and Rm
s_m^2 = the variance of Rm
Hence, in a liquid, divisible, and efficient market, the expected CAPM rate of return for farmland is:

$$E(RF) = rf + [E(Rm)\text{-}rf] \frac{sFm}{s_m^2} \quad (C.2)$$

where:
E(RF)=the expected return on farmland

$$BetaF = \frac{sFm}{s_m^2}$$

The CAPM is an equilibrium model which implies that all asset prices will adjust to offer investors the CAPM expected rates of return. In the case of farmland, if the beta is zero, then the CAPM required rate of return is equal to the risk-free rate. If the market for farmland is liquid, divisible, and efficient, the CAPM suggests that farmland prices will adjust so that the expected return to farmland ownership equals to the CAPM risk adjusted rate, E(RF). However, if there are impediments to investing in farmland, such as lumpy farmland assets or ownership restrictions, no such guarantee exists. The result is an observed rate of return which exceeds the E(RF). If the causes of persistent excess returns to farmland are non-divisibility, illiquidity, non-marketability, and thin markets, then the removal of these inefficiencies (possibly through F-REITs) could reduce excess returns and provide efficient farmland pricing.

The Arbitrage Pricing Theory Model

The Arbitrage Pricing Theory (APT) model developed by Ross (1974, 1976) is a competing model to the CAPM. The APT is an equilibrium model like the CAPM but does not require the assumptions of risk aversion and normally distributed returns. Ross suggested that an asset's risk premium is determined from the systematic risk associated with common market factors, where one factor could be the market portfolio, but not necessarily.
The general APT model is:

$$Ri = E(Ri) + Bi1[I1 - E(I1)] + ...Bin[In - E(In)] + ei \quad (C.3)$$

where:
Ri=the return on asset i
E(Ri)=the expected return on asset i
Ii=systematic sources of risk or common factors
ei=random error
As with the CAPM, the objective of the APT is to determine the risk adjusted required rate of return for each asset in the market. The required rate of return for an asset will be dependent upon its covariance with the common factors in the market. Assets with high betas display a high level of systematic risk, therefore requiring a high risk premium. Assets with low or zero betas display a low level of systematic risk and therefore, require a low or zero risk premium.

In order for the APT to fully describe required rates of return and asset pricing, there must be full and complete arbitraging between markets. If an asset in any single market is over or under priced, it is assumed that investors can quickly and with relatively small transaction costs, take advantage of the price discrepancy. The constant pursuit of arbitraging profits by investors causes asset prices to adjust to equilibrium values, where the expected returns are equal to the required returns for every asset.

In the absence of complete arbitraging between markets, prices may not adjust to APT equilibrium levels. Impediments to arbitraging such as non-divisibility, illiquidity, and non-marketability, could cause excess returns to persist. The market for farmland has impediments to arbitraging, such as lumpy farmland assets, poor marketability of farmland due to thin markets, and legislative ownership restrictions. Due to these impediments, there is no reason to believe that the APT could adequately explain rates of return or pricing in the farmland market. However, with the removal of the impediments to cross market arbitraging, the APT model could possibly provide a reasonable estimate of required rates of return for farmland.

Value at Risk (VAR)

VAR can be used to aggregate risk for a portfolio of different kinds of assets, such as stocks, bonds, real estate, farmland, gold and oil. VAR does not require normally distributed returns or any other assumptions about the probability distribution of gains and losses for the portfolio. While standard volatility measures such as variance of past returns measures both upside and downside volatility, VAR is only concerned with the probability of a large loss. VAR has three main components: a time period (can be a day, a month, a year), a confidence level (95% is very common), and a loss amount. For example, what is the largest expected loss over the next year for a mixed portfolio of stocks, bonds, farmland, and real estate, given a 95% confidence level? That % or dollar amount is the VAR. There is a 5% chance that the portfolio loss will be greater than the VAR estimate, which would be referred to as a VAR break.

There are three common methods of calculating VAR for an asset or portfolio: historical method, variance-covariance method, and the Monte Carlo simulation approach. The historical method plots all the return points in a frequency distribution chart for a past period of time–in this study it would be a frequency plot of annual returns for each portfolio being compared, for the period 1972–2011. The worst 5% of all returns for each portfolio (the left tail of the distribution) would indicate the 95% confidence limit. For example, if for a portfolio the left tail included annual losses of 10% to 35%, we would expect that, with a 95% confidence level, our annual loss next year would not exceed 10%.

The variance-covariance method assumes that portfolio returns are normally distributed so we only need to estimate the expected return and standard deviation for a portfolio to fully describe the distribution of returns. We also know that in a normal distribution a 95% confidence lower limit would be the expected return on the portfolio minus 1.96 x the standard deviation. For example, if the expected return on the portfolio is 8% with a standard deviation of 7.36%, the 95% lower limit would be -6.43% (loss). Thus, for this portfolio, there would be a 95% confidence level that the maximum loss next year would be 6.43%, with a 5% chance that the loss would be greater.

The third method of calculating VAR uses a Monte Carlo simulation model to generate a probability distribution of expected returns for each portfolio being compared. Probability distributions would be required for all portfolio assets, based on past return experience. The Monte Carlo model is used to generate outcomes of portfolio returns, based on randomly selected inputs from the individual asset probability distributions. The worst 5% of the Monte Carlo outcomes would provide the 95% VAR for the portfolio.

In summary, VAR would calculate the maximum loss expected on a portfolio for a given time period, for a specified degree of confidence. For this study, VAR is an alternative method of assessing risk that could be used to compare investment portfolios that include various mixes of stocks, bonds, real estate, farmland, gold and oil, to determine which mixes have the lowest value at risk.

