Performance of Farmland Investment

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Abstract:

This study evaluates the performance of farmland as an investment asset using institutional benchmarks, national data systems, and historical market evidence. Farmland delivers strong long-run returns with notably low volatility, supported by a return structure that blends stable rental income with long-term capital appreciation. Its weak correlation with equity markets and positive relationship with inflation enhance its role as both a diversifying asset and an inflation hedge. Portfolio analysis shows that farmland consistently improves risk-adjusted performance and remains comparatively stable during major financial disruptions. Even as farmland values adjust to changes in interest rates, income outlooks, and credit conditions, the sector's modest leverage and stable production cycle help absorb short-term market pressures. Overall, the findings highlight farmland as a resilient, inflation-responsive, and efficient component of long-horizon investment portfolios.

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Introduction

The purpose of this study is to present broad empirical evidence about the financial performance of farmland investments both from the perspective of a stand-alone investment, as well as in the context of a mixed-asset portfolio. Since the early 1980s, a set of agricultural investment conduits has emerged and grown to the point that reasonable performance indexing systems exist, and various different options or platforms for making both direct and indirect investments into productive agricultural assets are available.

In particular, long-duration institutional investors have developed large scale direct investment platforms to invest pension and insurance pool funds on behalf of annuitants and deferred obligations; and both publicly traded and private farmland Real Estate Investment Trusts (REITs) now exist alongside an industry that provides full-service management to high-net-worth individuals, family offices, and non-profit and religious foundations and organizations. Individual operators continue to consolidate into larger operations that increasingly rely on leased acreage, with the attendant need for external capital to allow efficient scale to be achieved, and/or to create access to direct marketing and input procurement channels.

In each case, a relevant market question is implied in terms of the efficiency of capital deployment and the performance of the investment in the context of alternatives or complements within the same investment pool. It is thus relevant to provide an independent empirical evaluation of the performance of these investments and to provide context for future evaluations in both direct-ownership and portfolio applications. To do so, this article first provides a brief description of the evolution of farmland investment options and the macro environments in which they occurred, followed by a set of practical considerations in accessing and measuring returns in agricultural investments.

A broad set of alternative presentations of the historical performance and a highly flexible approach for evaluating the role of farmland investments in mixed asset applications illuminates both the benefits and limits of farmland investments with context for interpreting changing conditions underlying the asset class.

Background

The emergence of farmland as an *asset class* can be partially traced to several historic episodes including the period in the early 1980s often referred to as the farm crisis. The sources of stress during that time period have been extensively documented including the world grain trade disruptions, fundamental changes of Federal Reserve policies that quelled inflation and focused on lower interest rates, an energy crisis and other world events that led to resetting of “cap rates” and land values. It was in the period that lenders acquired what was viewed at that time as substantial amount of farmland in lieu of mortgages or through foreclosure. Importantly, what was described as a crisis led to the beginning of financialization models where lenders with now meaningful agricultural portfolios needed coordinated farm management operations and had *de facto* external investors in farmland pools whether recognized and so described or not. These holdings evolved further into related “pooled capital” models that were launched when lenders either formalized the management of their agricultural holdings, or sought investors to buy out the pools of farmland originally acquired through their lending operations. At the same time, novel investment strategies were started through other limited partnership vehicles to pool investments in agricultural assets through firms like Westchester and Farmland Reserve (the investment arm of the Mormon Church). As the farm sector and asset class recovered rapidly, other purely financial investors also started farmland investment funds with particular prevalence in groups acting as general partners seeking investments on behalf of limited partners (often pension funds).

While this brief description is an oversimplification, the associated competition for investment funds required some independent measures of performance to be available beyond self-reported bespoke nascent investment pool results.

These pressures led to the formation of the National Council of Real Estate Investment Fiduciaries' (NCREIF) Farmland Index, which collects data from the major agricultural investment firms on a consistent accounting basis and publishes independently verified measures of the performance of agricultural investments.[i] The index has grown steadily through time and is now broadly viewed as the industry benchmark against which one's own performance in farmland investments can be evaluated. Around the same time, the USDA's Economic Research Service began more formally tracking the financial performance of both farms as business, and of financial service providers to agriculture resulting in an improved data system from which a far broader collection of agricultural enterprise performance data could be drawn. Academics likewise began tracking farmland as an asset class rather than focusing solely on the economics of farm unit businesses, and dedicated farmland acquisition and management business also emerged including groups like TIAA-CREF (now Nuveen), and Hancock (now Manulife) and Prudential (PGIM) and others with both lending and direct investment activities in agriculture. These post farm-crisis developments paralleled the growth in scale of economically viable production units, and the declining tenure in those farms that began to increasingly rely on leased farmland in their operations.

During the ensuing few decades, traditional financial equity markets experienced several notable corrections or "drawdowns" including Black Monday in October 1987 with a one day drop in the Dow index of nearly 23%, the *dot.com* bubble bursting in March of 2000 (Nasdaq down 80% in just over two years), the Housing Crisis of 2008-9 (Dow down 50% peak to trough), and the Covid Crash of 2020 (Dow down about 37% in two days). During each of these episodes, farmland returns remained relatively steady and less affected by short term macro events or even world health events. Through each of these historic equity market shocks, agricultural asset returns were viewed variously as safe haven, or uncorrelated, or less exposed, or less levered, or otherwise relatively unscathed and resistant to the revaluation pressures from shocks to macro factors.[ii]

Agricultural markets are not immune to factors affecting the income the assets generate or the cost of capital supporting the assets, but do have unique features that somewhat dampen the valuation responses to income shocks including annual-only income cycles in most cases, exceptionally low long-term leverage, and tax efficient composition of returns that favors capital appreciation over current income. The long-term thesis for increasing caloric demand on a world basis, and the limited ability to change *where* production occurs due to land fixity creates a situation where forward longer-term income prospects tend to be more stable than current income outcomes which are highly influenced by random weather that occurs after the majority of annual production decisions are made. Government support for agricultural production has steadily grown throughout time with expanded provision of heavily subsidized crop insurance, direct commodity price support programs, and increasing usage of *ad hoc* payments to offset anything from regional production issues to losses of market income from tariff and other government related policies. While again an oversimplification, the long-term risk in production agriculture is viewed by many to be increasingly offset by government support which in turn results in lower effective risk-adjusted capitalization rates, and attendant multiple expansion through time applied to increasingly subsidized incomes. Adding further to the narrative about farmland returns, historic returns have been positively correlated with inflation, and more importantly with shocks or “innovations” in inflation in a remarkably consistent manner across periods with highly differentiated sources of inflation. Likewise, an often-cited feature that creates demand for use in mixed-asset or large-scale portfolios is that farmland returns display low or negative correlations with equities. During the post-covid monetary expansion for example, farmland registered double digit gains through much of the heart of the production region but has waned after the runup through 2022-3 while the equity markets have moved to record levels on the strength of AI and tech-related momentum.

Literature Review

Farmland has long been recognized as both a productive and financial asset, generating return from agricultural production and capital appreciation. Reinsel and Reinsel (1979) demonstrated that land prices primarily reflect expectations about future net income and capitalization rates. Barry (1980) applied the Capital Asset Pricing Model (CAPM) to farm real estate and found a near-zero beta with returns exceeding those predicted by market risk, indicating strong risk-adjusted performance. Irwin, Forster, and Sherrick (1988) extended this analysis by incorporating inflation uncertainty and confirmed that farm real estate carried little systematic risk while providing an effective inflation hedge. Turvey, Driver, and Baker (1988) also validated the use of single-index models in farm portfolio selection, showing that systematic and non-systematic risk measures yield efficient farm investment plans comparable to full variance–covariance methods.

As farmland has become more integrated into institutional portfolios, its investment performance relative to traditional assets has been widely assessed. Hennings, Sherrick, and Barry (2005) demonstrated that including farmland in mixed-asset portfolios significantly improves risk efficiency, even when accounting for appraisal smoothing. Using the NCREIF Farmland Index, Kuethe, Walsh, and Ifft (2013) compared farmland to equities, gold, and Treasury securities before and after the 2008 financial crisis and concluded that farmland produced high average returns, low volatility, and weak correlation with financial markets. Duffy (2011) and Ifft and Kuethe (2011) further documented that farmland returns frequently outpaced those of the S&P 500 and remained stable during periods of equity market stress, attracting new investor classes to agricultural real estate. Portfolio optimization studies by Zhang and Mei (2019) and Noumir and Langemeier (2020) illustrated farmland's diversification benefits, showing that farmland's inclusion in mixed-asset portfolios improves efficient frontiers and risk-adjusted performance under mean-variance and mean–conditional value-at-risk frameworks.

Recent studies have reexamined farmland's relationship with systematic risk factors in modern asset pricing frameworks. Noumir and Langemeier (2022) tested whether farmland constitutes a priced systematic risk factor within conditional CAPM and generalized method of moments (GMM) estimations. Despite farmland's high Sharpe ratios, they found no evidence that farmland returns explain cross-sectional stock performance, suggesting its strong returns are not compensation for systematic risk. Using the Fama–French five-factor model, Turvey, Claessens, and He (2025) found farmland returns uncorrelated with the market, size, value, profitability, and investment factors but consistently producing excess returns above the risk-free rate. These results align with earlier work that farmland behaves as a low-beta, idiosyncratic asset. (Irwin et al. 1988; Bjornson and Innes 1992; Hardin and Cheng 2003)

In total, the literature underscores that farmland consistently delivers competitive real returns, low volatility, and limited exposure to systematic market risk, while offering meaningful diversification and inflation-hedging benefits. Building on these findings, this study evaluates farmland's returns and risk-adjusted efficiency within a diversified portfolio context based on recent data and performance benchmarks to assess how the asset's behavior aligns with the broader evidence.

Evaluating farmland as an asset class

Given the issues noted above, it is instructive to examine the performance of farmland investments, and to provide additional empirical information against both own histories, and within a more diversified portfolio of holdings as well. The analysis includes a broad set of alternative investments across a flexible presentation of history to provide a fair presentation across holding periods, different macro and political conditions, and against a broad set of alternative investment options and inflationary environments.

The institutional context in which farmland returns are generated and realized does require decisions about how to measure and represent returns to agricultural assets for purposes of comparing to other investments given the relatively small share of the total available for external investment and the relatively high transaction costs for acquiring and managing farmland compared to equities and fixed income investments. Moreover investor preferences for income versus capital appreciation likely differ across those who find agricultural investments to be attractive compared to other shorter term financial assets in which the income performance is the dominant feature evaluated.

In what follows, results are provided from the perspective of a farmland investor whose returns are in the form of cash rent and capital gains less property taxes. This approach proxies for individuals (including owner-operators whose benchmark for performance may include the opportunity cost of renting to a different operator), as well as managed returns on behalf of an institutional or private investor with purely return-seeking capital motivations. Importantly, no asset management fees or other financial frictions are removed from either the real asset returns series or the financial asset returns series, nor are potential differences in taxation of income considered. On balance, these are viewed as roughly proportional for each asset class (transactions costs are higher with real assets, and holding periods tend to be longer, but tax management of current income and capital gains in particular is advantaged with real assets). In the case of NCREIF related series, all returns are reported on unlevered basis with identical accounting treatments applied to valuations, income realization, capital improvements, and sale disposals. Because this treatment is critical to credibility of the results, sensitivity tests are performed against this treatment by testing the degree to which returns are over or understated and still remain in efficient portfolios, and the degree to which differences in measured volatility impact conclusions.

To construct the sample set of assets considered, historic returns data were compiled for alternative real estate investments, traditional equity investments, corporate bond and fixed income alternatives, commodities and inflation indexes, and default-risk free Treasury investments. These series were compiled from the National Association of Real Estate Investment Trusts (NAREIT) on all publicly traded real estate investment trusts (REITs), as well as mortgage REITs to provide alternative real estate benchmarks. For equity markets, returns data were collected on the Dow Jones Industrial index and the broader S&P 500 index as well as regional indices maintained by MSCI for the US, North America in total, EAFE, and developing markets. Returns on corporate bonds rated AAA to BBB, as well as commercial paper rates were collected to provide representative corporate debt investments along with yields on 3-month, 1-year and 10-year constant maturity series published by the Federal Reserve. Inflation indicators of the Consumer Price Index (CPI) and Producer Price Index (PPI) were taken from the Bureau of Labor Statistics to measure inflation hedging potential and the correlation of returns with items representing constant purchasing power.[iii] Finally, given the recent interest in gold and commodity indexes as inflation hedging vehicles, data on the Reuters/CRB commodity index and gold were also collected. All financial data were collected from 1970 or the earliest available date through the end of 2024 and annualized on a geometric annual basis.

For farmland returns, two different sources are included. First, data from 1970-2025(p) were collected on cropland rental rates, cropland values, and the total value of farmland per acre from USDA-ERS.[iv] To construct the returns measure, state-level data on the ratio of cropland rental rates to crop land values were used to create the current income series, and the capital gains rate was calculated from changes in the base land values. Estimates of average property taxes were subtracted from the sum of current income and capital gains. The returns are then converted to annual geometrically compounded rates of return that allows a measure of the accumulated returns through time to be consistently compared to alternate investments. USDA data rely on a definition of “farmland” and “cropland” that includes production units that would not be considered commercially viable and thus can provide attenuated measures of return relative to the asset class in total. Thus, to create a meaningful proxy for a well-diversified farmland investment portfolio, an aggregated index of the top 32 ag producing states is developed along with the individual state-level series. The "US Ag-32" index, as it has become somewhat broadly known, helps to provide an aggregate measure of the performance of actual US farmland over a broad set of historic conditions in the most important ag-related portions of the country. The USDA data are also easily grouped into production regions including the Corn Belt, Pacific NW, Lake States, Northern Plains, and other more homogeneous regions that correspond to both USDA production regions, and/or NCREIF production regions.

To represent actual historic farmland investor returns, NCREIF data are also considered for row crop production. The NCREIF farmland data series begin in 1991 and have grown through time to more than $16 billion at the peak. Data through Q3 2025 were collected and used to construct geometrically compounded annual returns through the end of 2024, and with an initial estimate for Q4 2025, have preliminary estimates through for 2025 as well. However, anti-corporate farming laws in a portion of the central US limit the ability of many of the NCREIF reporting members from owning land in Iowa, Minnesota, Wisconsin, Missouri, North and South Dakota, for example and thus the coverage is less complete than in the USDA data. Importantly, overlaying NCREIF and USDA data in common periods and common locations confirms the high degree of correlation between the groupings and adds credibility to the use of each other in circumstances (time period or location) where one or the other is more suitable. Importantly, NCREIF data on row crop returns show a consistent positive spread over the analogous USDA data again reflecting the impact of return-seeking capital motivations in the NCREIF data, and the inclusion of small and hobby farm or lifestyle units in the USDA data.

Figure 1 provides a historic view of the price pattern through time for US Ag-32 and the 5 states in the corn belt from 1970-2025 to provide perspectives about price patterns through time over the longest interval available. The long-term capital appreciation rate for cropland averaged just over 4.84% per year for the US Ag-32 index, and just over 4.92% for the corn belt states. Over the latter period from 1991-2025, the appreciation rates were 6.05% for the corn belt and 5.16% for the USAg-32 and 5.12% for the NCREIF Annual index cropland. From 2000-2025, the appreciation rates were 5.83%, 4.86% and 5.89% per year for the Corn Belt states, the US Ag 32, and the NCREIF Annual crop land index respectively.

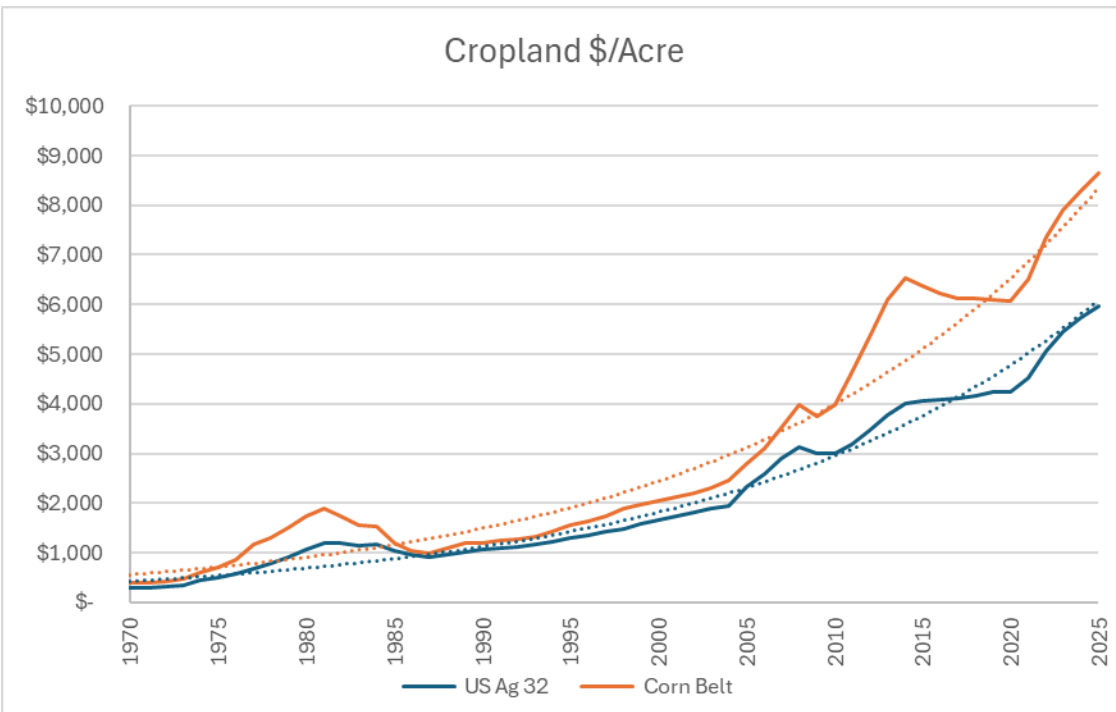


Figure 1. Average value of US Ag 32 composite series and Corn Belt, 1970-2025 (USDA and TIAA Center for Farmland Research)

To provide a sense of the correspondence of the various series available to represent farmland returns, figure 2 provides a long-term view of the returns to corn belt only, the US Ag-32 state series, and NCREIF's annual cropland series since 1991 in the form of indexed values (1991 =1). Importantly, the series agree especially closely in terms of rates of change, especially in the latter portion of the sample period.

Turning next to comparisons to alternative asset classes, and to help demonstrate the different epochs represented across time, table 1 provides summary statistics for returns by asset class for the complete period 1970-2024, and with comparable information in table 2 for 1991-2024 covering the subperiod during which the NCREIF index existed. All returns are calculated ignoring any transactions cost (which are likely higher for farmland investments); ignoring capital gains taxes (which are likely easier to avoid with real estate investments); ignoring income taxes (which have roughly equal effects on all classes); and assuming an unlevered, or zero debt position in all investments.

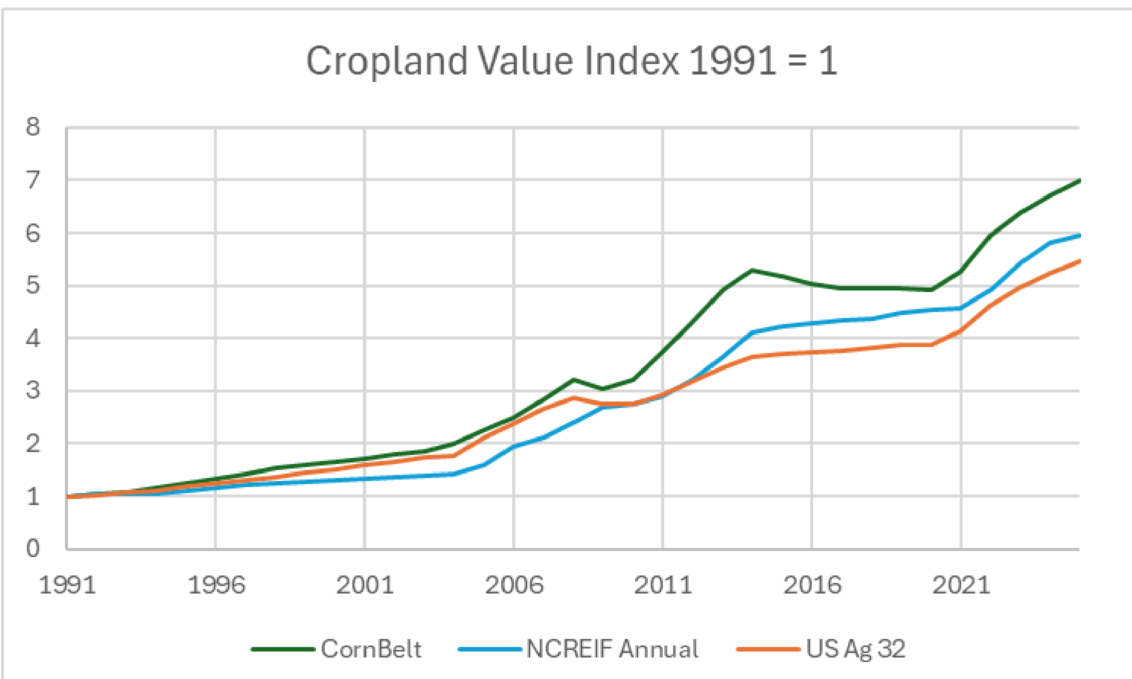


Figure 2. Cropland Value indexes, 1991=1 (USDA, NCREIF, TIAA Center

Table 1. Asset Return Characteristics

Asset/Index	Annual Ave. Return	Standard Deviation	Coefficient of Variation	US Ag 32 States Correlation	Minimum Return	Maximum Return
			-------------- 1970 - 2024--------------			
US Ag 32 States	10.5%	6.8%	0.65	1.00	-4.7%	29.5%
NASDAQ	10.5%	25.3%	2.41	-0.11	-52.0%	61.8%
S&P500	7.3%	16.6%	2.27	-0.25	-48.6%	29.3%
Dow Jones	7.1%	14.9%	2.09	-0.34	-41.3%	32.4%
EAFE	5.8%	19.8%	3.43	-0.20	-59.9%	51.2%
All REITS	8.6%	20.0%	2.32	-0.14	-54.9%	39.9%
AAA	7.2%	2.8%	0.38	0.10	2.5%	14.2%
BAA	8.2%	3.0%	0.36	0.08	3.4%	16.1%
Muni20	6.1%	1.9%	0.31	-0.07	3.1%	11.7%
TCM10Y	6.0%	3.1%	0.51	0.16	0.9%	13.9%
TCM3Y	5.4%	3.4%	0.64	0.22	0.4%	14.4%
Mort30F	7.7%	3.2%	0.41	0.12	3.0%	16.7%
Gold	7.5%	20.2%	2.69	0.29	-32.2%	78.4%
PPI	3.8%	5.2%	1.38	0.61	-7.1%	19.0%
CPI	3.9%	2.8%	0.71	0.67	0.0%	12.4%

Table 2. Asset Return Characteristics

Asset/Index	Annual Ave. Return	Standard Deviation	Coefficient of Variation	US Ag 32 States Correlation	Minimum Return	Maximum Return
			-------------- 1991 - 2024--------------			
US Ag 32 States	8.9%	4.1%	0.45	1.00	-1.0%	20.7%
NCREIF Annual Cropland	10.2%	4.7%	0.46	0.75	4.2%	23.6%
S&P500	8.1%	17.2%	2.13	-0.10	-48.6%	29.3%
Dow Jones	8.1%	14.1%	1.75	-0.11	-41.3%	28.9%
EAFE	3.2%	18.6%	5.88	0.06	-59.9%	30.2%
All REITS	9.7%	18.5%	1.91	-0.12	-46.7%	33.6%
AAA	5.5%	1.7%	0.30	0.18	2.5%	8.8%
BAA	6.5%	1.6%	0.25	0.11	3.4%	9.8%
Muni20	5.0%	0.9%	0.18	0.05	3.1%	6.9%
TCM10Y	4.1%	1.8%	0.44	0.24	0.9%	7.9%
TCM3Y	3.2%	2.1%	0.64	0.29	0.4%	6.8%
Mort30F	5.9%	1.7%	0.29	0.25	3.0%	9.2%
Gold	5.1%	13.7%	2.68	-0.04	-32.2%	33.0%
PPI	2.6%	4.8%	1.89	0.16	-7.1%	18.5%
CPI	2.5%	1.4%	0.54	0.25	0.0%	6.9%

The annual average return provides the most commonly reported feature of returns while the standard deviation represents the amount of uncertainty about that average – or the riskiness of the returns. To summarize the risk per unit of return, the coefficient of variation (CV) or the standard deviation divided by the average. Higher values of the CV are associated with relatively more risky investments. The column of correlation values depicts the degree to which each asset's returns are correlated with the US Ag 32 returns. Notably, the NCREIF returns are closely synchronized with the US Ag 32 returns as expected and also have very low risk. The farmland categories are generally negatively correlated with the equity index returns supporting the notion of diversification benefits in a mixed asset portfolio. Relative to fixed income analogs, farmland returns are generally slightly positively correlated. Perhaps the most important feature however, is the positive correlation with inflation, especially over the long run as shown in table 1. Interestingly, gold is often cited as the inflation hedge default, but over the period from 1970 to 2024, gold only has a .43 correlation with inflation as measured by the CPI, compared to .67 for the US Ag 32 index with inflation.

The final two columns show the maximum and minimum single year movement in each series over each sample period. Note that the largest loss for farmland was only 4.7% over the longer sample period and only 1% in the past 34 years compared to the equity indexes which have had drawdowns in the 40-50% range. Gold likewise, despite its potential usefulness in hedging uncertainty has also had a massive decline around 2013 as investors moved back out of gold and back into equities as part of the acknowledgment that the housing crisis recovery was nearly complete.

From the information in these tables, it is fair to conclude that US Ag-32 farmland has performed very well relative to most equity categories and fixed income alternatives, whether we use the average return to rank, the standard deviation, or the CV; and regardless of which subperiod is examined. Except for farmland, the general pattern in financial and fixed income assets over the longer period confirms that higher returns are accompanied by higher risk. In the case of farmland, there may be substantial "smoothing bias" from use of aggregated and average returns data from ERS, but from related examinations of property-level returns data, the number of separate farmland parcels needed to approach the stability of the state average is generally low (in the neighborhood of 30 properties). Thus, it is unlikely that the results are due to the methods used to construct the data series.

Expanding on the single column from tables 1 and 2, figure 3 shows the entire correlation matrix across the selected assets. Interestingly, the positive correlation with fixed income investments could also lead to the substitution of farmland for bonds in otherwise standard portfolio allocations due to its more negative correlation with higher return series.

Correlation Matrix of returns 1991-2024	NCREIF Annual Cropland	US Ag 32 States	NYSE	S&P500	TCM3Y	Dow Jones	Gold	AAA	All REITS	TCM10Y	TCM3Y	Mort30F	All REITS	PPI	CPI
NCREIF Annual Cropland	1	78.2%	-9.8%	-16.6%	1.3%	-18.7%	-7.1%	1.4%	-13.6%	4.4%	1.3%	3.5%	-13.6%	34.2%	26.3%
US Ag 32 States	78.2%	1	-14.3%	-21.3%	31.9%	-18.0%	-14.6%	22.8%	-17.4%	28.4%	31.9%	30.1%	-17.4%	19.4%	28.9%
NYSE	-9.8%	-14.3%	1	88.1%	11.0%	88.9%	7.5%	3.9%	66.0%	10.0%	11.0%	2.0%	66.0%	26.2%	22.6%
S&P500	-16.6%	-21.3%	88.1%	1	5.0%	95.6%	-1.9%	-6.1%	56.2%	1.7%	5.0%	-5.4%	56.2%	11.9%	8.4%
TCM3Y	1.3%	31.9%	11.0%	5.0%	1	11.0%	-18.7%	87.1%	2.2%	94.0%	100.0%	95.0%	2.2%	-11.2%	16.9%
Dow Jones	-18.7%	-18.0%	88.9%	95.6%	11.0%	1	-3.5%	2.1%	56.3%	8.9%	11.0%	0.7%	56.3%	15.8%	14.6%
Gold	-7.1%	-14.6%	7.5%	-1.9%	-18.7%	-3.5%	1	-21.4%	6.1%	-20.3%	-18.7%	-15.1%	6.1%	21.4%	9.0%
AAA	1.4%	22.8%	3.9%	-6.1%	87.1%	2.1%	-21.4%	1	10.9%	97.7%	87.1%	95.5%	10.9%	-19.8%	-1.6%
All REITS	-13.6%	-17.4%	66.0%	56.2%	2.2%	56.3%	6.1%	10.9%	1	11.3%	2.2%	2.2%	100.0%	22.2%	13.6%
TCM10Y	4.4%	28.4%	10.0%	1.7%	94.0%	8.9%	-20.3%	97.7%	11.3%	1	94.0%	98.0%	11.3%	-14.0%	7.8%
TCM3Y	1.3%	31.9%	11.0%	5.0%	100.0%	11.0%	-18.7%	87.1%	2.2%	94.0%	1	95.0%	2.2%	-11.2%	16.9%
Mort30F	3.5%	30.1%	2.0%	-5.4%	95.0%	0.7%	-15.1%	95.5%	2.2%	98.0%	95.0%	1	2.2%	-16.1%	9.4%
All REITS	-13.6%	-17.4%	66.0%	56.2%	2.2%	56.3%	6.1%	10.9%	100.0%	11.3%	2.2%	2.2%	1	22.2%	13.6%
PPI	34.2%	19.4%	26.2%	11.9%	-11.2%	15.8%	21.4%	-19.8%	22.2%	-14.0%	-11.2%	-16.1%	22.2%	1	76.3%
CPI	26.3%	28.9%	22.6%	8.4%	16.9%	14.6%	9.0%	-1.6%	13.6%	7.8%	16.9%	9.4%	13.6%	76.3%	1

Figure 3. Correlation characteristics across selected assets.

Investors often note that farmland returns are smoothed through time relative to other financial investments and that they display strong serial correlation – that is, positive returns tend to follow positive returns, and the negative returns are associated in time with other negative returns, while other assets have returns that appear more randomly distributed through time when aggregated into annual returns. To give a sense of the potential importance of this issue, the total holding period return for each category was calculated under alternative holding period definitions as though the investment had been made in each year from 1991 on, and then held until present. Figure 4 provides a graphical summary of the results showing the average holding period rate of return for a selected set of investments assumed. Most remarkable is that farmland has generated relatively similar returns regardless of the entry point with less variability than the equity indexes in particular which depend materially on the entry date relative to the 2008-9 period. After the fact, it is obviously easy to find the time period during which it would not have been as attractive to have initiated an investment, and by basic laws of averaging, the shorter periods (further right) should have greater variability than longer holding periods.

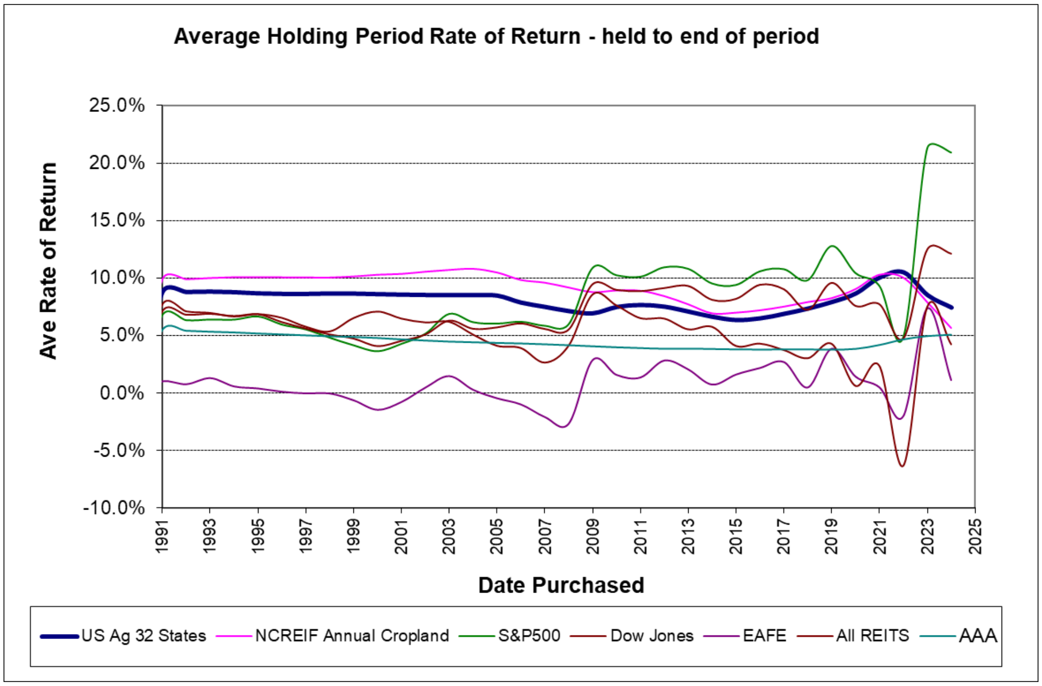


Figure 4. Average holding period returns, selected investments, held until end of 2024 (TIAA Center calculations)

Another meaningful consideration is to compare returns over all possible holding periods – essentially allowing the possible distribution of samples to be identified. The figures presented in the following provide a quick visualization tool for understanding the relative levels of returns through time, variability in returns and how quickly returns "average out" after any given shock or nonstationary. This presentation helps further inform the potential for any particular sample period to influence measured performance in the data and in the portfolio results presented later in the study. The figures show patterns in returns and relative risk in a number of related ways. Figure 5 shows the results for the NYSE index from 1991 to 2024. In the top portion of the figure, the triangular area contains color coded returns based on purchase at the beginning of the year on the vertical axis and held through the end of the year listed across the top. The inset three-dimensional graph shows the same information, but in a manner that allows a sense of the number of "excess" good and bad periods to be quickly grasped as the number of peaks and valleys relative to the plane at zero. The shading is standardized at the mean of the overall period (top right cell) with the lowest returns shown as darkest red in the upper triangular region regardless of value but standardized around zero in the 3-D graph. The complementary information shows both levels and when in the sample period returns were at their maximums and minimums.

To better understand the information contained in the figures, a few additional details are provided. The set of stair-stepped "boxes" down the diagonal of the shaded triangle diagonal simply contain the single year returns data that would occur if you bought on January 1 of each year and sold on December 31st of each year. Moving into the triangle on diagonal to the right of the annual returns provides the 2-year holding period returns for each starting period (row). The 3-year holding period is depicted in the third diagonal to the right and so on for any holding period originating at any point in the sample period. The furthest right cell on the top row contains the average over the longest period available, and the rightmost column shows the average over each potential starting point through the present. The uniformity of that column helps to provide a sense of the stability of the process, or the importance of the starting date in the data. The potential impact of a poorly or fortunately chosen starting date can also be viewed in the triangle portion as the length of the discernable "stripe" that occurs and the number of periods it takes to recover from a bad initial entry. In 2008 for example, if you entered on January 1, it would have taken nearly 8 years recover that year's loss. The vertical strip in 2008 also give a sense of the nonstationary (also confirmed with formal tests) and its long-lasting impact.

The 3-D inset graph can be thought of as "walking over the surface" in any direction and determining the impact on the average of however far up or down that unit of time affected the height or average. In this case, the dark green areas show the high returns periods and the red spike downward through the floor of the returns set occurs in the 2008 housing crisis and in 2022 when the Fed began it aggressive monetary tightening cycle. The front right face of the 3-D graph is analogous to the “held until present” information provided earlier, and “slices” at different previous disposition dates can be viewed in terms of units of time toward the left axis. This perspective helps avoid the possibility of selectively presenting particularly good or bad results due to sample period issues.

The middle panel helps further display the rate at which returns measures converge on more stable ranges, and on the width of the ranges. Within that panel, the various possible holding periods from 1 year to 10 years are provided as annualized values. Starting from the left, the 1-year returns (blue line) is followed by the two-year line (red) and three year (green) and so forth. The relationship will be more obvious in the case of farmland returns, but as the holding period increases, it would be expected that the variability of the sample would stabilize if the returns were randomly generated and sequenced from a single data generating process. In this case, as the holding period increases, the returns stabilize a bit until a red boxes appears above. The lower panel contains a plot of the sample average and standard deviation. The natural pattern would be for the average to remain relatively constant across time, but the standard deviation to shrink at a rate proportional to the square root of the sample period. As there are limitations on the number of holding periods of various length that can be constructed, the single period average has more of the areas represented as dark green due to starting and ending years being slightly higher than the longer period average. Note that summary statistics in empirical studies often only report the longest sample period – in this case, the single point in the top right corner of the shaded triangle, or the single frontmost corner point in the 3-D graph. The extent to which sampling variability impacts this measure as an accurate summary of other length holding periods is more evident in this type of presentation.

Figure 6 shows identically formatted information for the NCREIF Annual cropland returns. Several interesting contrasts to the equity indexes are evident. The farmland returns are obviously more stable and have no meaningful drawdown periods or penetrations through the “floor” of zero. There is also a generally elevated period in the early 200s during what is termed the ethanol expansion and in the period around 2012-13 when commodity prices remained elevated after a substantial drought. The lower panels provide strong evidence of consistency in returns and the reduced impact that selective sampling might have on the results. While there are two elevated periods of performance, the lack of sharp “turns” in the return series further confirms the longer-term, slower moving returns process in the case of annual cropland.

For contrast, figure 7 displays the East Asia and Far East (EAFE) market returns, viewed by some as an important source of diversification, and perhaps as a region with emerging positive equity prospects. The returns surface, and the slow convergence of the measured standard deviation are consistent with the occasional extremes as well.

Gold is presented in figure 8 that follows. Gold has been an asset of particular interest post-crash and in light of suggestions of its stable value under uncertain inflation prospects.   It does look particularly favorable in the recent few months having reached all time highs in 2025, but perhaps more intriguing is its somewhat opposite pattern relative to equities, but greater volatility than many assume to be the case.

The concluding two graphs are for US 10-year Treasuries in figure 9 and US-Ag 32 returns in figure 10. The Treasury series performs as expected with a long, slow general decline in levels from 1991 to present with only minor variation at all and completely well-behave time series properties. The US-Ag 32 state returns series performs somewhat like a muted NCREIF series with slightly lower returns and more consistent time series features as displayed in the lower panels. These comparisons are provided mainly to give a more complete sense of the behavior of different series across the periods of data used in the following development of measures at a portfolio. Importantly, the following analysis also test sample period and smoothing bias issues to avoid the common criticism of treating first stage estimates as though they contain no sampling variability when used in later portfolio applications.

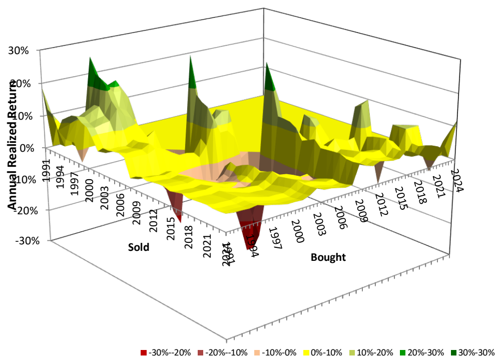
Choose asset

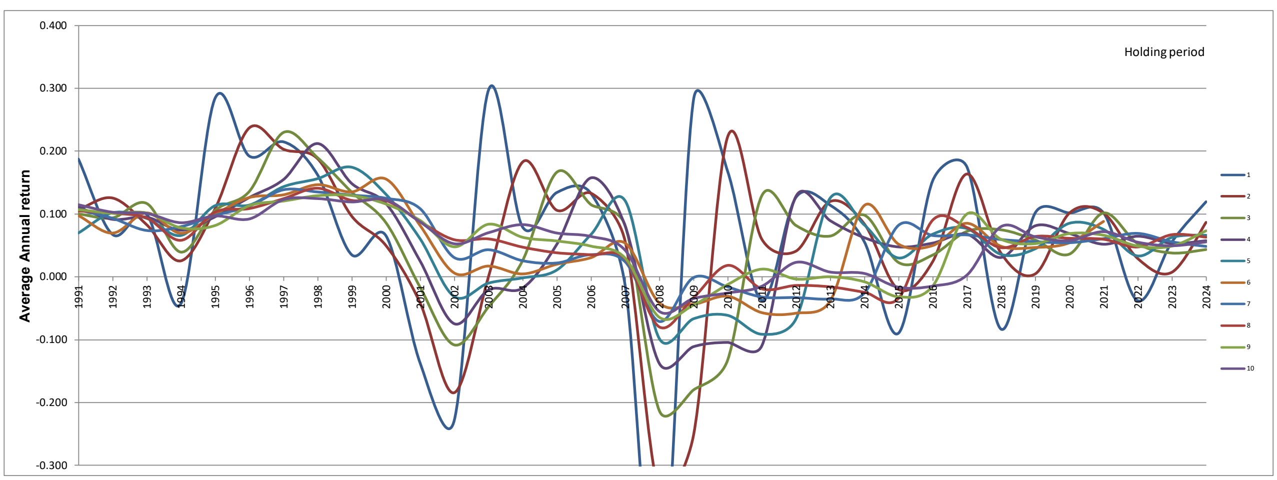
NYSE

Sell (end of year) / Buy (beginning of year)

Buy \ Sell	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
1991	18.72%	12.56%	11.67%	7.45%	11.35%	12.62%	13.84%	14.13%	12.90%	12.24%	9.59%	6.43%	8.06%	8.05%	8.40%	8.70%	8.08%
1992		6.72%	8.30%	3.93%	9.58%	11.44%	13.05%	13.49%	12.19%	11.55%	8.72%	5.38%	7.22%	7.27%	7.70%	8.06%	7.44%
1993			9.90%	2.57%	10.55%	12.65%	14.36%	14.66%	13.00%	12.17%	8.94%	5.25%	7.27%	7.32%	7.78%	8.16%	7.49%
1994				-4.27%	10.87%	13.58%	15.50%	15.64%	13.52%	12.49%	8.82%	4.75%	7.01%	7.09%	7.60%	8.02%	7.32%
1995					28.41%	23.72%	22.96%	21.24%	17.46%	15.56%	10.83%	5.93%	8.34%	8.30%	8.75%	9.12%	8.27%
1996						19.19%	20.33%	18.93%	14.87%	13.15%	8.15%	3.06%	6.06%	6.26%	6.96%	7.51%	6.74%
1997							21.47%	18.81%	13.46%	11.69%	6.06%	0.59%	4.31%	4.75%	5.68%	6.41%	5.68%
1998								16.20%	9.66%	8.60%	2.53%	-3.13%	1.69%	2.56%	3.85%	4.86%	4.22%
1999									3.48%	4.99%	-1.66%	-7.44%	-0.98%	0.44%	2.20%	3.52%	2.96%
2000										6.52%	-4.14%	-10.82%	-2.07%	-0.15%	1.99%	3.53%	2.90%
2001											-13.73%	-18.40%	-4.78%	-1.75%	1.11%	3.03%	2.39%
2002												-22.82%	0.04%	2.60%	5.20%	6.76%	5.35%
2003													29.69%	18.29%	16.64%	15.78%	12.12%
2004														7.89%	10.61%	11.48%	8.11%
2005															13.40%	13.32%	8.19%
2006																13.25%	5.67%
2007																	-1.40%

Buy \ Sell	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
1991	2.77%	3.97%	4.57%	4.16%	4.53%	4.82%	4.85%	4.26%	4.66%	5.11%	4.60%	4.79%	4.96%	5.13%	4.83%	4.86%	5.06%
1992	1.90%	3.21%	3.88%	3.48%	3.90%	4.23%	4.29%	3.70%	4.14%	4.62%	4.11%	4.32%	4.52%	4.70%	4.42%	4.45%	4.67%
1993	1.61%	3.00%	3.72%	3.32%	3.76%	4.11%	4.18%	3.57%	4.03%	4.54%	4.01%	4.23%	4.44%	4.63%	4.34%	4.38%	4.61%
1994	1.08%	2.59%	3.37%	2.96%	3.45%	3.83%	3.91%	3.29%	3.78%	4.32%	3.78%	4.02%	4.24%	4.45%	4.15%	4.20%	4.44%
1995	1.47%	3.06%	3.87%	3.40%	3.90%	4.28%	4.34%	3.66%	4.17%	4.71%	4.13%	4.37%	4.59%	4.79%	4.47%	4.50%	4.74%
1996	-0.35%	1.46%	2.41%	2.01%	2.61%	3.08%	3.21%	2.56%	3.13%	3.75%	3.19%	3.47%	3.73%	3.97%	3.67%	3.74%	4.01%
1997	-1.83%	0.21%	1.31%	0.96%	1.65%	2.20%	2.38%	1.75%	2.39%	3.06%	2.52%	2.84%	3.13%	3.40%	3.12%	3.21%	3.50%
1998	-3.71%	-1.39%	-0.10%	-0.37%	0.45%	1.10%	1.36%	0.76%	1.47%	2.22%	1.69%	2.06%	2.40%	2.71%	2.44%	2.56%	2.89%
1999	-5.50%	-2.85%	-1.35%	-1.54%	-0.59%	0.17%	0.50%	-0.08%	0.71%	1.53%	1.01%	1.43%	1.81%	2.16%	1.91%	2.05%	2.41%
2000	-6.45%	-3.46%	-1.78%	-1.94%	-0.89%	-0.06%	0.30%	-0.30%	0.55%	1.42%	0.89%	1.33%	1.73%	2.10%	1.84%	1.99%	2.37%
2001	-7.96%	-4.51%	-2.57%	-2.68%	-1.49%	-0.55%	-0.13%	-0.74%	0.19%	1.13%	0.58%	1.06%	1.50%	1.90%	1.63%	1.80%	2.20%
2002	-7.10%	-3.29%	-1.25%	-1.50%	-0.29%	0.63%	1.00%	0.26%	1.19%	2.14%	1.49%	1.96%	2.37%	2.75%	2.43%	2.57%	2.96%
2003	-4.18%	-0.12%	1.85%	1.21%	2.30%	3.09%	3.29%	2.29%	3.17%	4.07%	3.25%	3.64%	3.99%	4.31%	3.89%	3.96%	4.31%
2004	-9.81%	-4.38%	-1.61%	-1.88%	-0.37%	0.75%	1.18%	0.29%	1.37%	2.45%	1.69%	2.20%	2.65%	3.05%	2.68%	2.82%	3.24%
2005	-13.77%	-6.66%	-3.11%	-3.21%	-1.35%	-0.01%	0.53%	-0.37%	0.85%	2.04%	1.26%	1.83%	2.33%	2.78%	2.40%	2.56%	3.01%
2006	-21.29%	-11.09%	-6.11%	-5.73%	-3.30%	-1.57%	-0.81%	-1.65%	-0.22%	1.14%	0.38%	1.05%	1.63%	2.15%	1.79%	1.99%	2.49%
2007	-34.38%	-17.98%	-10.41%	-9.12%	-5.81%	-3.53%	-2.44%	-3.18%	-1.48%	0.11%	-0.62%	0.17%	0.85%	1.45%	1.11%	1.36%	1.92%
2008	-56.33%	-25.20%	-13.23%	-10.95%	-6.67%	-3.88%	-2.58%	-3.41%	-1.49%	0.26%	-0.55%	0.30%	1.03%	1.65%	1.28%	1.54%	2.12%
2009		28.13%	22.31%	12.92%	12.85%	12.55%	11.36%	8.19%	9.06%	9.96%	7.98%	8.18%	8.34%	8.48%	7.55%	7.41%	7.69%
2010			16.75%	6.00%	8.17%	8.96%	8.27%	5.19%	6.57%	7.88%	5.95%	6.36%	6.70%	6.98%	6.11%	6.07%	6.45%
2011				-3.76%	4.12%	6.49%	6.25%	3.02%	4.97%	6.67%	4.67%	5.26%	5.74%	6.14%	5.27%	5.29%	5.75%
2012					12.64%	12.01%	9.82%	4.78%	6.80%	8.52%	5.93%	6.45%	6.86%	7.18%	6.13%	6.08%	6.52%
2013						11.39%	8.43%	2.29%	5.39%	7.71%	4.85%	5.59%	6.15%	6.59%	5.50%	5.51%	6.03%
2014							5.56%	-1.98%	3.47%	6.81%	3.59%	4.66%	5.43%	6.01%	4.87%	4.93%	5.55%
2015								-8.98%	2.44%	7.23%	3.11%	4.48%	5.40%	6.07%	4.78%	4.87%	5.55%
2016									15.28%	16.38%	7.48%	8.14%	8.54%	8.81%	6.91%	6.74%	7.30%
2017										17.49%	3.78%	5.86%	6.92%	7.56%	5.58%	5.57%	6.34%
2018											-8.33%	0.49%	3.61%	5.21%	3.34%	3.70%	4.84%
2019												10.16%	10.16%	10.16%	6.49%	6.30%	7.21%
2020													10.16%	10.16%	5.29%	5.35%	6.64%
2021														10.16%	2.94%	3.80%	5.77%
2022															-3.81%	0.75%	4.35%
2023																5.54%	8.69%
2024																	11.93%





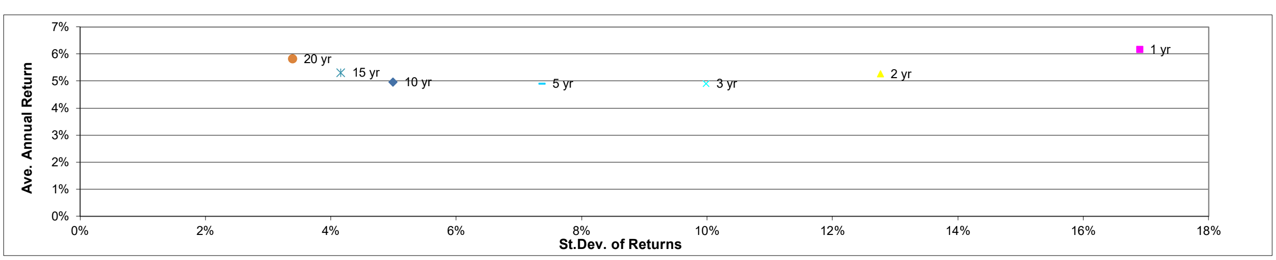


Figure 5. Buy-sell return performance, NYSE index 1991-2024

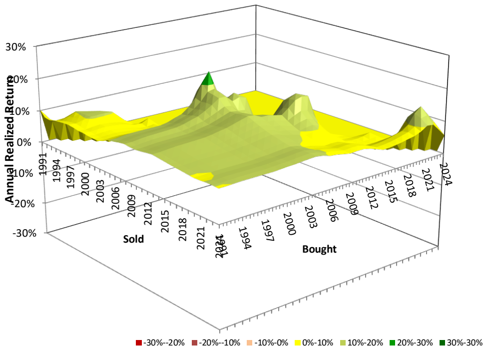
Choose asset

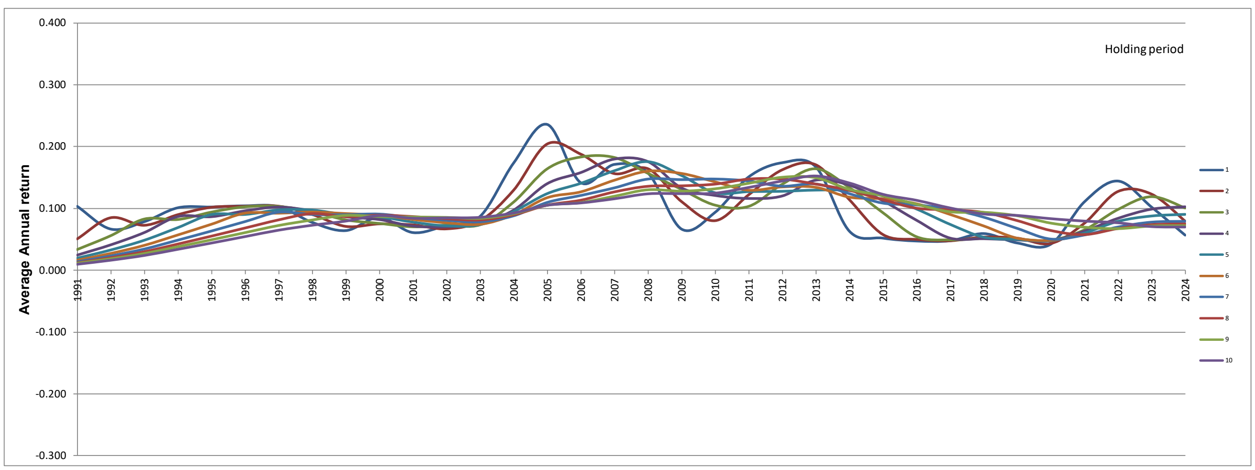
NCRIEF Ann Crop

Sell (end of year) — Buy (beginning of year)

Buy \ Sell	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
1991	10.33%	8.47%	8.27%	8.72%	9.02%	9.25%	9.40%	9.19%	8.88%	8.84%	8.59%	8.48%	8.49%	9.11%	10.02%	10.27%	10.66%
1992		6.65%	7.25%	8.19%	8.70%	9.04%	9.24%	9.03%	8.70%	8.68%	8.42%	8.31%	8.34%	9.01%	9.99%	10.27%	10.68%
1993			7.85%	8.97%	9.39%	9.64%	9.77%	9.43%	8.99%	8.94%	8.61%	8.48%	8.50%	9.21%	10.26%	10.53%	10.96%
1994				10.11%	10.17%	10.25%	10.26%	9.75%	9.18%	9.09%	8.71%	8.55%	8.56%	9.34%	10.46%	10.74%	11.18%
1995					10.23%	10.32%	10.31%	9.66%	9.00%	8.92%	8.51%	8.35%	8.39%	9.26%	10.49%	10.79%	11.27%
1996						10.42%	10.35%	9.47%	8.69%	8.66%	8.23%	8.09%	8.17%	9.15%	10.52%	10.84%	11.35%
1997							10.28%	9.00%	8.13%	8.23%	7.80%	7.71%	7.85%	8.99%	10.53%	10.89%	11.44%
1998								7.73%	7.07%	7.56%	7.19%	7.20%	7.45%	8.81%	10.56%	10.95%	11.56%
1999									6.40%	7.47%	7.01%	7.07%	7.39%	8.99%	10.97%	11.36%	11.99%
2000										8.55%	7.31%	7.29%	7.64%	9.52%	11.75%	12.09%	12.71%
2001											6.08%	6.66%	7.34%	9.76%	12.40%	12.69%	13.32%
2002												7.25%	7.98%	11.02%	14.04%	14.06%	14.57%
2003													8.71%	12.95%	16.40%	15.83%	16.09%
2004														17.36%	20.44%	18.31%	18.01%
2005															23.60%	18.79%	18.23%
2006																14.16%	15.63%
2007																	17.12%

Buy \ Sell	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
1991	10.94%	10.71%	10.64%	10.85%	11.14%	11.38%	11.16%	10.91%	10.67%	10.44%	10.28%	10.07%	9.87%	9.91%	10.05%	10.05%	9.92%
1992	10.97%	10.73%	10.66%	10.88%	11.18%	11.42%	11.20%	10.94%	10.68%	10.45%	10.28%	10.06%	9.85%	9.89%	10.04%	10.04%	9.91%
1993	11.25%	10.97%	10.88%	11.10%	11.41%	11.66%	11.41%	11.13%	10.85%	10.60%	10.42%	10.19%	9.97%	10.01%	10.15%	10.15%	10.01%
1994	11.48%	11.17%	11.06%	11.29%	11.60%	11.85%	11.58%	11.28%	10.99%	10.72%	10.52%	10.28%	10.05%	10.09%	10.23%	10.23%	10.08%
1995	11.58%	11.24%	11.13%	11.36%	11.68%	11.94%	11.65%	11.34%	11.03%	10.75%	10.54%	10.29%	10.05%	10.09%	10.24%	10.24%	10.08%
1996	11.68%	11.32%	11.19%	11.43%	11.77%	12.04%	11.73%	11.39%	11.07%	10.77%	10.55%	10.29%	10.04%	10.08%	10.24%	10.24%	10.08%
1997	11.79%	11.39%	11.24%	11.49%	11.85%	12.14%	11.80%	11.44%	11.10%	10.79%	10.56%	10.29%	10.03%	10.07%	10.23%	10.23%	10.06%
1998	11.93%	11.48%	11.32%	11.58%	11.96%	12.25%	11.89%	11.51%	11.14%	10.81%	10.57%	10.29%	10.01%	10.06%	10.23%	10.23%	10.06%
1999	12.36%	11.83%	11.62%	11.88%	12.27%	12.56%	12.16%	11.74%	11.33%	10.98%	10.72%	10.41%	10.12%	10.16%	10.33%	10.33%	10.15%
2000	13.04%	12.38%	12.11%	12.35%	12.73%	13.01%	12.55%	12.08%	11.63%	11.24%	10.95%	10.61%	10.30%	10.33%	10.51%	10.50%	10.30%
2001	13.61%	12.82%	12.47%	12.70%	13.09%	13.36%	12.84%	12.32%	11.83%	11.40%	11.09%	10.72%	10.39%	10.42%	10.60%	10.58%	10.37%
2002	14.73%	13.69%	13.20%	13.39%	13.75%	13.99%	13.38%	12.78%	12.22%	11.74%	11.39%	10.99%	10.62%	10.64%	10.82%	10.79%	10.56%
2003	16.03%	14.64%	13.97%	14.09%	14.42%	14.63%	13.91%	13.21%	12.58%	12.04%	11.65%	11.21%	10.81%	10.82%	11.00%	10.96%	10.72%
2004	17.55%	15.66%	14.74%	14.78%	15.07%	15.24%	14.39%	13.60%	12.89%	12.29%	11.85%	11.37%	10.93%	10.94%	11.12%	11.08%	10.81%
2005	17.60%	15.32%	14.31%	14.42%	14.79%	15.00%	14.10%	13.26%	12.52%	11.90%	11.47%	10.98%	10.54%	10.57%	10.79%	10.75%	10.49%
2006	15.66%	13.34%	12.53%	12.96%	13.58%	13.97%	13.09%	12.27%	11.57%	10.98%	10.58%	10.13%	9.72%	9.81%	10.07%	10.08%	9.84%
2007	16.42%	13.07%	12.13%	12.72%	13.49%	13.94%	12.96%	12.07%	11.31%	10.70%	10.29%	9.83%	9.41%	9.52%	9.82%	9.85%	9.61%
2008	15.73%	11.09%	10.51%	11.64%	12.77%	13.42%	12.38%	11.45%	10.68%	10.07%	9.69%	9.24%	8.84%	9.00%	9.35%	9.41%	9.18%
2009		6.65%	8.00%	10.32%	12.05%	12.97%	11.83%	10.85%	10.07%	9.46%	9.10%	8.67%	8.29%	8.50%	8.91%	9.00%	8.79%
2010			9.36%	12.20%	13.91%	14.60%	12.89%	11.57%	10.56%	9.82%	9.38%	8.87%	8.44%	8.65%	9.09%	9.17%	8.93%
2011				15.10%	16.25%	16.41%	13.79%	12.02%	10.76%	9.89%	9.38%	8.82%	8.35%	8.59%	9.07%	9.15%	8.90%
2012					17.41%	17.06%	13.36%	11.26%	9.92%	9.04%	8.59%	8.05%	7.62%	7.96%	8.53%	8.67%	8.44%
2013						16.72%	11.39%	9.28%	8.12%	7.44%	7.18%	6.78%	6.46%	6.96%	7.68%	7.91%	7.72%
2014							6.30%	5.74%	5.40%	5.24%	5.37%	5.21%	5.06%	5.80%	6.72%	7.07%	6.94%
2015								5.18%	4.95%	4.88%	5.14%	4.99%	4.86%	5.72%	6.77%	7.15%	7.00%
2016									4.71%	4.73%	5.13%	4.94%	4.80%	5.81%	7.00%	7.40%	7.21%
2017										4.75%	5.33%	5.02%	4.82%	6.04%	7.39%	7.79%	7.52%
2018											5.92%	5.15%	4.84%	6.36%	7.93%	8.30%	7.92%
2019												4.40%	4.30%	6.51%	8.44%	8.79%	8.26%
2020													4.20%	7.58%	9.82%	9.91%	9.05%
2021														11.06%	12.73%	11.89%	10.30%
2022															14.43%	12.30%	10.04%
2023																10.21%	7.91%
2024																	5.66%





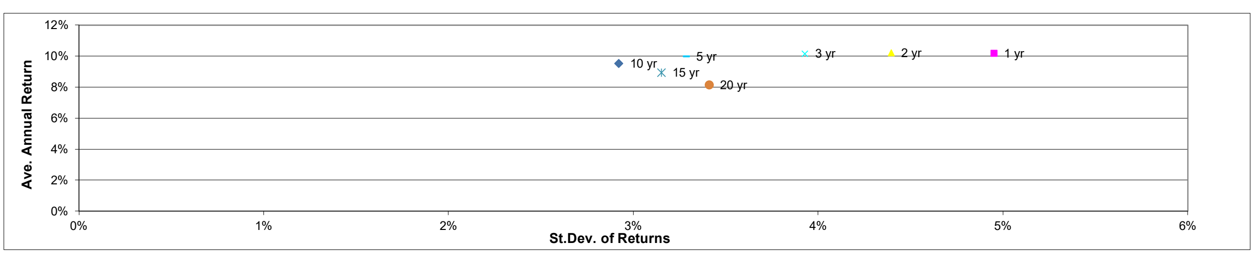


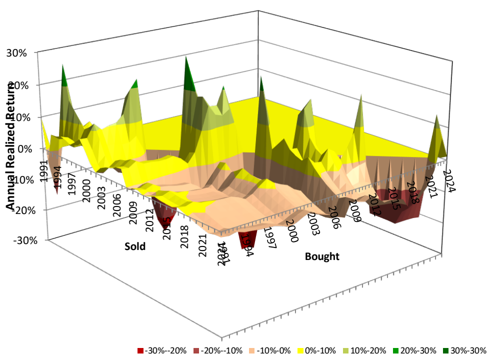
Figure 6. Buy-sell return performance, NCREIF Annual Cropland index 1991-2024

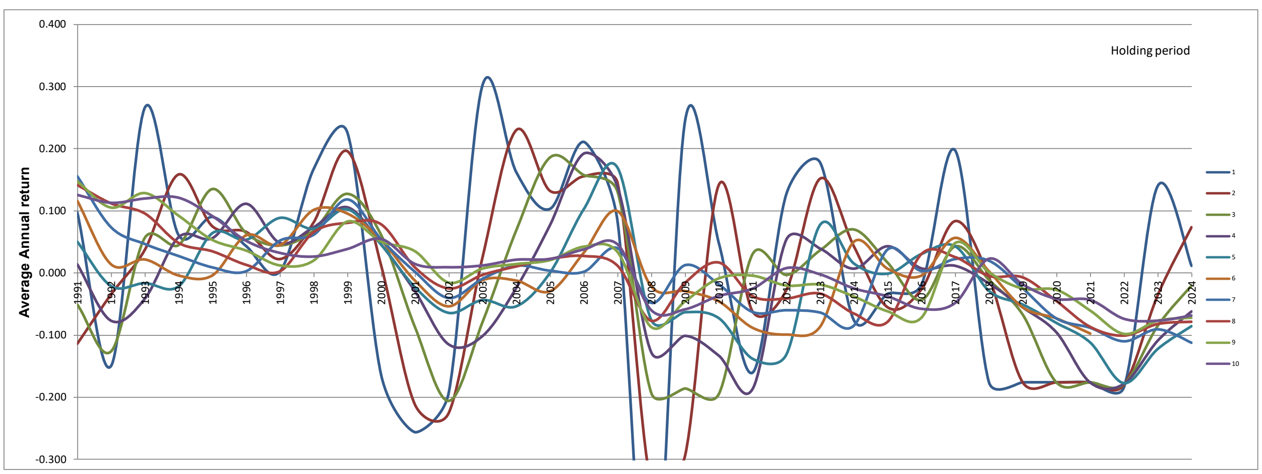
EAFE

Sell (end of year) — Buy (beginning of year)

Buy \ Sell	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
1991	9.70%	-3.41%	5.71%	5.80%	6.43%	6.07%	5.22%	6.60%	8.26%	5.48%	2.18%	0.20%	2.24%	3.18%	3.64%	4.65%	4.86%
1992		-14.95%	3.77%	4.53%	5.63%	5.36%	4.49%	6.16%	8.08%	5.03%	1.46%	-0.62%	1.64%	2.69%	3.22%	4.32%	4.57%
1993			26.62%	15.88%	13.54%	11.16%	8.88%	10.15%	11.84%	7.83%	3.47%	0.94%	3.30%	4.32%	4.77%	5.86%	6.02%
1994				6.05%	7.52%	6.44%	4.85%	7.13%	9.55%	5.39%	0.89%	-1.57%	1.22%	2.50%	3.13%	4.41%	4.68%
1995					9.00%	6.63%	4.45%	7.40%	10.27%	5.28%	0.18%	-2.49%	0.70%	2.15%	2.87%	4.27%	4.58%
1996						4.30%	2.25%	6.87%	10.59%	4.55%	-1.22%	-4.03%	-0.30%	1.41%	2.27%	3.85%	4.21%
1997							0.24%	8.18%	12.76%	4.61%	-2.29%	-5.35%	-0.94%	1.06%	2.05%	3.81%	4.21%
1998								16.75%	19.60%	6.10%	-2.92%	-6.43%	-1.13%	1.18%	2.28%	4.21%	4.61%
1999									22.53%	1.15%	-8.71%	-11.47%	-4.36%	-1.21%	0.36%	2.74%	3.34%
2000										-16.49%	-21.20%	-20.55%	-10.11%	-5.37%	-2.92%	0.19%	1.17%
2001											-25.63%	-22.51%	-7.87%	-2.37%	0.05%	3.28%	3.98%
2002												-19.26%	2.54%	6.91%	7.75%	10.29%	9.95%
2003													30.22%	23.01%	18.63%	19.24%	16.96%
2004														16.20%	13.22%	15.78%	13.86%
2005															10.31%	15.57%	13.09%
2006																21.08%	14.50%
2007																	8.27%

Buy \ Sell	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
1991	-0.60%	0.59%	0.79%	-0.08%	0.47%	1.16%	0.78%	0.61%	0.51%	1.17%	0.43%	-0.25%	-0.89%	-1.48%	-2.05%	-1.60%	-1.52%
1992	-1.17%	0.10%	0.34%	-0.55%	0.05%	0.79%	0.41%	0.25%	0.16%	0.85%	0.10%	-0.59%	-1.23%	-1.83%	-2.41%	-1.94%	-1.84%
1993	-0.24%	1.07%	1.27%	0.28%	0.86%	1.61%	1.17%	0.97%	0.85%	1.54%	0.73%	-0.02%	-0.70%	-1.34%	-1.96%	-1.48%	-1.40%
1994	-1.81%	-0.35%	-0.05%	-1.01%	-0.34%	0.50%	0.10%	-0.06%	-0.14%	0.61%	-0.19%	-0.92%	-1.59%	-2.22%	-2.82%	-2.30%	-2.20%
1995	-2.35%	-0.76%	-0.42%	-1.41%	-0.68%	0.22%	-0.19%	-0.35%	-0.42%	0.38%	-0.44%	-1.19%	-1.88%	-2.51%	-3.13%	-2.58%	-2.46%
1996	-3.17%	-1.42%	-1.02%	-2.03%	-1.22%	-0.25%	-0.65%	-0.79%	-0.84%	0.01%	-0.83%	-1.59%	-2.29%	-2.93%	-3.55%	-2.97%	-2.83%
1997	-3.77%	-1.85%	-1.39%	-2.44%	-1.56%	-0.51%	-0.92%	-1.05%	-1.09%	-0.19%	-1.06%	-1.84%	-2.55%	-3.21%	-3.84%	-3.23%	-3.08%
1998	-4.13%	-2.02%	-1.51%	-2.63%	-1.67%	-0.56%	-0.99%	-1.12%	-1.16%	-0.21%	-1.12%	-1.93%	-2.67%	-3.35%	-4.00%	-3.36%	-3.20%
1999	-6.00%	-3.57%	-2.90%	-3.98%	-2.87%	-1.62%	-2.00%	-2.09%	-2.07%	-1.03%	-1.94%	-2.75%	-3.48%	-4.14%	-4.78%	-4.09%	-3.89%
2000	-8.73%	-5.85%	-4.93%	-5.91%	-4.59%	-3.15%	-3.45%	-3.45%	-3.36%	-2.20%	-3.08%	-3.86%	-4.57%	-5.20%	-5.82%	-5.06%	-4.82%
2001	-7.71%	-4.59%	-3.69%	-4.88%	-3.53%	-2.04%	-2.45%	-2.51%	-2.47%	-1.29%	-2.27%	-3.15%	-3.93%	-4.63%	-5.30%	-4.53%	-4.30%
2002	-4.82%	-1.57%	-0.88%	-2.51%	-1.22%	0.24%	-0.39%	-0.61%	-0.69%	0.47%	-0.69%	-1.71%	-2.62%	-3.43%	-4.20%	-3.44%	-3.25%
2003	-2.17%	1.26%	1.69%	-0.45%	0.79%	2.23%	1.37%	1.00%	0.79%	1.95%	0.60%	-0.57%	-1.60%	-2.52%	-3.38%	-2.62%	-2.45%
2004	-7.61%	-2.90%	-1.84%	-3.74%	-2.03%	-0.22%	-0.91%	-1.12%	-1.18%	0.18%	-1.11%	-2.23%	-3.21%	-4.07%	-4.89%	-4.02%	-3.78%
2005	-12.76%	-6.33%	-4.56%	-6.29%	-4.10%	-1.89%	-2.48%	-2.56%	-2.51%	-0.95%	-2.25%	-3.35%	-4.31%	-5.15%	-5.94%	-4.98%	-4.68%
2006	-19.32%	-10.08%	-7.28%	-8.80%	-6.00%	-3.32%	-3.81%	-3.76%	-3.59%	-1.84%	-3.15%	-4.26%	-5.22%	-6.04%	-6.82%	-5.77%	-5.41%
2007	-34.14%	-18.57%	-13.27%	-13.83%	-9.89%	-6.38%	-6.53%	-6.19%	-5.77%	-3.69%	-4.94%	-5.98%	-6.86%	-7.62%	-8.33%	-7.15%	-6.70%
2008	-59.94%	-29.38%	-19.45%	-18.61%	-13.14%	-8.62%	-8.48%	-7.85%	-7.21%	-4.82%	-6.06%	-7.08%	-7.93%	-8.66%	-9.34%	-8.03%	-7.52%
2009		24.49%	14.21%	3.08%	5.41%	7.77%	5.03%	3.79%	3.06%	4.79%	2.30%	0.31%	-1.32%	-2.68%	-3.89%	-2.79%	-2.55%
2010			4.79%	-6.20%	-0.28%	3.95%	1.52%	0.69%	0.32%	2.56%	0.10%	-1.83%	-3.38%	-4.65%	-5.79%	-4.50%	-4.13%
2011				-16.04%	-2.72%	3.67%	0.72%	-0.11%	-0.41%	2.25%	-0.48%	-2.54%	-4.16%	-5.47%	-6.62%	-5.17%	-4.74%
2012					12.71%	15.20%	7.03%	4.33%	3.05%	5.66%	1.97%	-0.71%	-2.74%	-4.34%	-5.71%	-4.21%	-3.81%
2013						17.75%	4.29%	1.68%	0.77%	4.30%	0.28%	-2.49%	-4.52%	-6.07%	-7.38%	-5.61%	-5.07%
2014							-7.63%	-5.52%	-4.33%	1.19%	-2.89%	-5.51%	-7.34%	-8.69%	-9.82%	-7.68%	-6.91%
2015								-3.36%	-2.63%	4.31%	-1.66%	-5.08%	-7.29%	-8.84%	-10.09%	-7.68%	-6.84%
2016									-1.90%	8.37%	-1.09%	-5.50%	-8.06%	-9.72%	-11.01%	-8.21%	-7.22%
2017										19.71%	-0.68%	-6.67%	-9.53%	-11.21%	-12.44%	-9.08%	-7.86%
2018											-17.60%	-17.60%	-17.60%	-17.60%	-17.75%	-13.15%	-11.24%
2019												-17.60%	-17.60%	-17.60%	-17.79%	-12.24%	-10.14%
2020													-17.60%	-17.60%	-17.86%	-10.84%	-8.57%
2021														-17.60%	-17.99%	-8.47%	-6.16%
2022															-18.38%	-3.53%	-2.00%
2023																14.01%	7.38%
2024																	1.14%





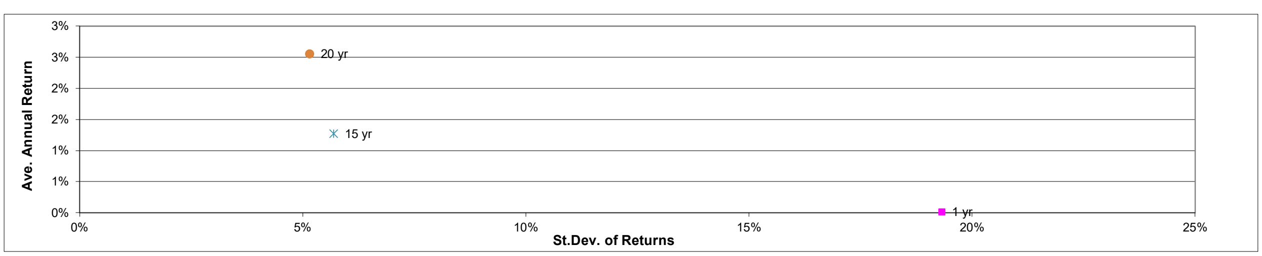


Figure 7. Buy-sell return performance, EAFE returns 1991-2024

Gold

Sell (end of year)

Buy (beginning of year)	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
1991	-8.95%	-7.44%	-0.13%	-0.65%	-0.32%	-1.07%	-4.74%	-4.26%	-3.71%	-3.90%	-3.48%	-1.53%	-0.14%	0.19%	1.19%	2.32%	3.66%
1992		-5.91%	4.60%	2.28%	1.96%	0.59%	-4.02%	-3.57%	-3.03%	-3.32%	-2.92%	-0.83%	0.63%	0.93%	1.96%	3.12%	4.51%
1993			16.28%	6.64%	4.72%	2.28%	-3.64%	-3.18%	-2.61%	-2.99%	-2.58%	-0.30%	1.25%	1.52%	2.59%	3.80%	5.24%
1994				-2.19%	-0.62%	-2.00%	-8.06%	-6.66%	-5.45%	-5.47%	-4.71%	-1.99%	-0.14%	0.27%	1.52%	2.89%	4.49%
1995					0.97%	-1.90%	-9.94%	-7.74%	-6.09%	-6.00%	-5.07%	-1.97%	0.09%	0.52%	1.87%	3.33%	5.03%
1996						-4.70%	-14.94%	-10.48%	-7.77%	-7.34%	-6.04%	-2.38%	-0.02%	0.47%	1.96%	3.55%	5.37%
1997							-24.09%	-13.24%	-8.78%	-7.99%	-6.31%	-1.99%	0.66%	1.14%	2.73%	4.41%	6.34%
1998								-0.83%	0.01%	-1.90%	-1.24%	3.15%	5.51%	5.37%	6.68%	8.17%	9.98%
1999									0.85%	-2.43%	-1.38%	4.17%	6.82%	6.44%	7.80%	9.36%	11.26%
2000										-5.60%	-2.48%	5.30%	8.37%	7.60%	9.01%	10.63%	12.63%
2001											0.74%	11.21%	13.47%	11.17%	12.19%	13.59%	15.51%
2002												22.77%	20.43%	14.88%	15.25%	16.35%	18.17%
2003													18.14%	11.13%	12.85%	14.80%	17.27%
2004														4.54%	10.29%	13.71%	17.06%
2005															16.36%	18.59%	21.55%
2006																20.86%	24.24%
2007																	27.70%
2008																	
2009																	
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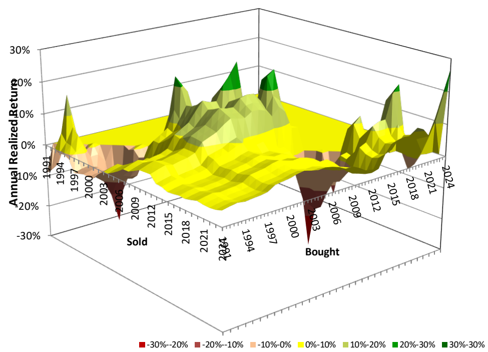
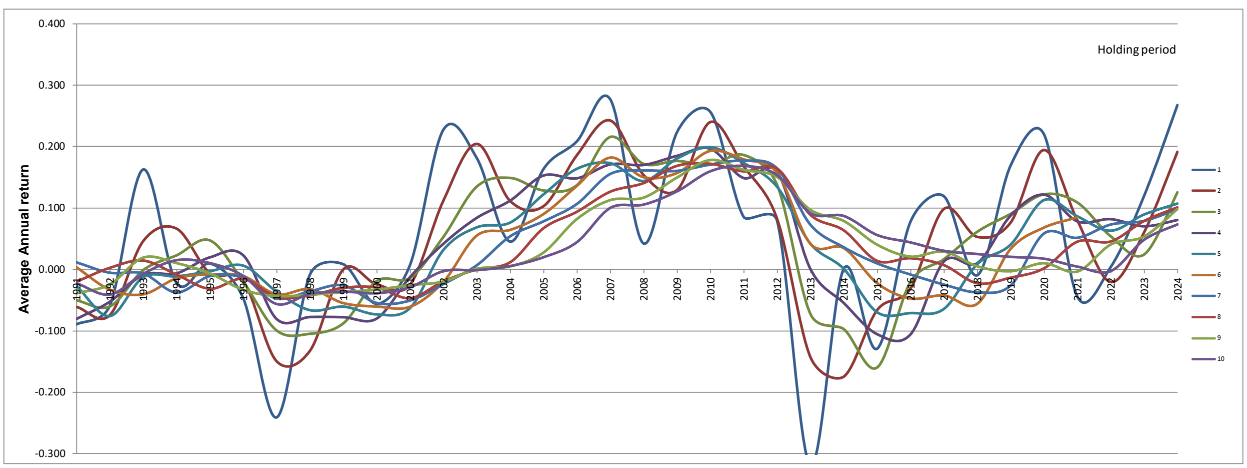
Buy (beginning of year)	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
1991	3.69%	4.60%	5.56%	5.71%	5.81%	3.80%	3.64%	2.92%	3.11%	3.42%	3.26%	3.70%	4.27%	3.97%	3.86%	4.10%	4.70%
1992	4.49%	5.41%	6.39%	6.50%	6.56%	4.42%	4.23%	3.45%	3.62%	3.93%	3.74%	4.19%	4.76%	4.44%	4.30%	4.53%	5.15%
1993	5.18%	6.12%	7.12%	7.19%	7.23%	4.94%	4.71%	3.88%	4.04%	4.34%	4.13%	4.58%	5.16%	4.81%	4.66%	4.89%	5.51%
1994	4.48%	5.51%	6.60%	6.71%	6.77%	4.40%	4.19%	3.35%	3.53%	3.87%	3.67%	4.15%	4.77%	4.42%	4.28%	4.53%	5.18%
1995	4.97%	6.05%	7.18%	7.26%	7.30%	4.76%	4.52%	3.62%	3.80%	4.14%	3.93%	4.42%	5.04%	4.68%	4.52%	4.77%	5.44%
1996	5.28%	6.42%	7.60%	7.66%	7.68%	4.97%	4.71%	3.75%	3.94%	4.29%	4.06%	4.56%	5.21%	4.82%	4.66%	4.91%	5.59%
1997	6.16%	7.33%	8.54%	8.54%	8.50%	5.57%	5.26%	4.22%	4.39%	4.74%	4.47%	4.99%	5.64%	5.22%	5.03%	5.28%	5.98%
1998	9.45%	10.47%	11.57%	11.35%	11.12%	7.77%	7.30%	6.07%	6.16%	6.44%	6.07%	6.54%	7.17%	6.66%	6.41%	6.61%	7.30%
1999	10.53%	11.56%	12.67%	12.35%	12.03%	8.37%	7.83%	6.49%	6.56%	6.83%	6.43%	6.91%	7.55%	7.00%	6.72%	6.92%	7.63%
2000	11.66%	12.69%	13.81%	13.36%	12.94%	8.93%	8.32%	6.85%	6.90%	7.18%	6.73%	7.22%	7.88%	7.29%	6.98%	7.18%	7.91%
2001	14.03%	14.93%	15.96%	15.26%	14.64%	10.13%	9.38%	7.74%	7.74%	7.98%	7.46%	7.94%	8.61%	7.95%	7.59%	7.78%	8.51%
2002	16.07%	16.84%	17.78%	16.83%	15.99%	10.95%	10.08%	8.25%	8.22%	8.45%	7.87%	8.36%	9.04%	8.32%	7.93%	8.11%	8.86%
2003	14.99%	16.01%	17.18%	16.18%	15.33%	9.94%	9.08%	7.21%	7.25%	7.56%	7.01%	7.56%	8.32%	7.61%	7.24%	7.46%	8.27%
2004	14.37%	15.66%	17.04%	15.94%	15.02%	9.15%	8.29%	6.35%	6.46%	6.84%	6.30%	6.94%	7.77%	7.05%	6.69%	6.95%	7.82%
2005	16.97%	18.02%	19.26%	17.67%	16.41%	9.67%	8.68%	6.51%	6.62%	7.02%	6.43%	7.10%	7.97%	7.20%	6.81%	7.08%	7.98%
2006	17.17%	18.44%	19.85%	17.89%	16.41%	8.86%	7.86%	5.57%	5.77%	6.27%	5.70%	6.46%	7.44%	6.65%	6.27%	6.58%	7.56%
2007	15.37%	17.65%	19.60%	17.30%	15.69%	7.25%	6.33%	4.00%	4.37%	5.04%	4.53%	5.43%	6.54%	5.77%	5.42%	5.80%	6.87%
2008	4.23%	12.92%	17.02%	14.84%	13.43%	4.17%	3.58%	1.36%	2.06%	3.00%	2.64%	3.76%	5.06%	4.35%	4.08%	4.56%	5.75%
2009		22.34%	23.99%	18.61%	15.85%	4.16%	3.48%	0.96%	1.79%	2.87%	2.48%	3.72%	5.13%	4.36%	4.07%	4.58%	5.85%
2010			25.65%	16.79%	13.76%	0.06%	0.07%	-2.22%	-0.85%	0.66%	0.49%	2.02%	3.69%	2.99%	2.79%	3.42%	4.83%
2011				8.55%	8.25%	-7.26%	-5.47%	-7.00%	-4.69%	-2.47%	-2.28%	-0.32%	1.72%	1.14%	1.08%	1.88%	3.48%
2012					7.94%	-14.28%	-9.72%	-10.53%	-7.13%	-4.20%	-3.74%	-1.37%	0.99%	0.43%	0.43%	1.34%	3.10%
2013						-31.92%	-17.44%	-15.96%	-10.56%	-6.46%	-5.56%	-2.63%	0.15%	-0.37%	-0.29%	0.76%	2.71%
2014							0.12%	-6.62%	-2.04%	1.28%	0.83%	3.35%	5.83%	4.49%	4.03%	4.79%	6.62%
2015								-12.90%	-3.11%	1.66%	1.01%	4.01%	6.81%	5.13%	4.52%	5.33%	7.30%
2016									7.79%	9.84%	6.12%	8.72%	11.26%	8.48%	7.28%	7.86%	9.81%
2017										11.92%	5.30%	9.04%	12.14%	8.61%	7.20%	7.87%	10.07%
2018											-0.93%	7.62%	12.22%	7.80%	6.28%	7.21%	9.80%
2019												16.92%	19.43%	10.88%	8.16%	8.91%	11.70%
2020													22.01%	7.98%	5.39%	7.00%	10.69%
2021														-4.43%	-2.04%	2.42%	8.03%
2022															0.40%	6.03%	12.53%
2023																11.97%	19.14%
2024																	26.77%





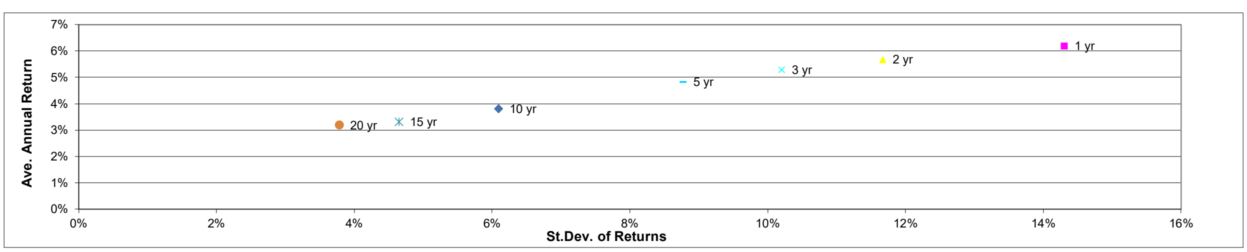
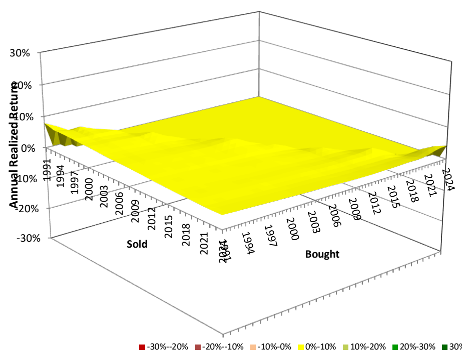


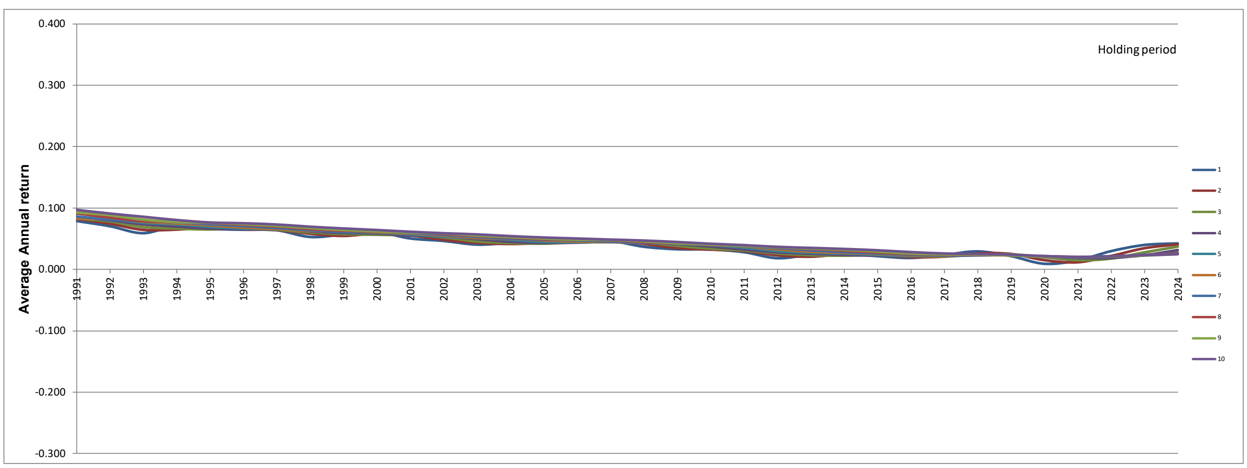
Figure 8. Buy-sell return performance, Gold index returns 1991-2024

TCM10Y

Sell (end of year)

Buy (beginning of year)	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
1991	7.86%	7.43%	6.91%	6.95%	6.88%	6.80%	6.74%	6.55%	6.45%	6.41%	6.28%	6.14%	5.98%	5.85%	5.75%	5.69%	5.63%	5.52%	5.40%	5.29%	5.17%	5.01%	4.89%	4.79%	4.69%	4.58%	4.49%	4.43%	4.36%	4.24%	4.15%	4.11%	4.10%	4.11%
1992		7.01%	6.44%	6.65%	6.63%	6.60%	6.55%	6.37%	6.28%	6.25%	6.13%	5.99%	5.82%	5.70%	5.60%	5.55%	5.49%	5.38%	5.26%	5.15%	5.03%	4.88%	4.76%	4.66%	4.56%	4.45%	4.36%	4.31%	4.23%	4.12%	4.03%	3.99%	3.99%	4.00%
1993			5.87%	6.47%	6.51%	6.49%	6.46%	6.26%	6.17%	6.16%	6.03%	5.89%	5.71%	5.59%	5.49%	5.44%	5.39%	5.28%	5.16%	5.05%	4.93%	4.77%	4.65%	4.56%	4.45%	4.34%	4.26%	4.21%	4.13%	4.01%	3.92%	3.89%	3.89%	3.90%
1994				7.08%	6.83%	6.70%	6.61%	6.34%	6.22%	6.20%	6.05%	5.89%	5.70%	5.57%	5.46%	5.41%	5.35%	5.24%	5.12%	5.00%	4.88%	4.71%	4.59%	4.50%	4.39%	4.28%	4.19%	4.14%	4.06%	3.95%	3.85%	3.82%	3.83%	3.84%
1995					6.58%	6.51%	6.46%	6.16%	6.05%	6.05%	5.90%	5.74%	5.55%	5.42%	5.32%	5.27%	5.22%	5.11%	4.99%	4.87%	4.75%	4.58%	4.47%	4.37%	4.26%	4.15%	4.07%	4.02%	3.95%	3.83%	3.74%	3.71%	3.72%	3.73%
1996						6.44%	6.40%	6.02%	5.92%	5.94%	5.79%	5.62%	5.42%	5.29%	5.19%	5.15%	5.11%	5.00%	4.87%	4.76%	4.64%	4.47%	4.35%	4.25%	4.15%	4.04%	3.96%	3.91%	3.84%	3.72%	3.63%	3.60%	3.62%	3.64%
1997							6.35%	5.81%	5.75%	5.82%	5.66%	5.48%	5.27%	5.15%	5.05%	5.03%	4.99%	4.88%	4.75%	4.64%	4.52%	4.35%	4.23%	4.13%	4.03%	3.92%	3.84%	3.80%	3.73%	3.61%	3.52%	3.50%	3.51%	3.54%
1998								5.26%	5.45%	5.64%	5.49%	5.31%	5.09%	4.98%	4.89%	4.88%	4.85%	4.75%	4.62%	4.51%	4.39%	4.21%	4.10%	4.00%	3.90%	3.79%	3.72%	3.68%	3.61%	3.49%	3.40%	3.38%	3.41%	3.44%
1999									5.64%	5.83%	5.56%	5.32%	5.06%	4.93%	4.84%	4.83%	4.81%	4.69%	4.56%	4.45%	4.32%	4.14%	4.02%	3.93%	3.82%	3.71%	3.64%	3.60%	3.53%	3.41%	3.32%	3.31%	3.33%	3.37%
2000										6.03%	5.52%	5.22%	4.92%	4.79%	4.70%	4.72%	4.71%	4.59%	4.46%	4.34%	4.21%	4.02%	3.90%	3.81%	3.71%	3.60%	3.53%	3.49%	3.43%	3.30%	3.22%	3.21%	3.24%	3.28%
2001											5.02%	4.81%	4.55%	4.48%	4.44%	4.50%	4.52%	4.41%	4.28%	4.17%	4.05%	3.86%	3.74%	3.66%	3.55%	3.45%	3.38%	3.35%	3.29%	3.17%	3.09%	3.08%	3.12%	3.16%
2002												4.61%	4.31%	4.30%	4.30%	4.40%	4.43%	4.32%	4.19%	4.08%	3.95%	3.75%	3.64%	3.55%	3.45%	3.34%	3.28%	3.26%	3.19%	3.07%	2.99%	2.99%	3.03%	3.08%
2003													4.01%	4.14%	4.19%	4.34%	4.40%	4.28%	4.13%	4.02%	3.88%	3.67%	3.55%	3.46%	3.36%	3.25%	3.19%	3.17%	3.11%	2.99%	2.91%	2.91%	2.96%	3.01%
2004														4.27%	4.28%	4.45%	4.50%	4.33%	4.15%	4.02%	3.86%	3.63%	3.50%	3.41%	3.31%	3.19%	3.13%	3.12%	3.06%	2.93%	2.84%	2.85%	2.90%	2.97%
2005															4.29%	4.54%	4.57%	4.34%	4.13%	3.97%	3.80%	3.55%	3.42%	3.33%	3.22%	3.10%	3.04%	3.03%	2.97%	2.84%	2.76%	2.77%	2.83%	2.90%
2006																4.79%	4.71%	4.36%	4.08%	3.91%	3.72%	3.45%	3.31%	3.22%	3.11%	3.00%	2.94%	2.94%	2.88%	2.75%	2.67%	2.68%	2.75%	2.83%
2007																	4.63%	4.15%	3.85%	3.69%	3.51%	3.22%	3.10%	3.03%	2.93%	2.82%	2.77%	2.79%	2.74%	2.60%	2.53%	2.55%	2.63%	2.72%
2008																		3.67%	3.46%	3.38%	3.23%	2.94%	2.84%	2.80%	2.72%	2.62%	2.59%	2.62%	2.58%	2.45%	2.38%	2.42%	2.51%	2.61%
2009																			3.26%	3.24%	3.09%	2.76%	2.68%	2.66%	2.58%	2.49%	2.47%	2.52%	2.48%	2.35%	2.28%	2.33%	2.43%	2.54%
2010																				3.21%	3.00%	2.60%	2.54%	2.54%	2.47%	2.38%	2.37%	2.43%	2.40%	2.27%	2.20%	2.26%	2.38%	2.50%
2011																					2.79%	2.29%	2.31%	2.37%	2.32%	2.24%	2.25%	2.34%	2.32%	2.17%	2.11%	2.18%	2.31%	2.45%
2012																						1.80%	2.08%	2.23%	2.21%	2.13%	2.17%	2.27%	2.26%	2.10%	2.04%	2.12%	2.27%	2.42%
2013																							2.35%	2.45%	2.34%	2.22%	2.24%	2.35%	2.32%	2.14%	2.06%	2.15%	2.32%	2.47%
2014																								2.54%	2.34%	2.17%	2.21%	2.35%	2.32%	2.11%	2.03%	2.13%	2.31%	2.48%
2015																									2.14%	1.99%	2.10%	2.30%	2.27%	2.04%	1.96%	2.08%	2.29%	2.48%
2016																										1.84%	2.09%	2.36%	2.31%	2.02%	1.93%	2.07%	2.30%	2.51%
2017																											2.33%	2.62%	2.46%	2.07%	1.94%	2.11%	2.37%	2.60%
2018																												2.91%	2.53%	1.98%	1.84%	2.07%	2.38%	2.64%
2019																													2.14%	1.52%	1.49%	1.86%	2.27%	2.59%
2020																														0.89%	1.17%	1.76%	2.30%	2.68%
2021																															1.44%	2.19%	2.78%	3.13%
2022																																2.95%	3.45%	3.70%
2023																																	3.96%	4.08%
2024																																		4.21%





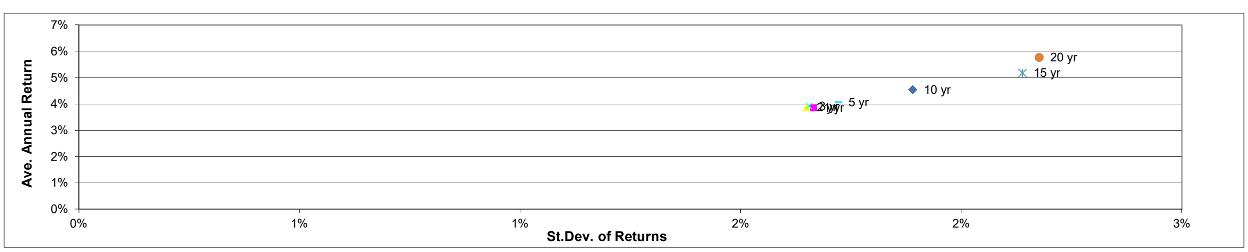


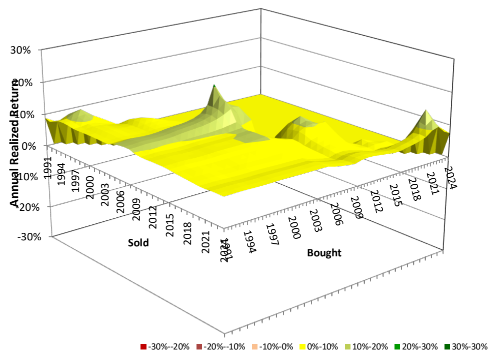
Figure 9. Buy-sell return performance, 10-yr Treasury security yields 1991-2024

US Ag 32 States

Buy (beginning of year) / Sell (end of year)

Buy \ Sell	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
1991	8.83%	8.25%	8.93%	9.65%	9.73%	9.57%	9.27%	9.25%	9.31%	9.34%	9.33%	9.29%	9.24%	9.24%	9.97%	10.27%	10.48%
1992		7.68%	8.98%	9.93%	9.96%	9.72%	9.34%	9.31%	9.37%	9.40%	9.38%	9.34%	9.28%	9.27%	10.05%	10.36%	10.58%
1993			10.29%	11.07%	10.72%	10.24%	9.67%	9.58%	9.61%	9.62%	9.57%	9.50%	9.42%	9.40%	10.23%	10.56%	10.78%
1994				11.87%	10.94%	10.22%	9.52%	9.44%	9.50%	9.52%	9.48%	9.42%	9.34%	9.32%	10.23%	10.58%	10.82%
1995					10.03%	9.41%	8.75%	8.85%	9.03%	9.14%	9.15%	9.11%	9.06%	9.07%	10.08%	10.47%	10.74%
1996						8.80%	8.12%	8.46%	8.78%	8.96%	9.00%	8.98%	8.94%	8.96%	10.09%	10.51%	10.80%
1997							7.44%	8.29%	8.78%	9.00%	9.04%	9.01%	8.96%	8.98%	10.23%	10.68%	10.98%
1998								9.13%	9.45%	9.53%	9.44%	9.33%	9.21%	9.21%	10.59%	11.05%	11.34%
1999									9.77%	9.72%	9.54%	9.38%	9.23%	9.22%	10.79%	11.29%	11.59%
2000										9.67%	9.43%	9.25%	9.09%	9.11%	10.97%	11.51%	11.82%
2001											9.19%	9.04%	8.90%	8.97%	11.22%	11.82%	12.12%
2002												8.89%	8.76%	8.89%	11.74%	12.35%	12.62%
2003													8.62%	8.89%	12.71%	13.24%	13.38%
2004														9.16%	14.80%	14.82%	14.61%
2005															20.74%	17.75%	16.48%
2006																14.84%	14.41%
2007																	13.97%

Buy \ Sell	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
1991	10.46%	9.83%	9.59%	9.57%	9.66%	9.67%	9.68%	9.54%	9.29%	9.12%	8.94%	8.79%	8.59%	8.57%	8.76%	8.78%	8.74%
1992	10.56%	9.88%	9.63%	9.60%	9.70%	9.70%	9.72%	9.57%	9.30%	9.13%	8.95%	8.79%	8.58%	8.57%	8.76%	8.78%	8.74%
1993	10.74%	10.02%	9.74%	9.70%	9.80%	9.80%	9.81%	9.65%	9.37%	9.19%	9.00%	8.83%	8.61%	8.60%	8.79%	8.82%	8.77%
1994	10.77%	10.00%	9.70%	9.67%	9.77%	9.78%	9.79%	9.62%	9.33%	9.14%	8.95%	8.77%	8.55%	8.54%	8.74%	8.77%	8.73%
1995	10.70%	9.87%	9.57%	9.54%	9.66%	9.67%	9.69%	9.52%	9.22%	9.03%	8.83%	8.65%	8.42%	8.42%	8.63%	8.66%	8.62%
1996	10.75%	9.86%	9.54%	9.51%	9.63%	9.65%	9.67%	9.49%	9.18%	8.98%	8.77%	8.59%	8.36%	8.35%	8.58%	8.62%	8.57%
1997	10.91%	9.95%	9.59%	9.56%	9.69%	9.70%	9.72%	9.53%	9.20%	8.99%	8.77%	8.59%	8.34%	8.34%	8.57%	8.61%	8.57%
1998	11.23%	10.16%	9.76%	9.72%	9.84%	9.84%	9.85%	9.65%	9.29%	9.07%	8.84%	8.64%	8.38%	8.37%	8.62%	8.65%	8.61%
1999	11.45%	10.25%	9.81%	9.76%	9.89%	9.89%	9.90%	9.68%	9.30%	9.06%	8.82%	8.61%	8.35%	8.34%	8.59%	8.63%	8.59%
2000	11.63%	10.30%	9.82%	9.76%	9.90%	9.90%	9.90%	9.67%	9.27%	9.02%	8.77%	8.56%	8.28%	8.28%	8.54%	8.59%	8.54%
2001	11.88%	10.37%	9.83%	9.77%	9.92%	9.91%	9.92%	9.67%	9.25%	8.99%	8.72%	8.50%	8.21%	8.21%	8.49%	8.54%	8.49%
2002	12.27%	10.52%	9.90%	9.82%	9.98%	9.97%	9.98%	9.71%	9.25%	8.97%	8.70%	8.46%	8.16%	8.16%	8.46%	8.51%	8.46%
2003	12.84%	10.75%	10.03%	9.93%	10.09%	10.07%	10.07%	9.77%	9.28%	8.98%	8.68%	8.43%	8.12%	8.12%	8.44%	8.49%	8.44%
2004	13.71%	11.11%	10.23%	10.09%	10.26%	10.22%	10.20%	9.86%	9.33%	9.00%	8.69%	8.42%	8.09%	8.09%	8.43%	8.49%	8.44%
2005	14.87%	11.50%	10.41%	10.23%	10.39%	10.34%	10.30%	9.93%	9.34%	8.99%	8.65%	8.37%	8.02%	8.03%	8.39%	8.45%	8.40%
2006	12.98%	9.31%	8.46%	8.57%	8.99%	9.10%	9.20%	8.90%	8.36%	8.07%	7.78%	7.54%	7.23%	7.28%	7.70%	7.81%	7.79%
2007	12.06%	7.52%	6.91%	7.35%	8.05%	8.31%	8.52%	8.26%	7.73%	7.47%	7.21%	7.00%	6.70%	6.80%	7.27%	7.41%	7.41%
2008	10.18%	4.44%	4.66%	5.76%	6.90%	7.39%	7.76%	7.57%	7.06%	6.84%	6.61%	6.44%	6.16%	6.30%	6.84%	7.01%	7.03%
2009		-1.01%	2.00%	4.32%	6.09%	6.84%	7.36%	7.20%	6.68%	6.48%	6.26%	6.10%	5.83%	6.01%	6.60%	6.80%	6.84%
2010			5.11%	7.10%	8.57%	8.90%	9.12%	8.63%	7.83%	7.45%	7.10%	6.84%	6.48%	6.62%	7.21%	7.38%	7.39%
2011				9.12%	10.34%	10.19%	10.14%	9.35%	8.29%	7.79%	7.35%	7.04%	6.62%	6.76%	7.39%	7.56%	7.55%
2012					11.58%	10.73%	10.49%	9.41%	8.12%	7.57%	7.10%	6.78%	6.34%	6.52%	7.23%	7.43%	7.43%
2013						9.88%	9.95%	8.69%	7.27%	6.78%	6.37%	6.11%	5.70%	5.97%	6.81%	7.06%	7.09%
2014							10.01%	8.11%	6.41%	6.02%	5.69%	5.49%	5.12%	5.50%	6.47%	6.78%	6.84%
2015								6.24%	4.66%	4.73%	4.63%	4.61%	4.33%	4.87%	6.04%	6.43%	6.53%
2016									3.11%	3.98%	4.10%	4.21%	3.95%	4.64%	6.01%	6.45%	6.56%
2017										4.86%	4.61%	4.58%	4.16%	4.95%	6.50%	6.94%	7.00%
2018											4.35%	4.44%	3.93%	4.97%	6.83%	7.29%	7.31%
2019												4.52%	3.72%	5.18%	7.46%	7.89%	7.81%
2020													2.91%	5.51%	8.45%	8.74%	8.48%
2021														8.17%	11.33%	10.76%	9.92%
2022															14.59%	12.08%	10.51%
2023																9.62%	8.53%
2024																	7.44%



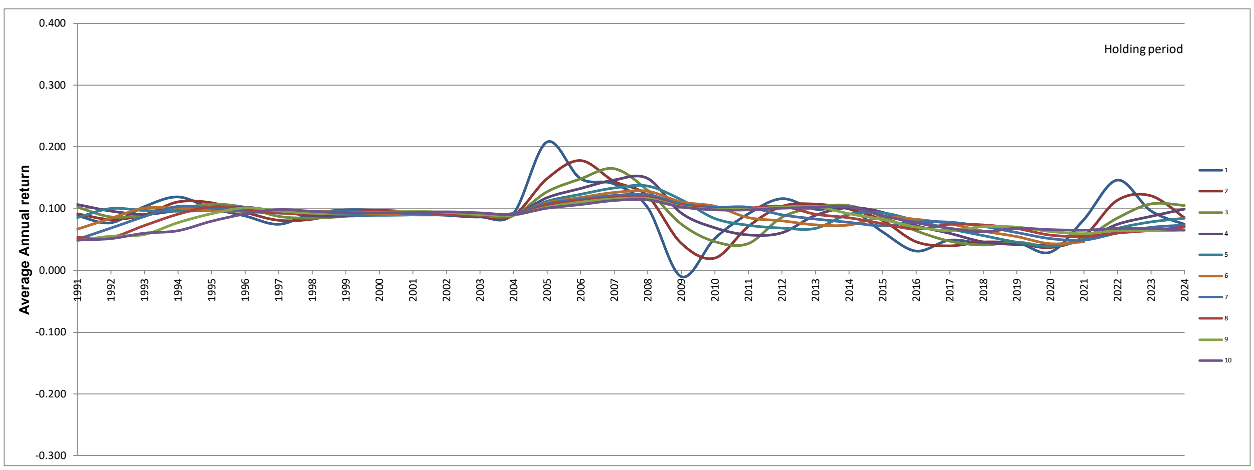


Figure 10. Buy Sell performance US Ag 32 State returns, 1991-2024

Portfolio Considerations

This section of the analysis evaluates the implications of adding farmland to a mixed asset portfolio and documents the impacts on portfolio-level risk efficiency, the maximum Sharpe ratio, and other features of farmland's interactions with other assets returns. To begin, figure 11 shows the individual portfolio assets being considered in a traditional E-V or expected return-volatility of returns graphic, for the period 1991-2024.

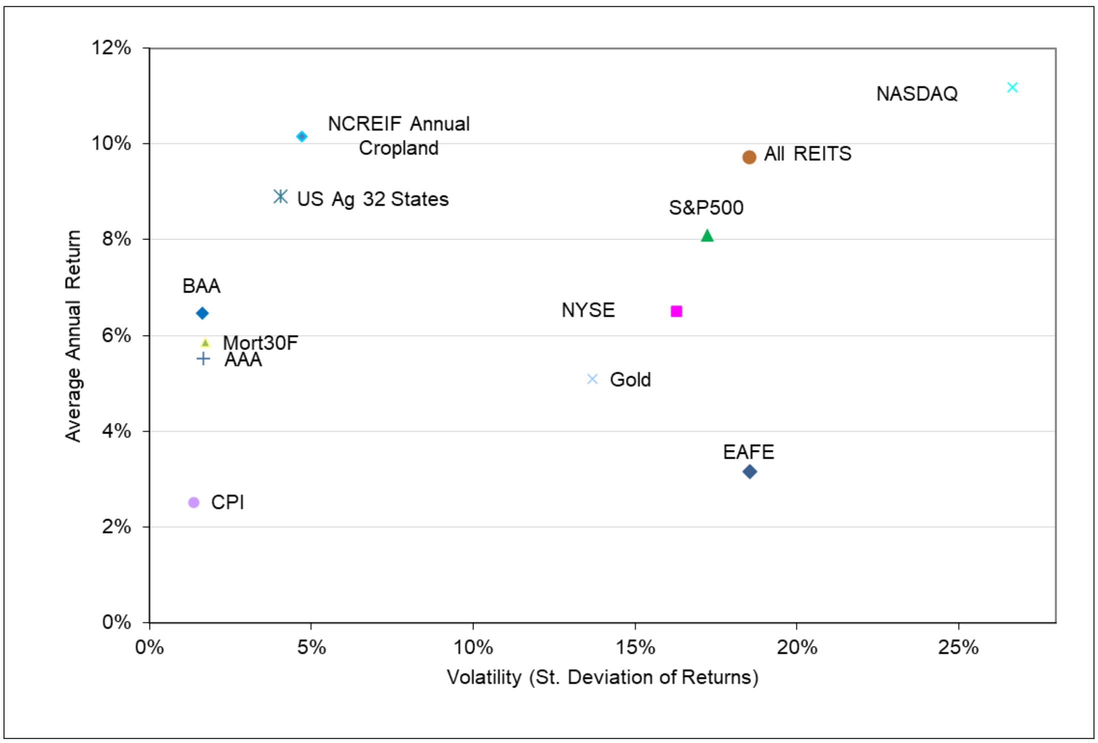


Figure 11. Risk-return characteristics of alternative asset classes and inflation measures

When evaluating the portfolio desirability of an asset, it is important to understand its role in diversification, its relationship to inflation, and other factors that affect future purchasing power. Measures of correlation provided earlier summary the degree to which returns move together, and hence the degree of diversification benefit is attainable from holding them together. Positive correlation with inflation is likewise desirable as it provides a greater hedge against the erosion of purchasing power, but it is not considered as an asset in the traditional sense of course despite its inclusion in the graph. Some consider gold to be an inflation hedging asset, but the correlation between gold returns and inflation has only been around 9% in the period since 1991. Moreover, gold is also sometimes viewed as a safe haven against equity returns, but that relationship seems somewhat in question given the correspondence in all-time highs in both gold and equity market indexes in late 2025.

To provide a broad sense of the impact of inclusion of farmland within a mixed asset portfolio, a standard approach is used of comparing the optimized holdings both with and without farmland as a potential asset to include alongside equites and fixed income related positions. Simple measures of both the Sharpe ratio and the more complete risk-efficient frontier depicting the entire set of possible risk-efficient holdings are solved to show the impact of farmland additions to more traditional diversified portfolio holdings. The practical limitations of the farmland market, and sensible restrictions within actual practices are considered as well by testing the degree to which returns and risk measures could be altered before fundamentally affecting the results.

To begin, a stylized equity and fixed income portfolio consisting of shares of S&P, AAA bonds, 10-yr.Treasuries (TCM-10), and alternative real estate positions is formed and the portfolio level expected returns ($E(r_p)$) and standard deviation (σ_p) and Sharpe ratio computed. (Table 3) In portfolio (a), the base case with 60% in the S&P equity index, 30% in AAA bonds, and 10% in 10-yr Treasuries results in a portfolio return that averaged 7.15% with a standard deviation of 10.4% and resulting Sharpe ratio of .399. All results are computed with an assumed 3% risk free rate. In column (b) 20% is allocated to farmland using the NCRIEF results as the proxy. The results indicate an increase in the portfolio mean return and Sharpe ratio. The reduction in the portfolio risk and increasing average return are consequences of the low correlations with farmland and the relatively high return to farmland. In column (d) the only change from the previous is that the US Ag 32 index is used as the measure of farmland returns.

The results are somewhat insensitive in terms of the reduction of risk and the improvement in the Sharpe ratio, but with slightly lower returns than the NCREIF index over this period, the US Ag-32 inclusion increases the return over case (a), but not as much as the NCREIF index. Finally, column (d) results are generated by solving for the weights that maximize the Sharpe ratio to demonstrate the im-portfolio impact of allowing all three of the real estate categories to enter. The impressive reduction in risk and the associated improvement in the Sharpe ratio come at the expense of return of course, but this example demonstrates the importance in risk mitigation that the farmland (and REIT) real estate shares provide.

Table 3. Sharpe Ratio and Portfolio Performance by asset class share

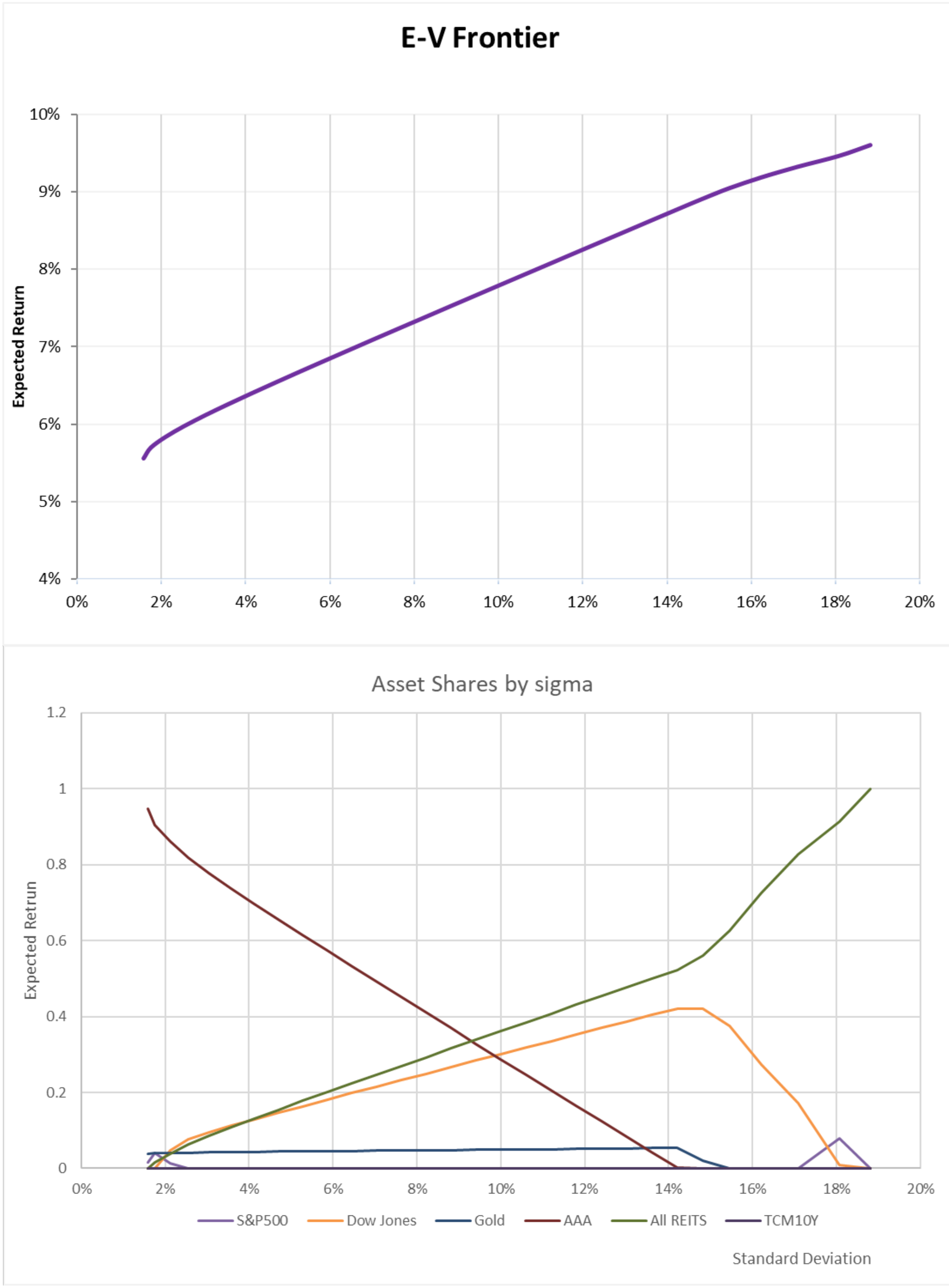
Asset	(a)	(b)	(c)	(d)
S&P500	60%	50%	50%	3.0%
AAA	30%	20%	20%	70.6%
TCM10Y	10%	10%	10%	0.0%
NCREIF Annual Cropland		20%		15.2%
US Ag 32 States			20%	7.7%
All REITS				3.6%
Portfolio				
$E(r_p)$	7.15%	7.71%	7.48%	6.50%
σ_p	10.40%	8.59%	8.55%	1.65%
Sharpe ratio	0.399	0.548	0.524	2.120

Data from 19981-2024, risk-free rate =3%

Moving next to a more generalized risk optimization framework, it is instructive to demonstrate the impact of adding farmland to a mixed asset portfolio across all feasible risk efficient portfolios. The approach creates a traditional return vs. risk or “E-V” frontier by solving for weights across this set of candidate investments that result in the minimum risk for each possible level of return. The approach is implemented by first solving for the weights that result in the global minimum risk portfolio, and then parametrically varying an additional restriction that the return increases from the level associates with the minimum risk portfolio to maximum return available across the individual assets. It can be thought of as finding the envelope of all possible risk-efficient combinations of assets from figure 11. No risk-free asset is included and no short sales were permitted throughout.

The baseline case is provided in figure 12 below. In the top panel, the E-V frontier shows the achievable return levels for each level of risk. In the bottom panel the shares of each asset at the corresponding point on the EV frontier above. As shown, the low risk-low return portfolio is dominated by a combination of around 95% AAA bonds as expected and a small combination of other assets that combine in a risk efficient fashion. REITS and equities begin to substitute for the bonds as the return increases and a small amount of gold between 3-4% stays in the portfolio over a wide range of outcomes until REIT fractions have to increase to gain the return at the expense of risk. Although the scale makes it difficult to see, the EV frontier is concave indicating that increasingly greater risk per unit of return is required as the portfolio positions move toward higher returns. This presentation is very standard and agrees qualitatively with both intuition and theory, and in the central range roughly mirrors traditional allocation models (and while not shown, if gold is excluded, the share loading moves mainly toward equities and REITs in this case).

Figure 12. Efficient risk-return frontier and associated asset shares by risk level.



To identify the impact of adding farmland to the opportunity set, the analysis was re-run with the option to include US Ag 32 farmland in the portfolio. Due to the low relative risk, low to negative correlation with equities and other real estate, and the relatively high return, the unrestricted analysis results in a very high share of farmland which then is replaced nearly 1:1 with REITs as the return moves to the highest allocations. Perhaps the simplest summary is to plot the resulting efficient frontier from figure 13 above with the resulting EV frontier when US Ag 32 farmland is available. In the central sections of the graph, the implied allocation to farmland exceeds 65% which is an impractical position for a large holdings, except perhaps as an individual farm owner. While the results do not suggest a practical portfolio, it is important to be included in the allowable assets, the remarkable feature is that the risk-efficient portfolio contains over 60% farmland at roughly the middle range of the feasible risk range. As the portfolio proceeds to the higher and higher return-risk combinations, farmland becomes the majority asset and then gives way to the highest risk-highest return single asset. This general result has been noted in prior work, and is typically explained away as “not easily adjusted” holdings, or due to omitted higher transactions costs, or unfeasibly long holding periods. It remains remarkable, however, that farmland returns measured in aggregate generate this result at all, regardless of the source of the deviation from empirical shares actually held.

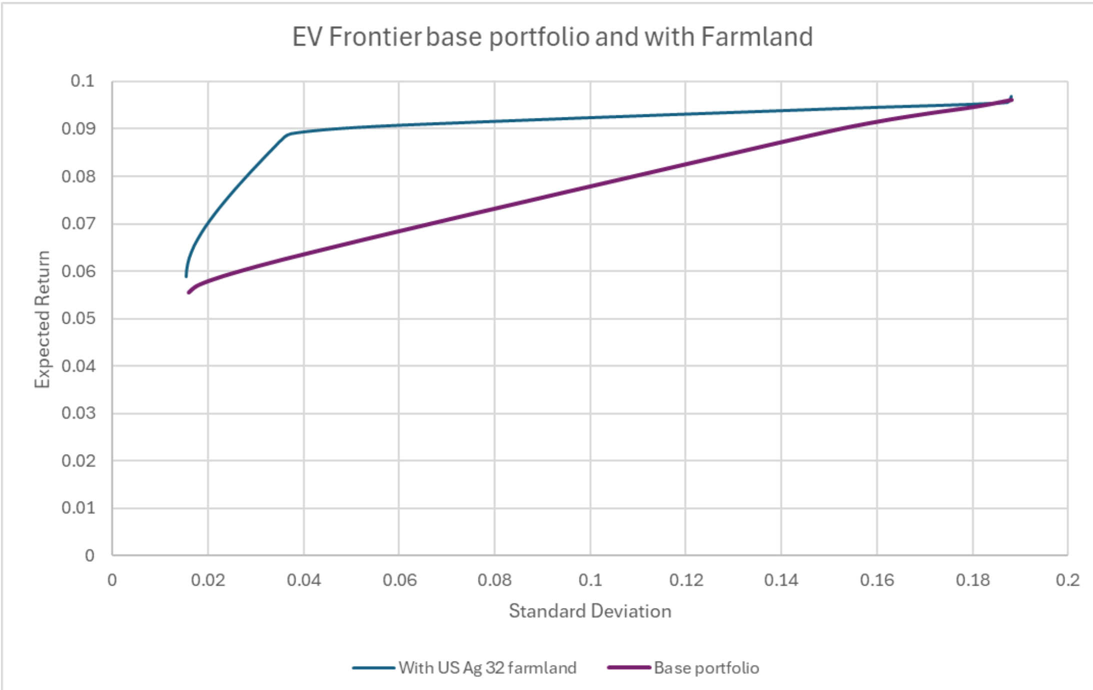


Figure 13. EV frontiers with and without farmland inclusion

To assess the impact of restricted portfolio holdings as might be more typical in real investment considerations, the exercise is repeated again, but with maximums of 25% by class, ensuring that at least 4 assets enter at each point in the restricted set. Interestingly, figure 14 displays the feature that the restriction actually increases the optimal holdings of farmland relative to fixed income assets, and gold and other real estate also enter in larger proportions. What might at first seem counterintuitive given the unrestricted portfolio results simply reflects the fact that farmland's returns are measured to have low volatility and hence substitute for the treasury securities at low risk levels on the E-V curve. The primary impact of the restriction is to lower the overall attainable returns profile.

Finally, to consider the impact of market frictions, farmland returns are reduced by 2% each period (to reflect transactions costs, management, etc.) and risk is increased by multiplying the variance by 130% of its sample value to reflect the possibility of smoothed aggregation bias. Importantly, there is little effect as farmland still enters the efficient frontier are relatively high levels throughout, though reduced from the unrestricted set, shown in figure 14. The main impacts again are on the achievable EV set where the lower return simply reduces the attainable return levels, but the risk mitigation effects remain. The robustness of the results to various potential levels of additional costs or risk required to include farmland is an important result as well. In other words, even if effective returns are diminished through higher transaction and management costs, and even if the variability is understated due to aggregation effects, the primary findings are qualitatively identical.

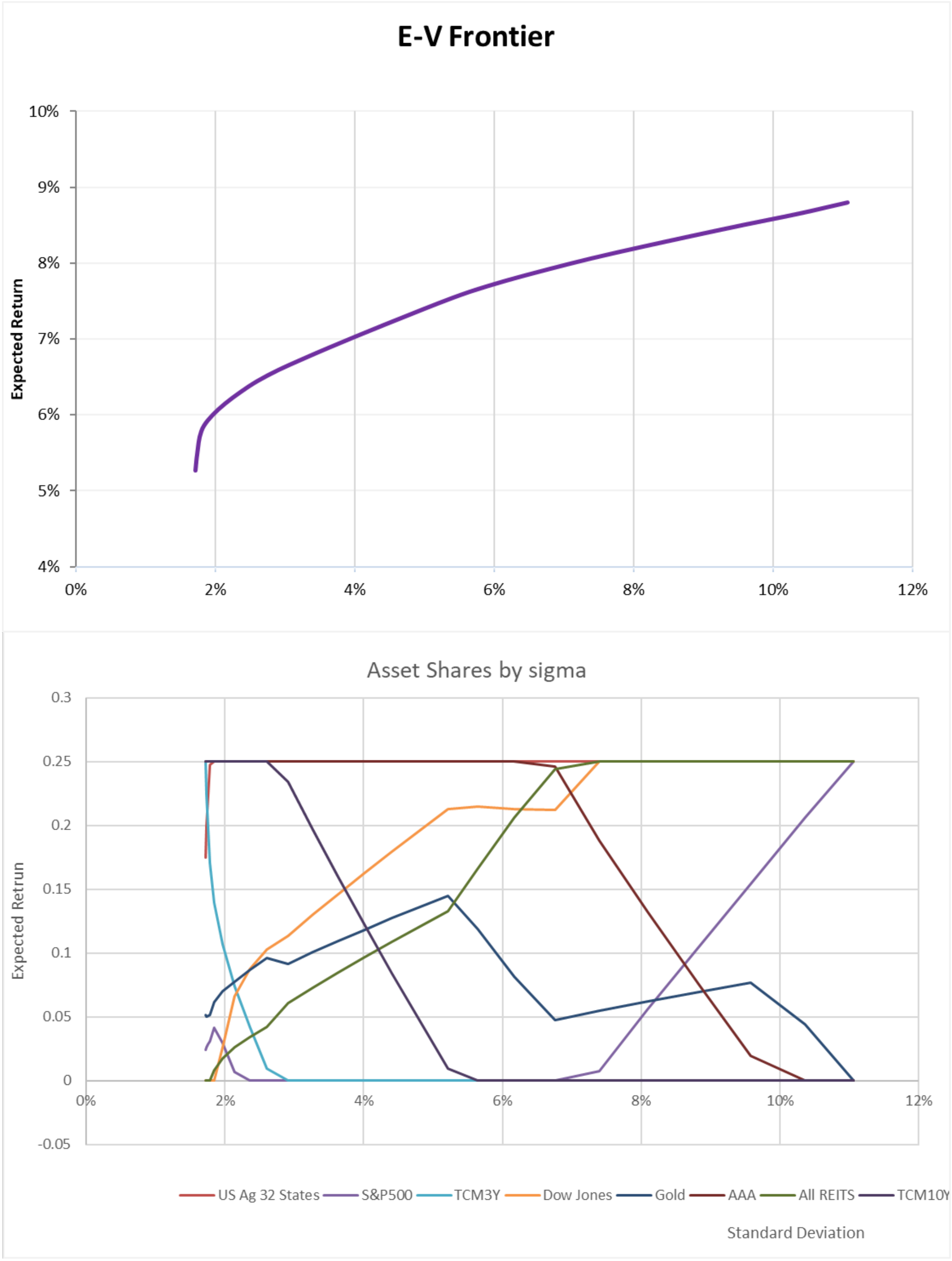


Figure 14. E-V frontier and shares of assets with max 25% restrictions

Summary and Implications

The evidence from a wide range of perspectives identifies farmland as an asset with stable relative income returns, stable total returns, strong correlation to traditional inflation statistics, relative negative correlation to other forms of financial assets and an investment periodicity which is unrelated to traditional financial asset classes. Investors have been increasingly motivated to explore agricultural investments as a result, and the continued elevated interest in the asset class has resulted in expanded institutional investments and increasingly available investor conduits into farmland assets.

The evaluation of farmland as a portfolio asset has been explored intermittently for several decades and the results herein continue to amplify the message that farmland has strong diversification benefits in a mixed asset portfolio, and strong long-term inflation hedging benefits as well. The income portion of the returns to farmland tends to be lower than and more stable than the long-term capital appreciation and thus a natural pool of investors who favor tax efficiency and perhaps long-duration hold periods do appear to make sense as these seem to be the emerging farmland buyers and aggregators.

It is important to view the results with an appreciation of the length of time over which these same or similar results have held, in particular because of the current pressures on farmland values arising from lower commodity prices and incomes, and international trade concerns related to tariffs and currency value uncertainty. The long-term thesis for expanded caloric demand that depends on row crop production to satisfy growing populations with improving diets and increasing fuel and energy uses remains intact and supportive through what can only be described as unprecedented efforts to restructure world trade.

In virtually all cases, the evidence suggests that the investment class has performed well whether viewed in isolation, or as a complement to other investment holdings and should be considered when evaluating any mixed-asset investment set. Returning to the opening questions, the returns from capital gains and current income less current property taxes provides one measure of the investment performance that is somewhat comparable to an equity investment that pays dividends and also experiences capital gains/losses and farmland has performed exceptionally well in this regard. The variability of returns to farmland investments demonstrates exceptional “risk efficiency” with reasonably low risk per unit of return whether viewed in isolation or in portfolio. Acquiring and managing real investments does require greater expertise than that for most financial assets, but it is hard to imagine that transaction costs, or asset specific knowledge has caused the relative performance to remain so attractive. Moreover, the results when using either the NCREIF data, or the longer-lived US Ag-32 indexing system are incredibly similar and stable over nearly any sample period examined. The correlations of returns are low or negative with most other investments that might accompany farmland in a portfolio, and perhaps most importantly, farmland returns have shown positive correlation with inflation measures. As always, one must be careful when interpreting the past as a projection of the future, but as an asset class, the returns performance has been remarkable in both levels and in measures of stability.

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Endnotes:

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[i] NCREIF is a non-profit association for institutional real estate professionals, serving as a data aggregator and industry standard-setter for commercial real estate investment performance.

ii Notable increased interest in farmland as a wealth preservation strategy seems to also follow periods of extreme upward movement in equity markets as well. Recently increased interest in farmland may also signal increasing concern about equity market stability in which investors are looking for risk offramps to some extent.

[iii] Data on the equity indexes were obtained from MSCI and Dow-Jones, REIT returns data from the NAREIT data warehouse, Treasury instrument data from the Federal Reserve h.15 release, and corporate debt rates from Moody's Investor Services.

[iv] Data from ERS on cropland values from 1970-1996 were spliced with data from NASS from 1995-2009. The splice was done using base values from the later data set to avoid any irregularities from the switch in data sources. Property tax rates were estimated at state levels from ERS sources on total farmland property taxes paid divided by total farmland values, excluding operator dwellings. The tax rates are then applied to farmland totals from both NASS and ERS sources.