Introduction

Farmland assets have delivered consistently strong returns over the past two decades. Private institutional investment in farmland delivered an average annualized return of 12.4 percent, while row and permanent crops generated average annualized returns of 11.4 percent and 12.8 percent, respectively over the past twenty years (1996 - 2015). In the six years following the Global Financial Crisis, investments in farmland outperformed timberland investments, the S&P 500, Small Cap Stocks, Corporate Bonds, and Long-term Government Bonds, generating average annualized returns of 14.8 percent for the period 2010-2015 (Figure 1). These strong returns on farmland assets coincide with an extended period of low interest rates and the Federal Reserve’s unprecedented accommodative monetary policy following the Global Financial Crisis.

In December 2015, the Federal Reserve took its first step to increasing interest rates, raising their target for the Fed Fund rate by 25 bps and indicating that the Fed Fund rate will continue to move higher over the next two years to a range of 2.0 - 3.5 percent by the end of 2017. After remaining near zero since 2008, this turning point for short-term interest rates raises the question as to whether a shift in monetary policy will negatively impact farmland returns. Many investors are concerned over what normalizing could mean to farmland asset returns. It is these concerns that prompted our investigation to evaluate the impact of rising interest rates on farmland returns.

We find that past periods of rising interest rates suggest that farmland returns have a moderate negative correlation with interest rates and that higher interest rates will represent modest headwinds for farmland returns. However, the Federal Reserve’s commitment to a “cautious” approach to monetary tightening will likely limit the influence of the expected interest rate increases on farmland returns. Broader market trends, and policy and trade developments, are more likely to have a greater impact on farmland returns than tightening monetary policy.
Methodology and Data

The yield on the 10-Year Treasury bond was used as the interest rate variable. The measure of farmland returns was constructed from the National Council of Real Estate Investment Fiduciaries (NCREIF) Farmland Property Index for the period 1991-2015 and the Ibbotson Associates Farm Real Estate Index was utilized for 1971-1990. These return series’ represent a combination of farm income (operating revenue and land sales) and capital appreciation.

This analysis assessed the historical relationship between farmland returns and interest rates over a forty-five year period from a number of perspectives:

1. A regression analysis to determine the degree to which the level of interest rates has value as a predictive indicator of farmland returns;
2. A correlation analysis to quantify the direction and magnitude of the relationship between farmland returns and interest rates;
3. A qualitative review of farmland returns during, and immediately following, past periods of rising real interest rates to gauge the interaction of inflation-adjusted interest rate movements with other market factors.

Results

Least squared regressions were conducted over the forty-five year period, 1971-2015, on both a nominal and inflation-adjusted basis. In both cases, a statistically significant negative relationship was demonstrated between the level of interest rates and returns on farmland. P-values in both the nominal and inflation-adjusted regressions were smaller than 0.05, indicating that the estimated βs are significant. Scatterplots with the fitted lines generated by the regressions illustrate the negative relationships between farmland returns and interest rates (Figure 2. and Figure 3. on page 4). Adjusting for inflation strengthened the relationship between interest rates and returns considerably. The relationship between inflation-adjusted interest rates and farmland returns exhibited a more negative slope, a lower standard error, a lower p-value and a higher R-squared value when compared to the nominal regression results (See End Notes, page 7).

R-squared values measure the explanatory powers of the model, and the regression analysis indicates that nominal interest rates explain 10 percent of the standard deviation of the changes in nominal farmland returns, while inflation-adjusted interest rates explain 18 percent of the standard deviation of inflation-adjusted farmland returns (Table 1, on page 5).
Farmland Returns: Gauging the Impact of Rising Interest Rates

Figure 2: Relationship Between Nominal Farmland Returns and Interest Rates (1971 - 2015)

Figure 3: Relationship Between Real Farmland Returns and Interest Rates (1971 - 2015)
The correlation between nominal farmland and nominal interest rates over the entire forty-five year period, 1971-2015, was moderately negative, with the nominal values showing a correlation of -0.43 and the correlation becoming more negative (-0.57) when both variables are adjusted for inflation (Table 1). Inflation-adjusted interest rates have a decidedly more negative relationship with real farmland returns, supporting the thesis that tighter monetary policy has implications for real farmland returns.

**Table 1: Farmland Returns and Interest Rates - Correlation and R-squared - 1971-2015**

<table>
<thead>
<tr>
<th></th>
<th>Correlation</th>
<th>R-squared values</th>
<th>Standard Deviation Explained (percent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal</td>
<td>-0.43</td>
<td>0.182</td>
<td>10.0</td>
</tr>
<tr>
<td>Real</td>
<td>-0.57</td>
<td>0.324</td>
<td>18.0</td>
</tr>
</tbody>
</table>

Source: NCREIF, Ibbotson, CBOE, HNRG Research

The correlation between nominal farmland and nominal interest rates over the entire forty-five year period, 1971-2015, was moderately negative, with the nominal values showing a correlation of -0.43 and the correlation becoming more negative (-0.57) when both variables are adjusted for inflation (Table 1). Inflation-adjusted interest rates have a decidedly more negative relationship with real farmland returns, supporting the thesis that tighter monetary policy has implications for real farmland returns.

**Farmland Returns: Gauging the Impact of Rising Interest Rates**

In light of the statistical evidence showing a moderate negative relationship between inflation-adjusted interest rates and inflation-adjusted farmland returns historically, we examined specific periods when real interest rates rose over a sustained period to determine whether a predictable pattern is apparent in the reaction of farmland returns to episodes of real tightening in credit conditions. Since institutional investment in farmland is a long-term investment, not suited to high-frequency trading, we defined the minimum length of time which characterizes a period of sustained increases in real interest rates to be two years. Three periods are identified with real interest rate increases meeting this two year criteria: 1975-76, 1980-82 and 2000-2001. All three periods of sustained increases in real interest rates overlapped with officially designated economic recessions (Figure 4, on page 6).

Looking across the three periods of sustained real interest rate hikes, no consistently repeatable pattern is discernible. In the first period, 1975-1976, inflation-adjusted farmland returns averaged 14.6 percent per year despite significant increases in real interest rates. The increase in real interest rates was substantial enough to be a contributing factor in the recession that occurred during this period. In the 1970s, the impact of rising real interest rates on farmland returns...
was subordinated to much more powerful policy and geopolitical factors that resulted in a historic boom period in agricultural commodity prices and farmland returns.

In the early 1970s, the convergence of a series of disastrous grain harvests in Russia and a shift in U.S. trade policy promoting off-shore trade resulted in strong growth in exports of U.S. grain and peak agricultural commodity prices, overshadowing tighter credit conditions and the downturn in the U.S. domestic economy. As a result, farmland returns increased substantially despite rising interest rates.

The period 1980-1982 is the most notable episode in the 45 years surveyed in which an increase in real interest rates is associated with a downward correction in inflation-adjusted farmland returns. During the period 1980-1982, the ten-year bond rate increased 15.7 percent and inflation-adjusted farmland returns declined an average of -1.1 percent. In the four years immediately following the increase in interest rates, farmland returns declined further to an average of -5.6 percent (Table 2, on page 7).

Although the Federal Reserve’s aggressive tightening of monetary policy under the leadership of Paul Volcker at the end of 1970s resulted in a significant economic recession in the U.S., a number of other concurrent negative factors added to the depth of the downturn in the farm sector in the first-half of the 1980s. Strong agricultural commodity prices in the late 1970s encouraged farmers to expand acreage under cultivation and boosted agricultural production to record levels. At the same time, demand for U.S. grains was negatively impacted by the January 1980 embargo on exports to Russia, which triggered a sharp drop in grain prices. Both domestic and export demand for U.S. grain was also negatively impacted by the 1981-1982 downturn in the U.S. economy and the associated slowdown in global economic growth.
In the most recent period of sustained rising real interest rates, 2000-2001, inflation-adjusted farmland returns declined to an annual average of 0.5 percent, down from an average of 4.9 percent in the preceding three years. Although this period of monetary tightening coincided with the Dotcom bust and the accompanying recession in the U.S. economy, the U.S. farm sector was more directly impacted by weak export demand following the Asian financial crisis in the late 1990s, strong production levels supported by a number of ad hoc U.S. government payment programs to crop producers, and increased production in South America which led to higher stocks and lower agricultural commodity prices (Table 2.)

<table>
<thead>
<tr>
<th>Period</th>
<th>Increase in Interest Rates</th>
<th>Average Real Farmland Total Return</th>
<th>Average Farmland Total Return Following an Interest Rate Increase (4 year period)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1975 - 1976</td>
<td>7.3</td>
<td>14.6</td>
<td>7.4</td>
</tr>
<tr>
<td>1980 - 1982</td>
<td>15.7</td>
<td>-1.1</td>
<td>-5.6</td>
</tr>
<tr>
<td>2000 - 2001</td>
<td>2.0</td>
<td>0.5</td>
<td>14.1</td>
</tr>
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Source: NCREIF, CBOE, HNRG Research

The Fed’s expected move to a series of increased interest rates over the next few years will present a headwind to farmland returns. Statistically, this study identified and quantified the moderate negative relationship between interest rates and farmland returns. However, our review of historical precedents suggests that rising interest rates are more an associated rather than a directly causative factor in declining farmland returns. In past periods of rising real interest rates, market factors such as overseas trade and government policy have been identified as the primary determining factors driving agricultural commodity prices and the performance of farmland returns rather than rising interest rates.

End Notes

<table>
<thead>
<tr>
<th></th>
<th>α</th>
<th>β</th>
<th>R²</th>
<th>t Stat</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal Regression</td>
<td>19.755</td>
<td>-1.241</td>
<td>0.182</td>
<td>-3.094</td>
<td>0.003</td>
</tr>
<tr>
<td></td>
<td>(2.892)</td>
<td>(0.401)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Real Regression</td>
<td>11.204</td>
<td>-1.484</td>
<td>0.324</td>
<td>-4.541</td>
<td>0.000</td>
</tr>
<tr>
<td></td>
<td>(1.289)</td>
<td>(0.327)</td>
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</tbody>
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Note: standard errors in parenthesis. 45 observations per regression.

Farmland total returns were estimated by the equation:

\[ Y = \alpha + \beta x + \epsilon \]

Where:

- \( Y \) = Annual Farmland Total Return
- \( \alpha, \beta \) = Estimation Parameters
- \( x \) = Annual 10 Year Treasury Yield
- \( \epsilon \) = Error term