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Theme Overview: Will Rising Interest Rates Lead to Intensifying Risks for Agriculture?

Ryan Kuhns and Kevin Patrick

JEL Classifications: Q14, Q11, Q17, G21
Keywords: Agricultural Finance; Interest Rates; Monetary policy; Agricultural commodity prices; Farmland Values

Articles in this theme:

To encourage economic recovery, the Federal Reserve responded to the Great Recession by slashing interest rates and engaging in monetary easing. Short-term interest rates were pulled down and held near zero for several years. Due to these historically low interest rates, borrowing has been inexpensive for farmers. Along with lower income, the availability of cheap debt encouraged farmers to take on more credit. According to the most recent official USDA Farm Income and Wealth Statistics data (2018), farm sector debt has grown by more than 50% since the Great Recession began. In 2018, outstanding sector debt volume is projected to reach its highest level since the early 1980s, and debt backed by farm real estate is expected to be at the highest level on record.

Recently, the Federal Reserve changed its policy course on interest rates. Since December 2015, the Federal Open Market Committee (FOMC) has raised the federal funds rate by 125 basis points. Continued gradual increases are expected. An increase in the federal funds rate makes it costlier for lenders to obtain funds, which puts upward pressure on interest rates throughout the economy. The FOMC also announced in June 2017 that the Federal Reserve will gradually reduce their holdings of assets, including U.S. treasuries and mortgage-backed securities, which were built up during the recent period of quantitative easing (Federal Open Market Committee, 2017); the FOMC has since indicated it has begun to implement the policy by not reinvesting to replace some of these maturing assets. The likely impact of this policy shift is additional upward pressure on interest rates, particularly on longer-term debt. With rising interest rates, the era of relatively inexpensive farm debt may be coming to an end. This raises the question: Are farmers prepared for rising interest rates?

Following historically high profitability for many farm sector participants from 2012 through 2014, prices for many commodities have declined substantially while input costs have not declined as much (Patrick, Kuhns, and Borchers, 2016). As result, net farm income, a measure of farm sector profitability, is now half of its peak in 2013. As one way to compensate for reduced income, farmers tapped into working capital built up during the preceding high-income years. As a result, farm sector working capital has declined by $100 billion since 2012. As previously mentioned, farmers also borrowed more. Multiple years of expanding farm sector debt and declining profitability and liquidity have raised concerns about the farm sector's financial resiliency.

Rising interest rates make it more expensive to service debt, potentially hurting profitability. Interest rates are also widely expected to influence real estate values (Barry and Ellinger, 2012). In addition to these avenues, rising interest rates can impact the farm sector's income statement and balance sheet in other ways. Given the interest in the farm sector's financial strength and the Federal Reserve's stated intention to continue gradually raising interest rates, the articles in this *Choices* theme explore ways in which interest rates influence the farm sector and how rising interest rates may impact farmers moving forward.

Henderson explores the complex relationships between interest rates, the money supply, exchange rates, and commodity prices. The article highlights how less (more) accommodating monetary policy can suppress (increase) commodity prices directly. The potential for indirect impacts on commodity prices from changes in relative interest rates and the resulting exchange rate impacts are also explained.

Next, Kuhns and Patrick consider the link between rising interest rates and farmers' ability to cover their interest payment obligations. To illustrate the impact of rising rates on the overall farm sector, they perform a scenario analysis to uncover how rising interest rates influence repayment risks. Farm-level survey data is also used to identify which types of farms would be most vulnerable to an increasing interest burden if interest rates increase.

Sherrick observes recent farmland value trends and explores whether they make sense in the context of the current interest rate environment. After providing background on the farmland value market, the article analyzes how farmland values could be impacted by rising interest rates. The article also explores how aspects of the changing interest rate environment and the relative performance of farmland compared to other asset categories could influence how farmland values respond to higher interest rates.

Finally, Takach explains how duration and modified duration can be used to gauge the level of interest rate risk inherent in the farm sector's balance sheet. The article also uses scenario analysis to highlight how interest rate risks can be caused by differences in the duration of assets and liabilities, known as the duration gap. The article then covers ways farmers can immunize their balance sheet from this type of risk.

For More Information

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Monetary Policy and Agricultural Commodity Prices: It's All Relative

Jason Henderson

JEL Classifications: Q11, Q14, Q17
Keywords: Agricultural commodity prices, Exchange rates, Interest rates, Monetary policy

U.S. macroeconomic policy is in transition. After the recent "Great Recession," the Federal Reserve Bank and other central banks across the world slashed short-term interest rates to historical, near-zero lows. Today, the Federal Reserve Bank has begun the process of normalizing rates. After bottoming out at 0.25%, the target range for the Fed funds rate rose to 1.5% in December 2017, with projections for additional increases in the future. In addition, the Federal Reserve has begun to shrink the assets it accumulated on its balance sheet in response to the Great Recession to trim the money supply.

Research has shown that changes in real interest rates and the money supply influence commodity prices. More accommodative monetary policy—which reduces interest rates and builds larger money supplies—tends to increase commodity prices. Less accommodative monetary policy—which raises interest rates and shrinks the money supply—tends to depress commodity prices. Monetary policy changes tend to affect commodity prices directly by altering demand for storable commodities, such as agricultural commodities. Through its influence on exchange rates, changes in relative interest rates can also affect agricultural commodity prices.

Although these channels have been widely known, research has also identified mitigating factors that can affect the size of these macroeconomic impacts. Specifically, inventories of agricultural commodities alter the responsiveness of agricultural commodity prices to macroeconomic fluctuations. While low inventories intensify exchange rate impacts on commodity prices, large inventories temper exchange rate impacts. In sum, higher interest rates typically place downward pressure on agricultural commodity prices, but the supply and demand dynamics of agricultural markets shape these impacts. Thus, as farmers and other agricultural stakeholders incorporate the influence of monetary policy in their strategic planning, they also need to recognize that commodity prices may not fall just because interest rates rise. The impacts depend on monetary policy in other countries and agricultural market dynamics.

Monetary Policy and Commodity Prices

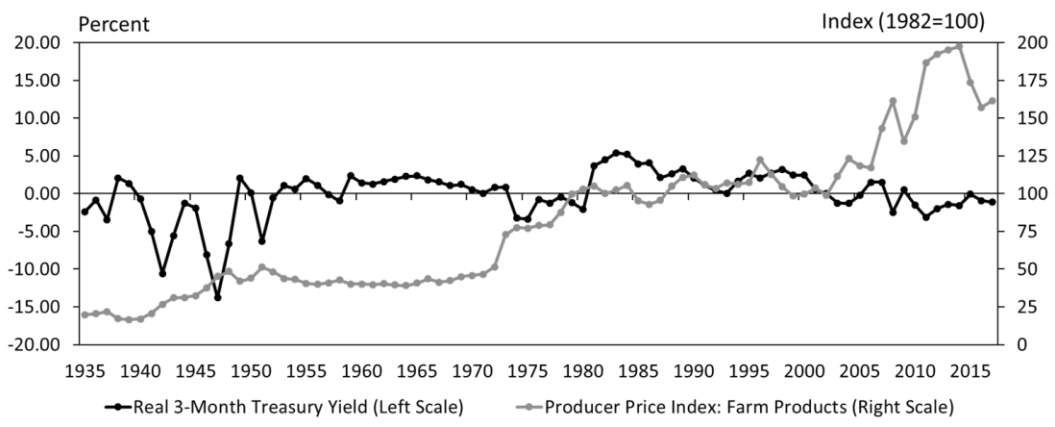
Economists have long known that macroeconomic policy affects agricultural commodity prices. Interest rate, money supply, and exchange rate shifts affect agricultural prices through an overshooting process (Dornbusch, 1976). Due to inflationary expectations, an exchange rate change would have a larger impact on flexible-priced goods to compensate for the slow adjustment of more fixed-priced goods. The relative flexibility of agricultural commodity prices means these prices tend to respond more quickly to changes in macroeconomic policy (Saghaian, Reed and Marchant, 2002). Given the interrelationships between interest rates and exchange rates, understanding the impact of interest rates on agricultural prices means understanding the direct and indirect impacts through exchange rates.

Changes in monetary policy, specifically shifts in interest rates and money supply, affect agricultural commodity prices by affecting the demand for storable commodities. Frankel (2006) identifies several channels by which higher interest rates and a smaller supply of money reduces the demand for storable commodities and vice versa. Higher interest rates reduce the incentive to carry inventories by increasing the value of current cash holdings

versus the present value of future income. Finally, higher interest rates entice speculators to shift financial assets toward treasuries and out of commodities, reducing the demand from this segment of market participants.

Historically, agricultural commodity prices tend to rise during periods of low real interest rates. For example, from 1940 to 1951, the producer price index for farm products rose 200% when real interest rates on 3-month treasuries were negative (Figure 1). A similar pattern emerged in the 1970s and more recently from 2005 to 2014. In fact, analyzing data from 1950 to 2005, Frankel (2006) found strong correlations between changes in real interest rates and agricultural commodity prices. The strongest relationships were in crop markets. Corn, wheat, soybean, and cotton prices fell 9.1%, 8.8%, 6.4%, and 6.1%, respectively, for every 1% increase in real interest rates. In contrast, cattle and hog prices fell 4.8% and 3.1%, respectively, for every 1% rise in real interest rates.

Figure 1. U.S. Real Interest Rates and Farm Product Prices



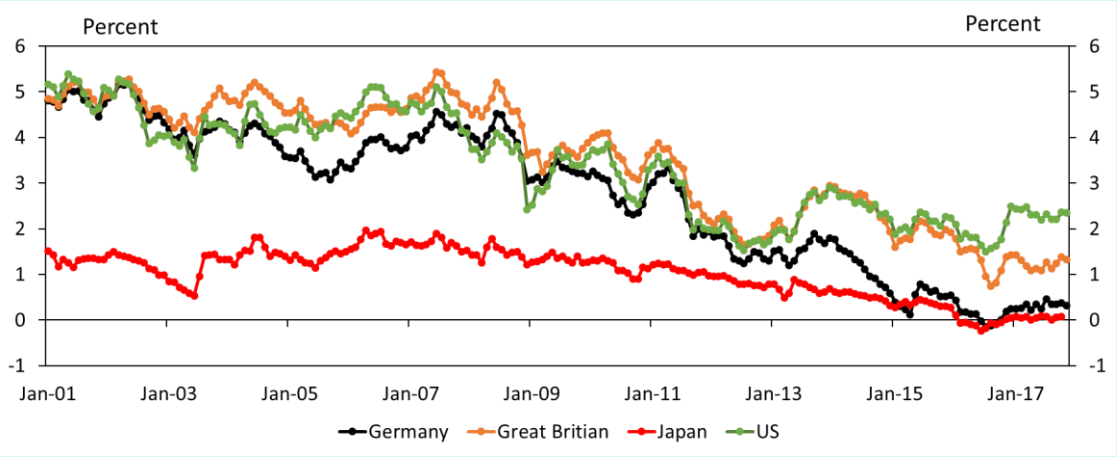
Notes: Calculations based on a 3-month treasury yield, producer price index, and consumer price index obtained from the Federal Reserve Economic Database (FRED).

However, the responsiveness of agricultural commodity prices to shifts in monetary policy may be different today in a period of unconventional monetary policy. During the most recent recession, the Federal Reserve engaged in unconventional monetary policy by purchasing assets such as long-term treasuries and federal agency debt, which increased its balance sheet to $4.5 trillion, quadrupling the level prior to the recession. Unconventional monetary policies could affect the adjustments between interest rates and agricultural commodity prices in addition to providing a new mechanism, changes in the balance sheet, to affect agricultural commodity prices. Research has found that the responsiveness of agricultural commodity prices during periods of unconventional monetary policy was different. During unconventional periods of monetary policy, the full responsiveness of agricultural commodity prices was delayed and a 1% increase in the Federal Reserve balance sheet was associated with a 2% increase in agricultural commodity prices (Amatov and Dorfman, 2017). Although monetary tightening through rising interest rates and a smaller balance sheet will place downward pressure on commodity prices, the size and timing of the impacts may not follow past cycles.

Monetary Policy and Exchange Rates

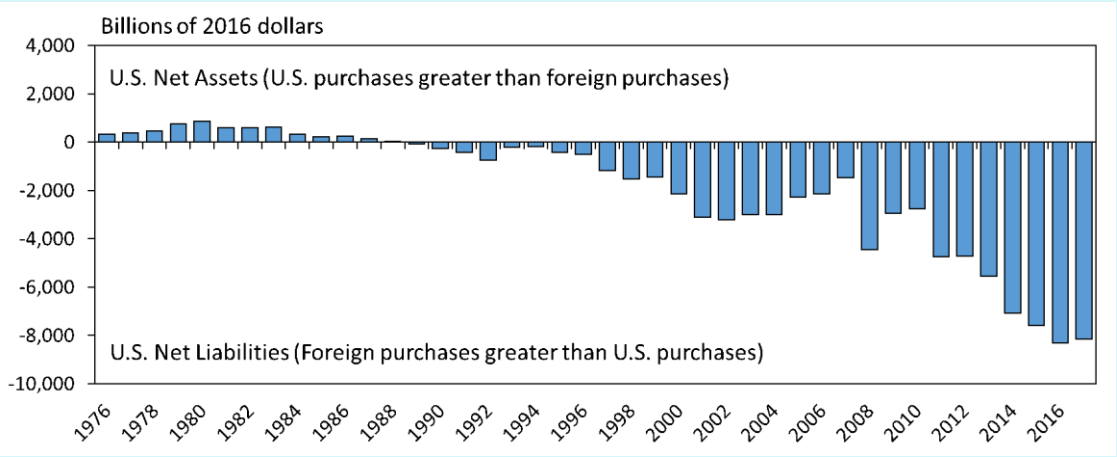
In addition to their direct impacts on commodity prices, higher relative interest rates could also lead to lower commodity prices by altering exchange rates. Analysis of the direct impacts of interest rates on agricultural commodities has assumed that global interest rates adjust simultaneously. In practice, monetary policy and interest rate movements vary by country, and relative changes in interest rates affect global exchange rates. For example, higher interest rates in the United States relative to other nations could increase demand for and thus the value of the U.S. dollar as financial investors seek to buy U.S. financial instruments, such as treasuries, that offer higher returns.

Figure 2. International 10-Year Bond Rates



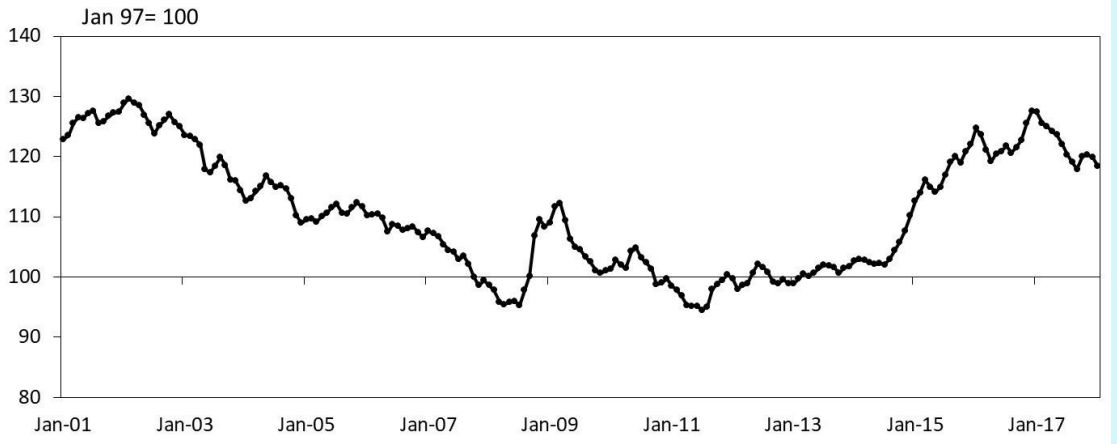
Source: Board of Governors of the Federal Research System obtained from the Federal Reserve Economic Database (FRED).

Figure 3. U.S. Net International Investment Position (Assets Minus Liabilities)



Source: Bureau of Economic Analysis.

Figure 4. Trade-Weighted U.S. Dollar Index: Broad Currencies



Source: Board of Governors of the Federal Reserve System obtained from the Federal Reserve Economic Database (FRED).

In recent years, differences in global interest rates have coincided with a shift in global investment flows. Since 2014, a gap between U.S. interest rates and interest rates in other developed nations emerged (Figure 2). As the yield on the 10-year treasury fluctuated around 2%, the yield on 10-year bond instruments from Germany, Japan, and the United Kingdom dropped below 1%. Negative interest rates in Europe pushed German interest rates to -0.12% by mid-2016.

Coinciding with the higher level of U.S. interest rates, foreign purchases of U.S. assets have increased sharply. In the balance sheet of U.S. accounts, U.S. purchases of foreign assets are an asset and foreign purchases of U.S. assets are a liability. The difference between these assets and liabilities indicates the level of financial flows between U.S. and foreign markets. Net assets (more assets than liabilities) indicate more U.S. purchases of foreign assets than foreign purchases of U.S. assets. Net liabilities (more liabilities than assets) indicate more foreign purchases of U.S. assets than U.S. purchases of foreign assets. Since 2007, net liabilities have increased substantially, with increases in both debt and equity purchases by foreign investors (Figure 3).

At the same time, the value of the dollar has increased sharply, rising approximately 20% since 2014 against a broad set of currencies (Figure 4). The rise in the value of the dollar was driven in part by investor demand for U.S. dollars to purchase U.S. assets. The opposite pattern emerged at the end of 2017 as the spread between U.S. and international interest rates narrowed. During this time, net foreign purchases of U.S. assets declined and the dollar weakened. Since agricultural commodity prices are priced in dollars, fluctuations in the U.S. dollar affect agricultural commodity prices: A stronger U.S. dollar boosts the price of agricultural commodity prices in global markets, thus reducing U.S. exports and vice versa.

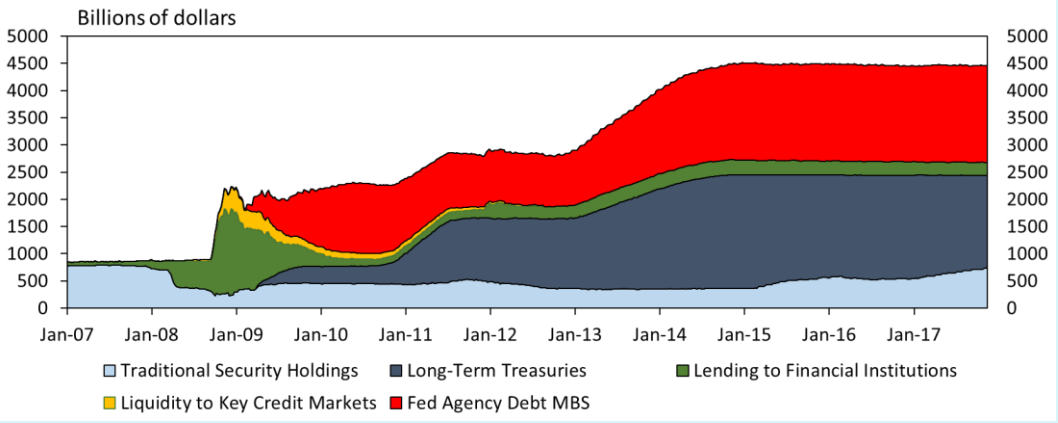
Recently, economists have shown that the exchange rate impacts on agricultural commodity prices vary over time due to differences in supply and demand fundamentals. Specifically, tighter long-run inventories of agricultural commodities, ethanol policy mandates under the Renewable Fuels Standard, and stronger imports caused demand for commodities to be more inelastic, making commodity prices more responsive to exchange rate changes (Hatzenbuehler, Abbott, and Foster, 2016). In short, during periods of tight supplies and lean inventories, commodity prices would be more sensitive to exchange rate movements compared to periods of burgeoning supplies and swelling inventories.

The Future Path of Interest Rates and Exchange Rates

With stronger U.S. economic growth, the Federal Reserve is beginning to unwind its accommodative monetary policies by raising interest rates and shrinking its balance sheet. Higher interest rates have historically contributed to lower agricultural commodity prices. Yet future impacts will depend on global shifts in monetary policy and shifting dynamics in agricultural markets.

U.S. interest rates are starting to edge up. The Federal Reserve has increased the target for the overnight fed funds rate from 0.25 to 1.5%. The December quarterly projections on monetary policy suggest that rates could increase further. The central tendency from Federal Open

Figure 5. Federal Reserve Balance Sheet – Assets



Source: Federal Reserve Bank of Cleveland

Market Committee (FOMC) members at the Federal Reserve for the fed funds rate is projected to rise to a range of 2.5%–3.5%, with a median rate of 2.9%, by the end of 2020. In contrast, futures markets suggest that the fed funds rate could increase more slowly, rising to 2.0% by 2020.

In addition, changes in the Federal Reserve's balance sheet could also influence agricultural commodity prices. Past research has shown that, historically, money supply shifts impact commodity prices beyond interest rate impacts (Chambers and Just, 1982). Between 2008 and 2014, the Federal Reserve expanded its balance sheet from $800 billion to approximately $4.5 trillion to maintain the U.S. money supply as the velocity of money declined (Figure 5). In 2017, Federal Reserve assets consisted primarily of long-term treasuries and federal agency debt in the form of mortgage-backed securities (MBS).

In 2014, the Federal Reserve began its strategy of normalizing its balance sheet. The first step was to hold the levels of its balance sheet flat at $4.5 trillion. In July 2017, the Federal Reserve announced its strategy to shrink its balance sheet in the future by reducing the number of purchases of MBS and treasury bills to replace maturing securities. By October 2017, the Federal Reserve had implemented this policy. If followed, it will take several years to shrink the balance sheet to pre-recession levels. In isolation, higher interest rates and a smaller balance sheet would be expected to weigh on agricultural commodity prices going forward. However, the size of these impacts is uncertain in an era of unconventional monetary policy. In fact, the influence of interest rates will depend on global monetary policy movements and exchange rates.

The process of normalization in U.S. monetary policy has coincided with increases in U.S. exchange rates, which has contributed to lower agricultural commodity prices. However, further normalization—higher interest rates and a shrinking Federal Reserve balance sheet—may not necessarily lead to a stronger dollar if other central banks begin removing monetary stimulus in the face of stronger economic growth.

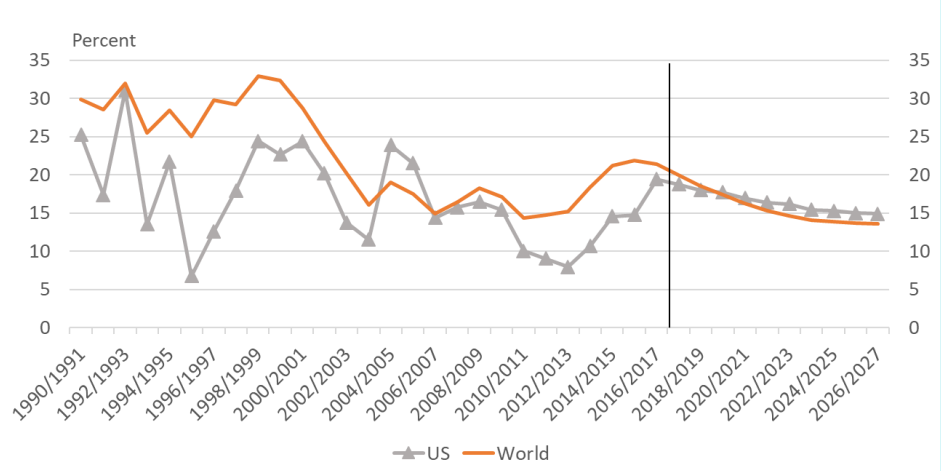
In the second half of 2017, economic growth unexpectedly strengthened in advanced countries. For example, quarterly U.S. economic growth forecasts were revised up in the second and third quarters of 2017, topping 3% after tepid growth in the first quarter of 2017. Economic growth forecasts point toward stronger unexpected growth in the Eurozone. In the January 2018 World Bank Global Economic Prospects Report, annual U.S. GDP growth was revised up 0.2 percentage points to 2.3% in 2017 compared to the June forecast, while the Eurozone forecast was revised up 0.7 percentage points to 2.4%. Similar revisions emerged for the 2018 forecasts. As a result, if stronger growth emerges in the Eurozone in 2018 and spreads to other regions, monetary policy could tighten globally, narrowing the gap between U.S. and international interest rates and weighing on the U.S. dollar, as currently indicated by futures markets.

Heading into 2018, a new pattern has begun to emerge. During the first few weeks of 2018, the spread between U.S. and international interest rates has narrowed. For example, the spread between the U.S. and German 10-year bonds had narrowed to 2.0 percentage points by the end of 2017, slightly less than the 2.4 percentage points in December 2016. In addition, after peaking in December 2016, the value of the dollar had declined roughly 7% against a broad set of U.S. currencies by the end of 2017. Heading into 2018, the impact of interest rates on agricultural commodity prices will depend on global monetary policy shifts and the spread between U.S. and international interest rates. More aggressive tightening in U.S. monetary policy compared to the rest of the world could lead to a wider interest rate spread, a stronger dollar, and weaker agricultural commodity prices. In contrast, less aggressive tightening in U.S. monetary policy could lead to a narrower interest rate spread, a weaker dollar, and support for higher agricultural commodity prices.

Although monetary policy should influence agricultural commodity prices, the presence of large crop inventories could mute the impact of macroeconomic factors (interest rates and exchange rates) on agricultural commodity prices. Burgeoning crops reduce the responsiveness of agricultural commodity prices to exchange rate movements decreasing the market elasticity of demand (Hatzenbuehler, Abbott, and Foster, 2016). After bottoming in 2014, crop inventories have increased substantially. For example, U.S. corn supply-to-use ratios have more than doubled, from 7.9 for the 2012/13 crop year to 19.9 for the 2017/18 crop year. During the same time, soybean supply-to-use ratios have risen from 7.9 to 20.5 and wheat supply-to-use ratios have risen from 51.7 to 82.3. USDA baseline

projections suggest that inventories could remain elevated over the next decade, which would limit the impacts of exchange rates on agricultural commodity prices over the next decade compared to 2009 and 2014.

Figure 6. Corn Stocks-to-Use Ratios



Notes: Projection based on growth rates from USDA Ag Baseline Projections 2017.
Source: USDA Foreign Agricultural Service.

Shifting supply and demand dynamics could determine how crop inventories evolve over time. USDA projections indicate crop production will stabilize at current levels and that modest growth in global demand will trim inventories. For example, USDA projects planted acres for corn and corn production in the United States to decline over the next decade, with modest 1% annual growth in domestic use and export activity. Stronger than expected economic growth in advanced countries could spur agricultural commodity demand if stronger economic growth spreads globally to emerging countries, spurring agricultural trade.

Conclusion

Similar to past agricultural cycles, shifts in monetary policy are a risk to agricultural commodity prices. Rising U.S. interest rates and a smaller Federal Reserve balance sheet could weigh on agricultural commodity prices. Still, the magnitude of these impacts from monetary policy is uncertain and depends on global shifts in monetary policy, inflation, and its impacts on exchange rates. The impacts of monetary policy will depend on real interest rates, which are an interaction of inflation and nominal interest rates. As a result, if the Federal Reserve is ahead of the inflationary curve and increases nominal interest rates more swiftly than inflationary pressure increases, real interest rates would rise and depress agricultural commodity prices. Alternatively, if monetary policy falls behind the inflationary curve and short-term interest rates rise more slowly than inflation, real interest rates would fall and potentially underpin higher agricultural commodity prices.

In addition, the impact on agricultural commodity prices will also depend on the relationship between U.S. and international interest rates. A wider gap between U.S. and international interest rates could lead to a stronger dollar and lower agricultural commodity prices. In contrast, a narrower gap could lead to a weaker dollar and stronger agricultural commodity prices.

At the same time, the economic forces shaping the relative position of U.S. and international interest rates could also affect demand for agricultural products and thus commodity prices. Stronger economic growth, especially in developing nations, could spur demand for agricultural commodities and trim inventories of agricultural products, which would trigger some countervailing impacts on agricultural commodity prices. Rising interest rates would place downward pressure on agricultural commodity prices, and smaller inventories would increase the responsiveness of agricultural commodity prices to monetary policy factors. On the other hand, stronger economic growth internationally could increase demand for agricultural products and lead to a weaker dollar, which would support higher agricultural commodity prices.

U.S. monetary policy is in transition. Over the past century, shifts in U.S. monetary policy, economic growth, and exchange rates relative to other global shifts have shaped agricultural commodity prices. By itself, higher U.S.

interest rates and shrinking balance sheets at the Federal Reserve will place downward pressure on agricultural commodity prices. Yet the size of these impacts could vary dramatically based on the relative shifts in international interest rates and agricultural market conditions. Understanding the relative relationships between U.S. and international markets is crucial to understanding the boom and bust cycles of U.S. agriculture.

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How Sensitive is the Farm Sector's Ability to Repay Debt to Rising Interest Rates?

Ryan Kuhns and Kevin Patrick
JEL Classifications: G21, Q12, Q14, Q18
Keywords: Agricultural finance, Farm debt repayment, Financial stress, Interest rates, Monetary policy

Recent farm sector trends, including rising debt and declining income, have led to comparisons between agriculture's current economic environment and the period leading up to the farm financial crisis. Between 1970 and 1980, inflation-adjusted farm sector debt grew rapidly, expanding by 5.6% annually. Over the most recent decade, inflation-adjusted farm sector debt was still climbing an average of 4% per year, and the USDA currently projects inflation-adjusted debt to be at its highest level since the early 1980s. After inflation-adjusted net farm income declined nearly 50% between 1973 and 1979, a sharp rise in interest rates in the late 1970s—as well as other factors—led to a wave of financial stress in many agricultural sectors. As of 2016, net farm income has also declined by 50% from its 2013 peak, and a rising interest rate environment is expected as the Federal Reserve transitions toward tighter monetary policy.

In the 1980s, the concurrent trends of higher debt, lower income, and rising interest rates combined with other factors to increase farm debt repayment challenges. This article considers whether today's rising interest rate environment could also lead to increased farm sector repayment risk. Analyzing the impact of several interest rate path scenarios on farm repayment risk suggests that the sector remains well positioned to handle interest rate increases within a likely range. However, farmers starting from a worse financial position and farmers with a larger share of variable-rate debt may face greater financial stress.

Rising Interest Rates Can Lead to Increased Risks for the Farm Sector

Rising interest rates can place downward pressure on farmland values in part by reducing the current value of income farmland can produce in the future. Since farmland makes up over 80% of the total value of farm assets, a reduction in farmland values could increase the sector's debt-to-asset ratio, increasing the risk of insolvency. But the farm sector remains relatively well insulated from potential solvency impacts because its debt-to-asset ratio, a common measure of solvency, remains relatively low by historical standards.

Higher interest rates will also mean that farmers will need to pay more for new or variable-rate credit over the next several years. Agricultural finance institutions commonly compare farmers' projected principal and interest payments to their cash flow available to service their debt, often referred to as repayment capacity (Barry and Ellinger, 2012). Therefore, some borrowers could find it more difficult to qualify for new credit in a higher interest rate environment when interest payments climb relative to cash flows.

Borrowers may also find it more difficult to service their debt in a rising interest rate environment. The agricultural sector has endured lower income levels as commodity prices adjusted downward more quickly than input costs (Patrick, Kuhns and Borchers, 2016). Despite increasing the last several years, delinquency rates on farm real estate loans at commercial banks and Farm Credit institutions have remained low relative to the Great Recession and the 1980s farm financial crisis (FDIC, 2017; FCA, 2017). However, delinquency rates could increase in the

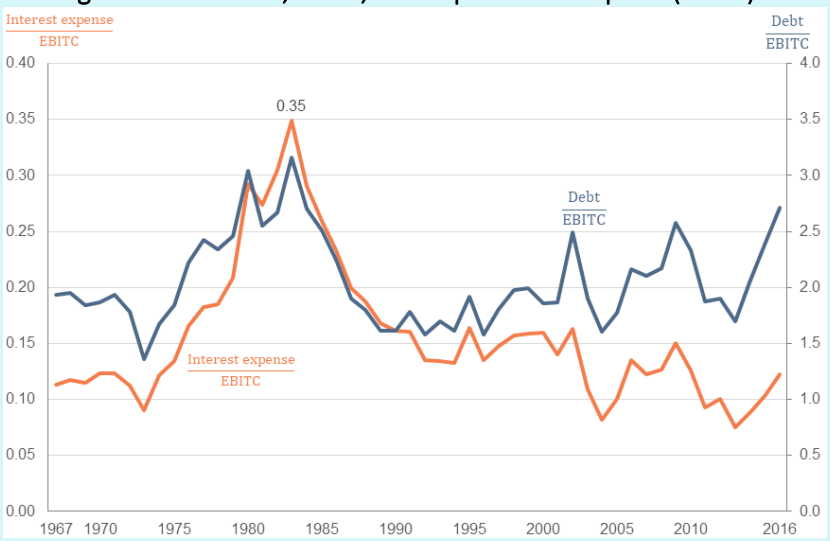
future if interest rates continue to rise. Direct and indirect effects of the Federal Reserve's monetary tightening suggest the possibility for additional commodity price declines (Henderson, 2018). This could further reduce the income farmers have available to make their principal and interest payments. Borrowers taking on new loans, renewing operating lines, or holding debt with a variable rate that adjusts higher as interest rates rise may also find it more difficult to service their debt as interest payments rise relative to income levels.

Farm Sector Debt Repayment Risk Measures Rising but Below 1980s Levels

Measures of solvency like the debt-to-asset ratio are often used to gauge the farm sector's financial position, but they are not a good measure of the farm sector's ability to repay outstanding debt since they don't reflect farmers' income levels. An alternative is to compare the level of debt to the sector's cash flows (Ellinger, Featherstone, and Boehlje, 2016). Comparing the ratio of debt to earnings before interest, taxes, and capital consumption (EBITC) provides a general measure of the farm sector's debt relative to money available to pay principal and interest. The sector's interest-expense-to-EBITC ratio has been climbing over the last several years (Figure 1), reaching a recent high of 2.81 dollars of debt per dollar of annual cash flow. This implies building liabilities compared to the sector's income stream, yet this only tells part of the story.

Equally central to understanding the sector's repayment position is how well the sector can handle required interest payments. The ratio of interest expenses to EBITC shows the percentage of cash flows the farm sector has to spend just to cover the interest on its outstanding debt. A rising ratio could indicate growing debt repayment challenges because a greater share of available income is needed to make interest payments. The interest-expense-to-EBITC ratio steadily increased in the late 1970s and early 1980s and reached a record high in 1983, with interest expenses accounting for a record 35% of the sector's income stream. Despite increasing since 2013, the value is estimated at 12.2% in 2016.

Figure 1. Farm Sector Debt Level and Interest Expenses Relative to Earnings before Interest, Taxes, and Capital Consumption (EBITC)



Source: Author's calculations using USDA (2018).

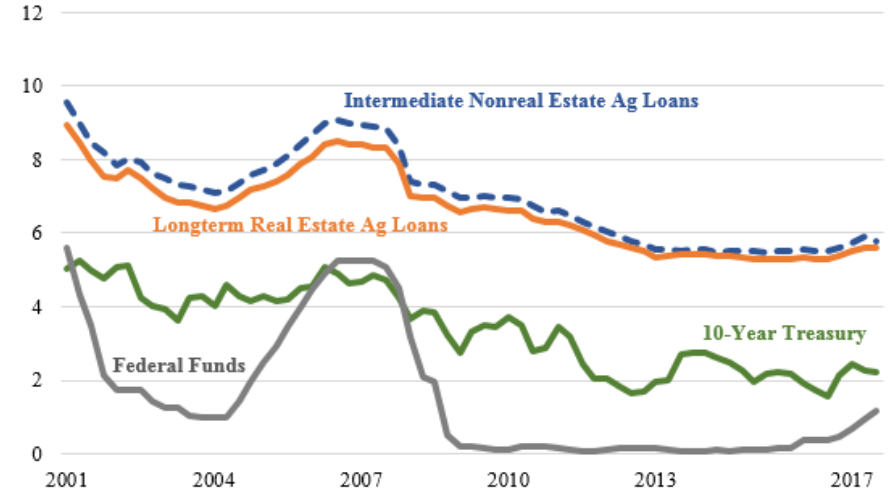
Combining the information from both ratios shows that the farm sector's financial position has benefitted from a lower interest rate environment. Interest expenses have not grown as quickly relative to cash flows, despite rising debt levels. This stands in contrast to the 1980s, when the farm sector's high debt-to-EBITC ratio coincided with historically high interest-expense-to-EBITC ratios. At that time, farmers had a relatively large amount of debt and it was costly to service. Although interest rates are unlikely to return to 1980s levels in the short term, rising rates will still put upward pressure on the sector's interest costs and likely increase repayment issues.

Citing a strengthening U.S. economy, the Federal Reserve began the process of transitioning away from the near-zero interest rate environment during the December 2015 Federal Open Market Committee (FOMC) meeting. The FOMC has implemented four additional 25-basis-point (bp) rate increases since that time and signaled that further upward movement is likely if the economy stays on its current path. Additionally, the FOMC began to gradually reduce holdings of long-term U.S. treasury bonds and mortgage-backed securities, which may put upward pressure on long-term rates.

Will Rising Interest Rates Lead to Farm Sector Repayment Challenges?

Although a rising interest rate environment is expected, whether this will lead to challenges repaying debt is uncertain. Changes in interest rates on short-term farm loans, like operating credit, tend to follow the Federal Funds rate. On the other hand, changes in interest rates on fixed-rate agricultural real estate loans and intermediate non–real estate loans tend to track changes in the 10-year treasury rather than the Federal Funds rate (Figure 2). To gauge the potential impacts of rising farm borrower costs, we consider changes in the farm sector's debt-to-EBITC and interest-to-EBITC ratios under a baseline interest rate path scenario and an alternative scenario where rates rise more quickly. As a baseline interest rate scenario, we use data on 2017 farm interest rates from the *Agricultural Finance Databook* (Kansas City Federal Reserve, 2017) as well as median January 2018 *Wall Street Journal* (WSJ, 2018) economist survey forecasts for the Federal Funds rate (up 70bps in 2018 and 64.25 bps in 2019) and the 10-year treasury (up 48 bps in 2018 and 37.5 bps in 2019). To analyze the effects of a quicker rise in interest rates, we use the 90th percentile rather than median values of the WSJ survey economist predictions for the Federal Funds rate (up 82.5 bps in 2018 and 90.5 bps in 2019) and 10-year treasury (up 79 bps in 2018 and 69.5 bps in 2019).

Figure 2. Interest Rates on Longer-Term Loans in the Kansas City Federal Reserve District Tend to Follow the 10-Year U.S. Treasury



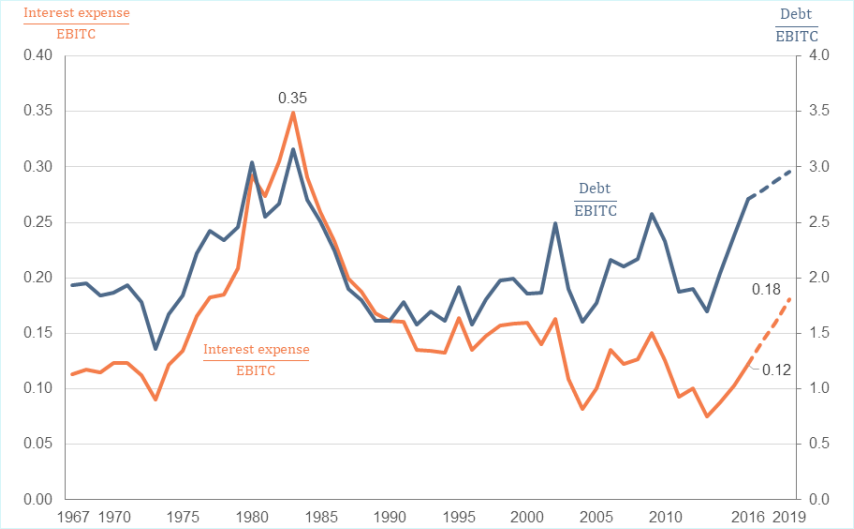
Source: St. Louis Federal Reserve (2018) and Kansas City Federal Reserve (2017)

In each scenario, we use the USDA official estimates of farm sector debt, interest expense, and cash flow through 2016. Roughly 27% of both farm real estate and non–real estate debt with a term longer than 1 year has a variable interest rate (USDA, 2015). Since more than 75% of this variable-rate debt is listed as repricing annually, to simplify the analysis all variable-rate debt is assumed to adjust to the current interest rate level each year. We also assume that the USDA's November 2017 forecast of 4.6% growth in real estate debt and 0.4% growth in non–real estate debt continues through 2019, with the new debt entering the sector's balance sheet at prevailing interest rates.

Given the simple debt growth assumptions used in both scenarios, the farm sector's debt-to-EBITC ratio would continue rising, reaching nearly 3.0 in 2019 (Figure 3). If farmers add debt and cash flows remain similar to today's levels, this ratio could approach its 1980s peak in the near future. The recent lower interest rate environment allowed the sector to keep the interest-to-EBITC ratio at historically low levels despite higher debt, but our analysis suggests it could increase in a rising interest rate environment. Under our baseline interest rate scenario, the sector's interest-to-EBITC ratio is projected to reach 0.17 by 2019 (Figure 3). This value is higher than today but largely in line with the relatively stable levels seen in the 1990s and early 2000s. While a rising interest-to-EBITC ratio does signal the potential for increased repayment stress in the farm economy, the projected values remain well below the levels throughout the 1980s.

Under the faster rate increase scenario, interest-to-EBITC would be somewhat higher, reaching 0.18 in 2019. As expected, if farmers continued to borrow at the same levels, faster interest rate increases would increase the degree of repayment stress in the sector. But again, the interest-to-EBITC ratio would be lower than it was during the farm financial crisis, where the value remained above 0.25 from 1980 to 1985. For the interest-to-EBITC ratio to reach 0.25 by 2019, interest rates would have to rise by an additional 4–4.5 percentage points beyond the increase assumed in the quicker interest rate increase scenario. Based on the Federal Reserve's stated interest rate policy goals, this outcome seems unlikely.

Figure 3. Farm Sector Debt- and Interest-to-EBITC Ratio Are Both Likely to Rise under the Baseline Scenario



Note: The baseline scenario assumes the federal funds rate increases by 70bps in 2018 and 64.25 bps in 2019, while the 10-year treasury rises 48 bps in 2018 and 37.5 bps in 2019. Debt is assumed to continue growing at the rate USDA projects for 2017.
Source: Author's calculations using USDA (2018).

Since today's interest rate environment is more favorable relative to the 1980s, many farmers appear to be better positioned to service their debt. But our analysis assumed that farmers' cash flows remain constant. Upward pressure on expenses or further reductions in commodity prices over the next few years would lead to reduced profitability and additional debt repayment challenges. In addition to increasing interest expenses, a rising interest rate environment could also lead to downward pressure on commodity prices. However, Henderson (2018) considers the complex interaction between a rising interest rate environment, exchange rates, and supply and demand in determining commodity prices. His results indicate that higher interest rates could lower commodity prices, which would lead to more debt repayment challenges than our scenarios indicate. But Henderson also concludes that supply and demand fundamentals are likely to remain larger drivers.

To better understand how changing income levels could interact with rising interest rates and affect the farm sector's ability to repay debt, we calculate interest-to-EBITC ratios under alternative cash flow scenarios (Figure 4). If cash flows rise relative to current levels, interest-to-EBITC will not rise as quickly. However, if cash flows were to

Table 1. Interest-to-EBITC Ratio in 2019 by Interest Rate Increase Scenario and Change in Cash Flows

Interest Rate Scenario	Change in Cash Flows Relative to 2016						
	+30%	+20%	+10%	No Change	-10%	-20%	-30%
Baseline	0.132	0.143	0.156	0.172	0.191	0.215	0.245
Quicker	0.139	0.151	0.164	0.181	0.201	0.226	0.258

Note: The baseline scenario assumes the federal funds rate increases by 70bps in 2018 and 64.25 bps in 2019, while the 10-year treasury rises 48 bps in 2018 and 37.5 bps in 2019. The quicker scenario assumes a faster rise in the federal funds rate (up 82.5 bps in 2018 and 90.5 bps in 2019) and 10-year treasury (up 79 bps in 2018 and 69.5 bps in 2019). Both scenarios assume debt continues to grow at the rate USDA projected for 2017.

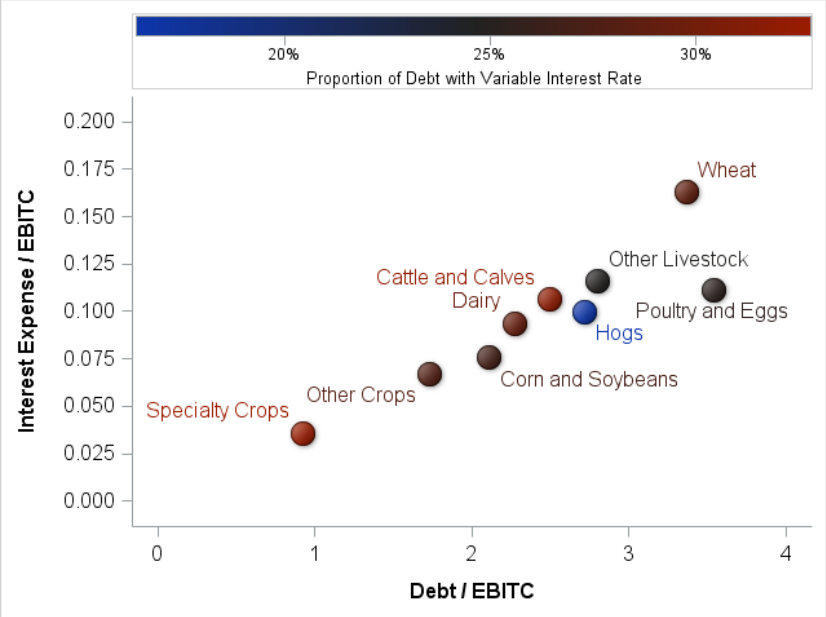
continue trending lower over the next several years, repayment stress is likely to increase. A further 10% drop in cash flows, for example, would cause the sector's interest-to-EBITC ratio to exceed 0.2 under the quicker interest rate increase scenario. Either interest rate scenario would see the ratio climb into the vicinity of 0.25—a level last reached during the farm financial crisis—if cash flows were to fall 30% between 2016 and 2019. This reinforces the idea that, although the sector should be able to handle the expected interest rate increases if cash flows remain near recent levels, further income declines could lead to greater financial stress.

In addition to fluctuating income levels, several other assumptions used in the analysis could lead to the actual impact of rising interest rates being different than our scenarios suggest. Assuming all variable-rate debt adjusts each year simplifies the analysis, but likely overestimates interest-to-EBITC ratio's sensitivity to interest rate changes. Additionally, if producers act to minimize their sensitivity to rate increases over the next several years, either by reducing their reliance on variable-rate debt or increasing debt levels less quickly, then the scenarios may also overstate the actual impacts. The use of U.S level data obscure differences likely to manifest at a more granular level. In the next section, we use USDA's Agricultural Resource Management Survey (ARMS) data to better understand how different types of farms may be impacted in a rising interest rate environment.

Certain Types of Farms may be More Sensitive to Rising Interest Rates

Even when the farm sector as a whole appears to be able to handle rising interest rates, individual farms will be affected differently. Rising interest rates could be particularly impactful for farms with a greater share of variable interest rates on debt already on their balance sheets or those that already have worse debt repayment measures. Since these characteristics vary across different types of operations throughout the farm sector, rising interest will impact various parts of the farm sector differently.

Figure 4. Commodity Specializations with More Variable-Rate Debt, Higher Interest-to-EBITC, and Higher Debt-to-EBITC Would Face More Repayment Stress in a Rising Interest Rate Environment

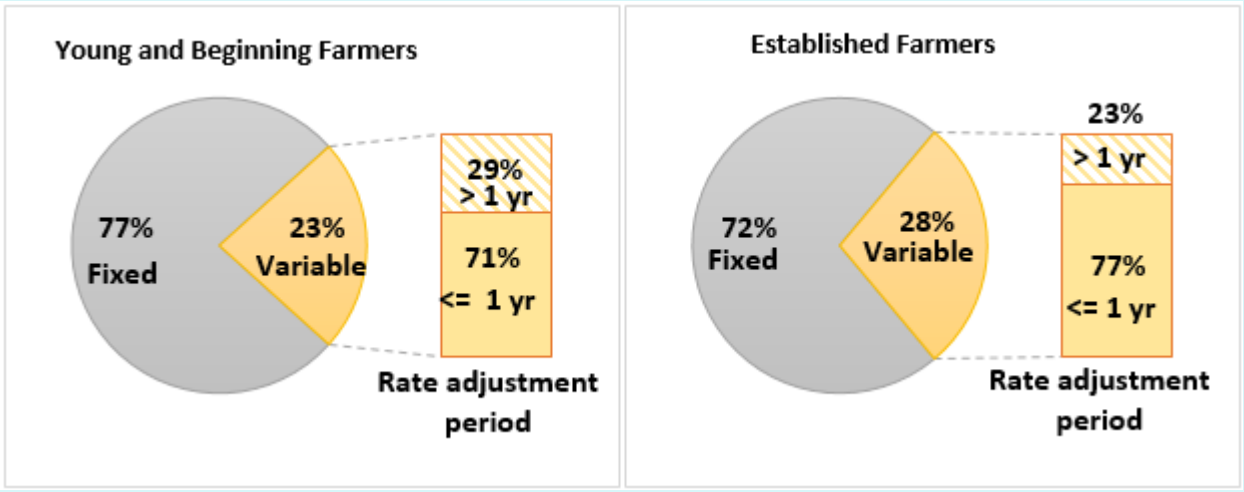


Source: Author's calculations using USDA (2015) and USDA (2016).

The type of commodity primarily produced on the farm affects not only the income received but also the type and volume of capital needed to adequately run a farm. Farms specializing (>50% of value of production from a particular commodity) in livestock production, particularly poultry, tend to finance more capital through debt than similarly sized farms producing other commodities (Ifft, 2014). Each livestock-specialized farm type had a higher debt-to-EBITC ratio (ranging from 2.27 to 3.54) than every crop-specialized farm type (ranging from 0.92 to 2.11) except for wheat (3.36) in 2016 (Figure 4). A similar pattern holds for the interest-to-EBITC ratio in 2016, which indicates that interest expenses represent a larger share of cash flows for all livestock-specialized farm types (ranging from 0.09 to 0.12) compared to crop-specialized farm types (ranging from 0.04 to 0.07) except for wheat (0.16).

Taking this together, wheat-specialized farms may have faced more debt repayment challenges than other commodity sectors in 2016, when wheat prices were low by historical standards. It also shows that livestock operations tend to have higher ratios of debt and interest to cash flow. This could put these production specializations under greater financial stress if their cash flow declines or interest rates rise.

Figure 5. Young and Beginning Farmers Have Less Variable-Rate Debt on Their Balance Sheets Than Established Farmers



Note: Young and Beginning Farmer is defined as a farmer that substantially participated in the operation of a farm for not more than 10 years.
Source: USDA (2015).

However, rising interest rates don't necessarily translate to more debt payment issues unless previously acquired debt has a variable interest rate. An individual farmer's decision between fixed and variable interest rate debt depends on their risk preferences and the different terms associated with variable and fixed rate financing options. For example, a variable rate loan will often have a lower interest rate than a fixed rate loan with a similar maturity because the borrower is assuming interest rate risk. Each borrower must determine if the interest rate savings are worth the additional risk associated with rising rates. Although this likely varies based on farmers' risk preferences, the share of variable-rate debt is fairly stable between commodity specializations, ranging from 25% to 33% (Figure 4). The hog sector is an exception, with only 16% of debt with a variable interest rate indicating that hog farms may be more resilient in a rising interest rate environment. On the other side of the spectrum, specialty-crop operations had the highest proportion of variable-rate debt (33%) but also may be more resilient to rising interest rates because they are starting from a less risky debt- and interest-to-EBITC position.

Characteristics of the farm operator, including age and years of experience operating a farm, can also impact an operation's borrowing needs (Ifft, 2014) and sensitivity to rising interest rates. The USDA's Farm Service Agency's loan programs enable young and beginning farmers (substantially participated in the operation of a farm for not more than 10 years) access to loans with lower fixed interest rates, which may be unavailable to established farmers (substantially participated in the operation of a farm for more than 10 years). This may be one reason why 23% of debt held by young and beginning farmers had a variable interest rate compared to 28% for established farmers and young and beginning farmers' variable-rate debt tended to adjust less frequently (Figure 5). Young and beginning farmers' reduced reliance on variable-rate debt indicates that they may be relatively less impacted by rising interest rates.

Conclusion

Farm income and debt trends have prompted comparisons with the 1980s farm financial crisis. Rising debt levels and lower farm income have led the farm sector's debt relative to cash flows to approach levels last observed during the 1980s, a potential sign of debt repayment challenges in the agricultural economy. But the low interest rate environment over the last several years has made it relatively inexpensive to service interest payments on borrowed funds. Based on a simple analysis of several plausible future interest rate scenarios that conservatively assumes farmers do not adjust borrowing behavior, the farm sector currently remains unlikely to see debt repayment challenges, as proxied by the interest-to-EBITC ratio, rise to 1980s levels. While the farm sector currently appears to have the financial strength to handle rising interest rates overall, additional income declines could lead to greater debt repayment issues.

Yet, not all farms will be well positioned to handle rising interest rates. Farms with more debt on their balance sheet relative to cash flows, farms that need a greater share of their cash flows to pay interest expenses, and farms with a greater proportion of variable-rate debt will likely be impacted the most. Livestock and wheat farms had higher levels of debt and interest relative to cash flows in 2016. While these commodity specializations may be starting from a less ideal financial position, higher interest rates won't necessarily impact these farms if they have fixed rate debt. Farmers will have to contend with rising interest rates driven by factors outside their control, but they remain able to choose the amount of debt and proportion of variable rate financing that makes sense for their operation.

For More Information

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Understanding Farmland Values in a Changing Interest Rate Environment

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*The job of an economist is not to explain what **should be**,*
*but rather to observe **what is** and help explain why it makes sense to be so.*
(—Anonymous)

Farmland values are driven by a complex set of factors, including variables that affect expectations about future agricultural returns, alternative investment options, and macroeconomic conditions. Farmland prices also vary across locations due to urban influence, differences in agricultural production practices, crop suitability, and local policies. In addition, several structural characteristics of farm real estate markets—including idiosyncratic property features, ownership concentration, unique rental market features, and very thin transaction markets —may make farmland price dynamics appear to be more complex than those of traditional financial assets. Farmland markets may also be impacted by broader trends that affect other assets. With the stock market at record highs and bond yields near historically low levels, investors are paying higher multiples for future anticipated income—essentially, price-to-earnings ratios have risen or, alternatively, capitalization rates have declined. Because farmland generates income well out into the future, a similar effect could occur in farmland valuations if farmland markets behave similarly.

These characteristics have simultaneously puzzled some financial market observers and induced others to make claims of irrational values. In recent years, about the same number of commentators have indicated expectations of "bubbles" as have touted the asset class for its relatively strong performance and desirable diversification benefits. The popular press continues to devote significant coverage to links between land value and lease rates, with questions about future turning points, or substantial recalibrations from one direction to the other. Participants in the brokerage industry continue to report that many areas are still experiencing low volumes of sales but that there seems to be some strength returning in prices, with farmers remaining the primary buyers.

This article explains how interest rates impact farmland returns in the context of traditional capitalization arguments. Additional context is provided by considering characteristics of the farmland asset class and the changing interest rate environment that could affect how rising interest rates impact farmland returns. The intent remains to improve the basic understanding and appreciation of what is, not to claim that particular relationships are out of balance or to predict a future that is different from the present.

Recent Trends in Farm Real Estate Values and Returns

Farmland has historically been and remains a key input in agricultural production as well as an important asset for U.S. farmers. In 2017, just over 83% of the sector's $3 trillion in assets were held in real estate (U.S. Department of Agriculture, 2018). Data also show that national farm real estate assets have increased at an annual rate of 6.5% since 2010 and by 3.3% in 2017 alone, providing a source of capital gains in addition to annual income streams from operating or renting the land. In row-crop regions of the United States, asset values have had a remarkably common pattern of appreciation through roughly 2014, with varying but smaller relative declines for the years thereafter. Many observers of Midwestern land markets have begun to indicate that a soft bottom seems to be

Table 1. Comparing Farmland Return Characteristics to Alternative Asset Classes

Asset/Index	Annual Return			
	Average	Standard Deviation	Coefficient of Variation	Correlation
	1980 - 2016			
32-State Farmland Aggregate	8.55%	5.32%	0.621	1.000
S&P 500 Stock Index	8.19%	15.87%	1.936	-0.132
NASDAQ Stock Index	9.63%	25.14%	2.611	-0.118
AAA Bond Yield	7.56%	2.82%	0.374	-0.059
CMT-10	6.32%	3.23%	0.510	-0.013
Mortgage Rate (30-year)	8.10%	3.40%	0.420	-0.022
All REITs	10.29%	17.08%	1.659	-0.043
Gold	2.18%	16.09%	7.391	-0.128
Consumer Price Index	3.10%	2.10%	0.679	0.390
	1990 - 2016			
32-State Farmland Aggregate	9.27%	3.54%	0.381	1.000
S&P 500 Stock Index	6.84%	17.22%	2.519	-0.122
NASDAQ Stock Index	9.15%	26.93%	2.942	-0.157
AAA Bond Yield	6.15%	1.57%	0.254	0.153
CMT-10	4.74%	1.85%	0.391	0.250
Mortgage Rate (30-year)	6.39%	1.76%	0.275	0.252
All REITs	9.74%	18.68%	1.918	-0.150
NCREIF Farmland Index	11.85%	6.66%	0.562	0.634
Gold	3.91%	14.29%	3.654	0.049
Consumer Price Index	2.41%	1.13%	0.471	0.223
	2000 - 2016			
32-State Farmland Aggregate	9.09%	4.36%	0.480	1.000
S&P 500 Stock Index	2.48%	18.31%	7.390	-0.166
NASDAQ Stock Index	1.65%	26.69%	16.216	-0.226
AAA Bond Yield	5.23%	1.11%	0.212	0.205
CMT-10	3.60%	1.20%	0.334	0.409
Mortgage Rate (30-year)	5.37%	1.27%	0.237	0.377
All REITs	10.88%	19.19%	1.763	-0.166
NCREIF Farmland Index	13.69%	7.58%	0.554	0.721
Gold	8.08%	14.99%	1.855	0.043
Consumer Price Index	2.12%	1.03%	0.487	0.288

Notes: CMT-10 is the 10-year constant maturity Treasury bond yield, Mortgage rate (30-year) is the average yield on new 30-year residential mortgages, All REITS is from the AREIT series averaging all public REITS returns, NCREIF is the National Council of Real Estate Investment Fiduciaries Farmland Index returns, available from 1991 to present. Source: TIAA Center for Farmland Research.

forming and have noted that overall price changes have been less responsive relative to current incomes than is typical in other real asset markets.

Amazingly, total farm real estate debt was only $236 billion in 2017, or 9.4% of farm real estate asset values—representing far lower leverage than exists in most other sectors. If farmland were viewed as a traditional investable asset class, the relatively low aggregate leverage would represent a potentially attractive aggregation feature. Assets with low leverage but returns that are higher than the cost of debt capital can often be combined and borrowed against to increase the return on equity. However, historically isolated ownership of individual farmland parcels and low cash flow relative to total returns have limited the ability for individual owners to actively adjust the level of debt capital or to actively manage the optimal capital structure in individual farmland holdings.

Farmland performance data are somewhat difficult to assemble as most farmland is held by individuals and returns data are not collected or reported to any single source. Moreover, the annual production cycle of most crops means agricultural income is only determined annually. However, the U.S. Department of Agriculture conducts annual surveys of farm-level performance including a variety of indicators, and the National Council of Real Estate Investment Fiduciaries (NCREIF) publishes an aggregated index of returns reported under identically enforced standards across all members who own and manage farmland. The TIAA Center for Farmland Research assembles these yearly and develops measures of returns standardized across asset classes, including a series aggregating equally weighted cropland returns across the 32 states with the top agricultural production (32-state farmland aggregate).

Table 1 compares the returns to farmland investments (income plus capital gain less property taxes), as measured by the NCREIF and the 32-state farmland aggregate, to alternative asset classes. The comparison is provided across various sub-periods along with summary correlation measures of aggregate farmland returns to other key investment categories. Interestingly, the mean farmland returns are generally in the upper end among the asset classes compared during each period analyzed. The NCREIF returns, which are representative of farms managed for active investment, tend to have higher—but slightly more variable—returns.

Farmland also exhibits characteristics that make it a potentially attractive diversification option. The reported correlations, which are all relative to the 32-state farmland aggregate, illustrate that farmland has displayed negative correlation with equities, near zero correlation with fixed income investments, and a positive correlation with inflation for virtually any sub-period examined. Diversification most effectively reduces risk when asset returns are uncorrelated or negatively correlated and inflation erodes the value of an investment. These characteristics of farmland returns can make them both effective for portfolio diversification and wealth preservation.

Does the Farmland Market Make Sense?

At a basic level, farmland markets should behave similarly to other income-generating assets and have prices that reflect underlying expectations about future income, income growth potential, and the cost of capital supporting the investment in the asset. The use of a simple theoretical model relating income expectation and current values can be insightful to understand how farmland values may react to changes in their fundamentals. To this end, farmland is commonly modeled as an asset earning income (R) at each period (t), indefinitely into the future. While the exact present value of future returns is unknown, farmland values should reflect some form of current expectations of the present value of these returns:

$$Farmland\ Value_t = Expectation_t\left[\sum_{i=1}^{\infty}\frac{R_{t+i}}{(1+r)^i}\right]. \quad (1)$$

Under the simplifying assumptions of constant discount rate (r) and growth in future income (g), the model can be simplified to find that current farmland values are a function of today's income and the growth adjusted capitalization rate:

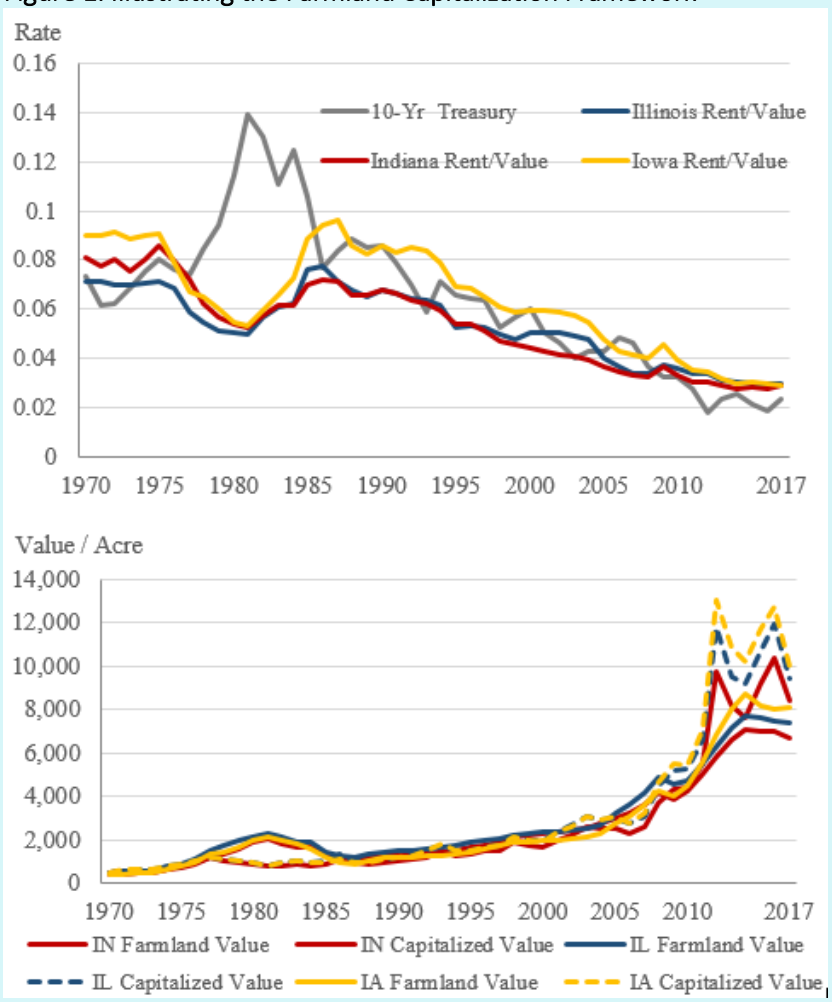
$$Farmland\ Value_t = R_t\left[\frac{1}{r-g}\right].$$

(2)

Both equations highlight that farmland values are determined by fundamental determinants: income, the growth rate in income, and discount rates. Of course, individual owners can also choose to abstract from these features and implicitly accept lower returns or create higher returns through superior management of specific assets, but, in general, one might expect that typical financial constructs hold at the margin. Accordingly, an upward (downward) shift in future returns, or the growth of returns, should result in higher (lower) farmland values (Schnitkey and Sherrick, 2011). Since prevailing interest rates are often used to discount future returns to today's dollars, they are also a fundamental determinant of farmland values in the capitalization framework. All else equal, rising interest rates would be expected to reduce the value of farmland by decreasing the present value of future returns, while a lower interest rate environment would support higher values (Schnitkey and Sherrick, 2011).

Figure 1 shows two related concepts applying the capitalization framework to farmland values in Iowa, Illinois, and Indiana. The top panel shows the implied capitalization rates, calculated as each state's rent-to-value ratio, which are fairly consistent with the 10-year constant maturity U.S. treasury (CMT-10) yield; the implied capitalization rates tend to track the CMT-10 except in the early 1980s, when the divergence from fundamentals was fueled by idiosyncratic policies and lending practices that largely do not exist today. The farmland capitalization rates for each state have also remained above the 10-year CMT interest rate for the last several years. The bottom panel shows actual farmland values versus those implied when a simple version of the capitalization framework is used and current income is divided by the most recent CMT-10 rate. While the two graphics illustrate similar information, the lower panel highlights that the end of the sample period shows a pattern where farmland values did not fully adjust upward to the implied levels found by capitalizing current income.

Figure 1. Illustrating the Farmland Capitalization Framework

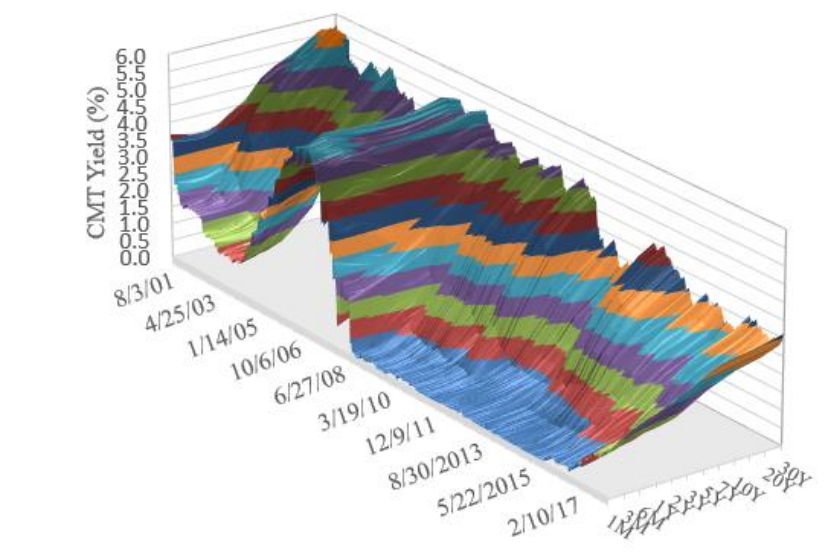


Sources: Federal Reserve H.15, U.S. Department of Agriculture (2017), and TIAA Center for Farmland Research.

A past analysis of the sensitivity of Illinois farmland values to rising interest rates suggested that the current gap between implied and actual farmland values could provide some cushion if rates increase; however, if interest rates move toward the long-run policy goals stated by the Federal Reserve's Federal Open Market Committee (FOMC), there could be substantial downward pressure on Illinois farmland values (Schnitkey, 2016). But one complication is that factors leading

interest rates higher are also likely to impact the growth rate in earnings, muddling the impact of higher interest rates on the farmland capitalization rate. As presented earlier in Table 1, farmland returns have historically been positively correlated with the Consumer Price Index, which is a measure of inflation. As inflation often leads to increases in nominal income generated by commodity producing assets, this correlation could temper the impact of a rising rate environment on farmland values. Additionally, characteristics of the changing interest rate environment may affect the impact of rising interest rates on farmland values.

Figure 2. U.S. Treasury Term Structure 8/3/01–2/16/18

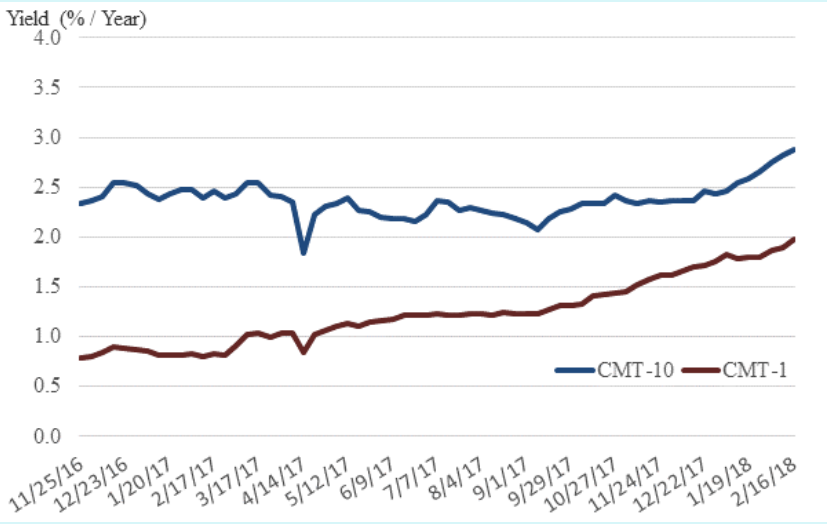


Note: M=month; Y=year.
Source: Federal Reserve H.15 Series.

Figure 2 shows a long period of weekly U.S. treasury yields, with the vertical axis indicating the interest rate, the front axis showing the time from early 2001, and the right axis showing the length of time to maturity. Following the housing crisis of 2008, the shorter-maturity end of the yield curve has been stable at historically low levels. Although the short end of the yield curve has gradually increased in response to the FOMC's five federal funds rate increases since December 2015, the impact has not propagated forward to longer-term yields. The 10-year constant maturity U.S. treasury (CMT-10) rates, often used as a proxy for farmland capitalization rates, have thus far been less affected by the Federal Reserve's interest rate policy normalization. The low and relatively stable interest rate markets have likely contributed to the continued resilience of farmland values, despite current lower farm income levels.

Potential structural changes related to additional investment in lower-yielding, short-term assets and the possible "permanentization" of lower interest rate levels, along with low inflation pressures, could also influence how interest rate changes impact farmland values. The amount of common equity capital at financial firms has roughly doubled since 2008, and most of this capital has been invested in lower yielding assets at shorter terms to maturity. Higher demand for shorter-maturity assets and lower interest rate levels in fixed income markets could spur investment in other classes as investors search for higher yield. In turn, this extra demand can drive valuations higher for other assets by increasing their current

Figure 3. The Spread between Shorter-Term 1-Year and Longer-Term 10-Year Treasury Yields Has Flattened



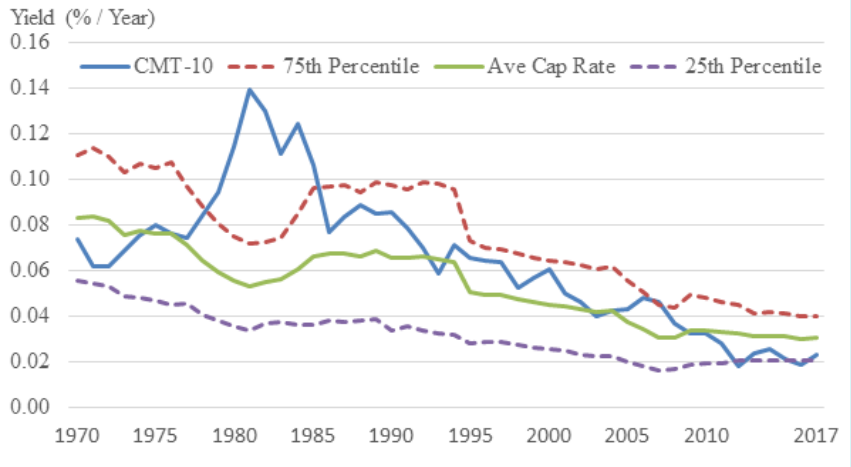
Source: Federal Reserve H.15 Series.

price relative to unchanged future income streams, an effect commonly cited as expansion of the valuation multiples.

A "new normal" of a sustained lower and flatter yield curve would be consistent with increases in prices paid for future income and would favor assets with longer-term income streams. Given the relatively long duration of farmland, this could also support higher values moving forward if a similar relationship holds in farmland markets. Figure 3 compares the 1-year and 10-year CMT yields from a few weeks prior to the December 2016 FOMC rate increase through February 16, 2018. This illustrates the flattening of the yield curve, as the 1-year treasury yield has risen in response to Federal Reserve Rate increases, while the CMT-10 yield has remained largely range bound until 2018, when a set of news events began pushing yields upward.

To further explore the relationship between farmland returns patterns and interest rate conditions, the implied cap rate was calculated for each of the states included in the 32-state farmland aggregate used in Table 1 from 1970 to the present. For each year, a simple average of the implied cap rates and the 25th and 75th percentiles across these 32 states were identified (both directly and under a parameterized version with virtually identical results). Figure 4 shows these results through time and visually confirms the same information suggested by the analysis of Iowa, Illinois, and Indiana presented earlier. Moreover, the early period shows a far greater dispersion of capitalization rates across the 32 states—as measured by the spread between the 25th and 75th percentiles—when interest rate markets were at generally higher and more volatile levels. Interestingly, the 10-year CMT has been below the average cap rate for farmland in the top 32 agricultural states since the housing crisis and has recently hovered around the 25th percentile. These presentations help highlight why institutional investors have renewed interest in the asset class, as it provides an alternative potential returns pattern that appears favorable in terms of relative levels – even at these historically low rates.

Figure 4. Comparing the Distribution of 32 State Farmland Cap Rates to the 10-Year Constant Maturity Treasury (CMT-10)



Source: Author's calculations using U.S. Department of Agriculture (2017) and Federal Reserve H.15 Series.

Of course, historical farmland valuations may not appear irrational in the capitalization framework for several reasons. For example, farmland values may not have fully responded to increases in income in the mid-2010s because the income increases were viewed as transitory. Farmland, like other long-duration, inflation-sensitive assets, might also increase in value relative to other assets under declining and stabilizing capital-cost environments. Alternatively, the flattening of the yield curve could have allowed a small risk premium in farmland assets to show up as an increase in yield relative to a constant-term, risk-free security, all else equal. While space prevents a more complete presentation of the nuances of these arguments, farmland prices overall seem rational relative to the implications of capitalization arguments. The flip side of that argument would be that farmland values would also be expected to fall if interest rates and the cost of capital underlying farmland were to rise dramatically, all else equal.

Other Market Issues: "What's the Ticker Symbol for Farmland?"

Given the above discussion and the historic performance of the asset class, one might expect it to be offered in a deeply traded and well-understood platform. However, there is no broadly available, well-functioning equity market for agricultural real estate, and individual owners still represent a large share of operators. Development of ag-related funds and institutional agricultural investment platforms holds promise for increased standardization or access to equity investments in the asset space. But the total fraction of the $3 trillion sector represented in these cases remains small. For context, the value of land held in the NCREIF index comprises less than 0.5% of the total value of all farm real estate. Even if one were to eliminate non-cropland real estate and small and hobby farm holdings and make other adjustments to approach what might be thought of as institutionally appropriate farmland (perhaps less than 50% of the total), institutionally held farmland would remain a relatively small proportion of the total. While the pace toward more complete financialization is difficult to predict, this could be a source of additional future farmland demand.

But the acquisition and management platforms required to meaningfully operate in this space represent substantial investments and cannot be expected to exist for one-time rebalancing efforts. A few institutional investors have made the significant commitment to the infrastructure needed to operate in this space and have done so with an internationally active scope as well. TIAA (Nuveen) has the single largest fund structure and has by far the largest acquisition and management platform, with significant scale international investments as well. Several publicly traded Farmland real estate investment trusts (REITs) have also emerged as farmland investment options. While the two most visible publicly traded REITs in the United States (Farmland Partners (ticker: FPI) and Gladstone (ticker: LAND) have begun to make inroads, they are each still very small relative to the scale of the sector. Still, these are viewed as critically important efforts in the ongoing maturation of the market and the eventual development of an equity market that allows direct access to returns from investments into farmland.

Another feature of the asset class that could explain why higher-than-expected returns seem to have been sustained is the incredibly low primary turnover in farmland markets. Only about 1% of farmland turns over at arm's length each year, even though considerably more changes title due to estate settlement within families and transfers among related parties (Sherrick, 2012). Simply put, farmland is a difficult asset to acquire at scale in a short period of time, and the "excess returns" found in relatively naïve assessments of historic performance would be forfeited through market frictions and liquidity premia if one tried to acquire and dispose of it in shorter periods.

Summary

Farmland markets have received substantial attention, partly due to the relatively attractive historic performance and partly due to what many perceive as puzzling stability relative to income variation through time. While no claim is made that all transactions are rational or that the market is particularly efficient relative to other, more developed financial markets, the aggregate measures provided relating returns and capital costs to values do not show any notable aberrations from the commonly used capitalization concept. This means rising interest rates may put downward pressure on farmland values. But this impact could be less than the capitalization model would suggest if structural changes result in the "permanentization" of relatively a relatively lower and flatter yield curve, leading investors to pay higher multiples for future income.

Characteristics of the farmland asset class could also affect how a rising interest rate impacts farmland values. The presented comparison of farmland returns and correlations to other asset classes illustrate both the relatively strong level of farmland returns, and its potential diversification benefits. These benefits likely mean there will be continued interest in expanding farmland investment options. Combined with the relatively low turnover of farmland, this additional demand could also help support values.

Continued investment interest in farmland could also help improve the information and technology available to assess land's production potential. This could make the investment class more routine and easily interpreted, potentially leading to less-sensationalized income movements or revaluations occurring in response to changes in

future income and capital cost changes. The continued evolution of the farmland market will ensure it remains an interesting asset class to study.

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Farmers Aren't Immune to Interest Rate Risk: A Duration Gap Analysis of Farm Balance Sheets

Jackson Takach

JEL Classifications: G12, G32, Q12, Q14
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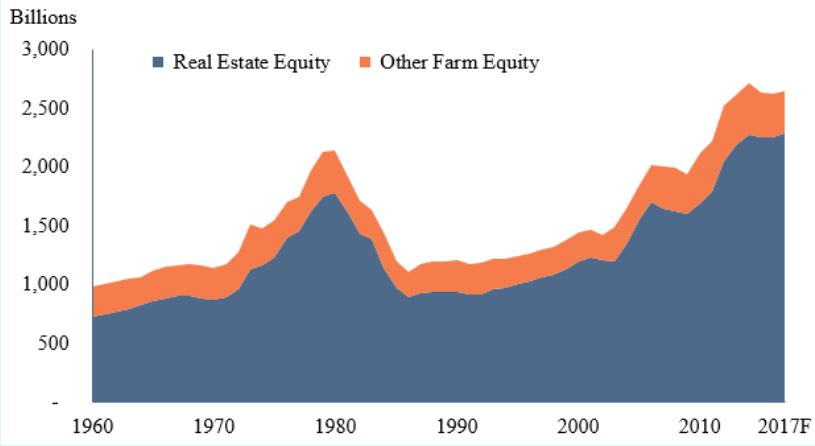
Interest Rate Risk in Farm Balance Sheets

A rising interest rate environment has far-reaching implications for America's farmers and ranchers. Higher interest rates could impact farmers' income statements by affecting commodity prices and interest expenses (Henderson, 2018; Kuhns and Patrick, 2018). Increasing interest rates are also likely to impact farmers' balance sheets by impacting the market value of both their assets and liabilities. The USDA currently projects that farm sector debt has increased by more than 30% over the last decade, even after adjusting for inflation. But farm asset values have also grown and the farm sector, in aggregate, still has relatively low leverage, with debt accounting for only 13% of asset values. This has left farmers with a record $2.7 trillion in equity at the end of 2017 according to current USDA projections (ERS, 2017), most of which is held in farm real estate (Figure 1). If farm assets decline in value or farm debt rises more quickly than assets, farm equity is eroded and, with it, the hard work and savings of millions of farmers and ranchers. Since the market value of assets and liabilities is affected by interest rate fluctuations, farm equity is also sensitive to interest rate changes.

Figure 1. Farm Equity Composition through Time (Adjusted for Inflation)



Analysis of the interest rate risk inherent in farmers' balance sheets has often focused on the direct impact of interest rate changes on asset values. Long-run interest rates have been used to proxy farmland capitalization rates, and rising rates could reduce the land values supported by current income levels (Schnitkey and Sherrick, 2011). Rising interest rates can also have a direct impact on the value of farmers stored commodity inventories by reducing the value of their future revenue streams (Henderson, 2018). While often not explicitly specified, these types of analyses are related to the financial concept of duration, which is often used in financial analysis to measure the average timing of a stream of cash flows. Modified duration can be used to gauge a financial instrument's sensitivity to interest rate movements. Differences between the timing the cash flows associated with farmers' assets and liabilities, often referred to as a duration gap, can also expose farmers' balance sheets to interest rate risk.

This article illustrates how duration can be applied to farmers' balance sheets. After illustrating their application, the concepts are used to measure the farm sector's duration gap or the difference between the timing of the cash flows associated with the sector's assets and liabilities. Since equity is the difference between assets and liabilities, this analysis can be used to determine how the equity in farm operations is impacted by changes in interest rates. The sections below outline the basics of financial duration, demonstrate how a single balance sheet is affected by changing interest rates, and then apply these concepts to at the U.S. level to show how farm sector equity may be impacted by changes in interest rates. Practical implications of the exposure to interest rate risk are provided along with guidance for managing the risk exposure for farm businesses.

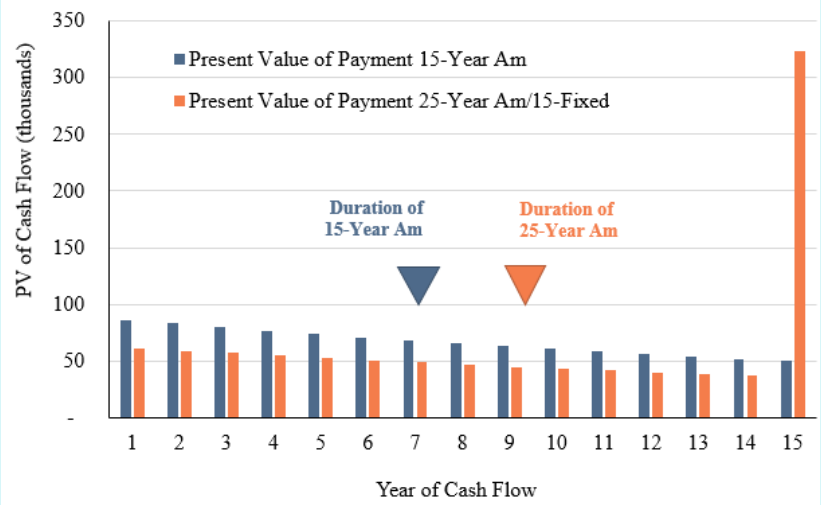
Duration Applied to the Farm Balance Sheet

In finance, an asset's value is often expressed as the sum of the present value of its future cash flows. Duration is used to provide a measure of the timing of cash flows associated with a given financial instrument (Macaulay, 1938). When calculating duration, the timing of each cash flow is weighted by the size of the present value of that cash flow relative to the present value of all cash flows:

$$Macaulay\ Duration\ (Years) = \sum_{i=1}^{n} time_i \times \frac{PV\ of\ Cash\ Flow_i}{PV\ of\ All\ Cashflows}. \quad (1)$$

Because duration considers the timing and size of cash flows as well as the discount rate used to calculate the present value of future cash flows, it can be thought of as measuring the weighted average timing of the cash flows generated by a given asset or liability. Short-term assets and liabilities have lower duration values because cash flows happen over a short period, whereas long-term assets and liabilities have higher duration values because cash flows are more spread out over a longer period.

Figure 2. Comparing Cash Flows for Loans with Equal Term but Different Amortization Periods



Applying duration to the cash flows associated with a farm operation's debt provides a way to measure the average timing of cash flows due from a given liability. For example, a farm-operating loan with a single payment due in 12 months would have a duration of 1.0 year. On the other hand, a 15-year fixed rate farm real estate loan has an approximate duration of 9.5 years if the payments do not vary during the life of either debt. Even if two loans have the same term, they may not have the same duration if there are differences in the size or timing of payments. Figure 2 demonstrates this concept by calculating the duration of two long-term real estate loans, each with a term of 15 years. The first loan is fully paid off at the end of the 15-year term (typically referred to as being fully amortizing), while the second has a 25-year amortization period. The balance remaining after the 15-year term is due as a balloon payment. Although the loans have the same 15-year term, the loan with the balloon payment has more cash flow weighted in later years and thus has a longer duration.

Compared to calculating the duration of farm debt, where the timing of cash flows is often known, the application of duration to farmers' assets can require careful consideration of the underlying cash flows. Once the timing of cash flows is determined, the same analysis can also be applied to a farm operation's assets to understand the

average timing of the cash inflows they generate. For example, farmland can generate cash flows in the form of annual lease payments, or the sale of crops and livestock can generate cash flows in the form of one-time cash payments.

While understanding the timing of cash flows provides useful information on financial instruments, the idea of duration has been extended to provide an indication of the instrument's interest rate sensitivity. Modified duration provides a useful extension of duration that measures the change in the value of an asset resulting from a change in market interest rates (Redington, 1952). Modified duration is the change in the value of an asset or liability given a change in market interest rates. For example, if a farm loan had a modified duration of 1.5, a 1-percentage point increase in interest rates would cause a 1.5% decrease in the value of the loan. This interpretation of modified duration is incredibly powerful: In one number, an analyst, portfolio manager, banker, agricultural lender, or farmer can measure exactly how much interest rate risk exists on any asset or liability. The higher the number, the greater the change in the value of the asset or liability in response to movements in market interest rates and therefore, the greater the interest rate risk:

(2)

$$Modified\ Duration\ (D)\ =\ \frac{Macaulay\ Duration}{1+y}$$

(3)

$$\Delta\, Value\ =\ -Modified\ Duration\ \times\ \Delta\, Interest\ Rates\ \times Value\ of\ Asset\ or\ Liability$$

Both assets and liabilities are exposed to changes in interest rates. Falling interest rates lead both asset and liability market values to rise by increasing the present value of associated cash flows, while rising interest rates decrease the present value of future cash flows, causing the market value of asset and liability values to decline. For a farmer, the expected rise in interest rates will cause the market value of assets and debt to fall, all else equal. Whether the market value of a farmer's equity rises or falls with interest rates depends on the relative sensitivity of assets and debt. However, the market value of equity must be exposed to interest rate risk since it is the difference between assets and liabilities and each is exposed to interest rate risk.

Since modified duration measures this sensitivity, the weighted difference between the modified duration of assets and liabilities, typically referred to as the duration gap, can be used to measure the sensitivity of equity to interest rate fluctuations:

(4)

$$Duration\ Gap\ =\ Duration_{Assets}\ -\ \frac{Liabilities}{Assets}\times Duration_{Liabilities}.$$

Once calculated, the duration gap can be combined with a farmer's current asset position and the interest rate change to determine the movement in equity:

(5)

$$\Delta Equity\ =\ -AssetsXDuration\ Gap\times\Delta Interest\ Rates.$$

If assets have a longer duration than liabilities, the duration gap is positive, and the value of equity and a rising interest rate environment will reduce that value of equity. Conversely, if the debt has a longer duration, the duration gap will be negative, and a rising interest rate environment will increase that value of equity.

Farmland and Balance Sheet Duration Gaps

Duration gap analysis has been used extensively by the banking and insurance sectors for decades as a way to measure and manage portfolio interest rate risk (Bierwag and Kaufman, 1985). Taken one step further, portfolio managers can immunize their balance sheets from interest rate risk by selecting assets and debts that offset to a duration gap of zero (Redington, 1952). For perfectly immunized portfolios, interest rates can go up and down and the value of the equity in the portfolio will not budge because any changes to asset values will be perfectly offset by changes in the value of liabilities. Applying the analysis to the farm sector highlights the inherent interest rate risk in the farm sector's balance sheet from differences in the duration between farmers' assets and liabilities.

Table 1. Farm Balance Sheet Duration Assumptions

Balance Sheet Category	Assumed Duration	Logic	Base Case Value
Cash and Short-term Investments	0.0	Cash in hand or highly liquid investments provide no rate sensitivity.	50,000
Crop Inventory	1.0	At least half of crop inventories will be liquidated within the calendar year, with some carryover to the following year.	200,000
Animals and Animal Products	1.9	Animals and breeding livestock have varying cash conversion cycles with cattle turnover taking multiple years and poultry and hogs on a much shorter cycle. Two years is a modest average across all livestock in inventory.	50,000
Machinery and Vehicles	4.2	Based on a 10-year useful life and the average of three depreciation methods (MACRS, straight-line, and double-declining balance)	150,000
Real Estate	17.0	The duration of a perpetuity is (1 + Yield) / Yield. The long-run average return to farm real estate has been estimated at 7.7%, but recent returns have been closer to 5%. A value of 6% was used for this calculation.	1,500,000
Real Estate Debt	9.1	Calculated using a 15-year fixed rate, 25-year amortization with a balloon payment in year 15.	500,000
Non–Real Estate Debt	1.9	Operating debt is renewed annually but equipment financing may be up to seven years. Two years is an approximate middle ground for the blend of short and medium-term financing.	200,000

To simplify the calculations, the farm balance sheet has been broken up into seven categories, each with a defined duration value (see Table 1). Most assets and debt categories have relatively straightforward expected cash flows. The largest exception also happens to be the largest category, farm real estate. For demonstration purposes, this analysis treats farm real estate as a perpetuity that pays an annual yield of 6%, which is in line with USDA estimates (ERS, 2017). A perpetual average return of 6% implies a duration of 17 years.

Table 1 also lays out a hypothetical cash grain operation in the Midwest with moderate levels of leverage. The values in Table 1 are like those from the USDA's 2016 Agricultural Resource Management Survey (ARMS) but with slightly more debt to better illustrate the effects of duration analysis. The hypothetical operation has very low levels of cash and animal inventory and has more of its assets in either crops in the bin or in the ground, as well as in machinery and land. Approximately 75% of this operation's assets are in the value of farm real estate, a level that mimics the overall sector. On the other side of the balance sheet, the operation has a real estate loan with a 33% loan-to-value and an operating line that mirrors the value of crop for marketing. Weighting the durations by the balance sheet values, the assets have an average duration of 13.5 and the liabilities have an average duration of 7.1. Given the weight of assets and liabilities on the balance sheet, this leaves a duration gap of 11.0. The duration gap implies that a 100-basis point increase in underlying interest rates will decrease the value of equity by 11% of assets, resulting in a loss of roughly $215,000.

What is the farm operation to do about this erosion of equity? Immunization theory provides a few simple options. The operation could extend the repayment period on their loans to extend the duration of liabilities. Table 2 compares a pair of alternatives for minimizing the impact of rising rates on the operation's equity value to the baseline scenario. The operation could use a strategy that merely affects the length of the leverage rather than the overall amount of leverage in the firm. By simply lengthening the duration of liabilities by refinancing $100,000 of debt into the longer-term real estate loan, the operation can protect $8,000 of its equity from interest rate risk. Another option is for the operation to increase its leverage and change the composition of its assets to shorten their average duration. For example, the firm could take out an additional $100,000 on the long-term loan and use the proceeds to increase their working capital by investing in short-term assets or cash. Holding more short-term cash assets would allow the operation to add liquidity to the balance sheet and reduce the duration gap by shortening the average duration of assets and increasing the average duration of liabilities. In turn, the operation can protect nearly $20,000 of its equity from interest rate risk.

Table 2. Single Farm Operation Duration Example

	Balance Sheet Group	Initial Value	Value after 1% Rate Increase	Impact
Baseline	Assets	1,950,000	1,685,947	(264,053)
	Liabilities	700,000	650,481	(49,519)
	Equity	1,250,000	1,035,466	(214,534)
Move $100k Debt to RE	Assets	1,950,000	1,685,947	(264,053)
	Liabilities	700,000	643,269	(56,731)
	Equity	1,250,000	1,042,677	(207,323)
Add $100k Debt in Cash	Assets	2,050,000	1,785,947	(264,053)
	Liabilities	800,000	734,135	(65,865)
	Equity	1,250,000	1,051,812	(198,188)

Importantly, in this example it is virtually impossible for this farm to fully immunize the balance sheet from interest rate risk due to the relatively high duration of farm real estate. Financial institutions often overlay off-balance sheet derivatives such as interest rate futures or swap contracts to tighten the duration gap (Bierwag and Fooladi, 2006). These complex financial instruments are often inaccessible to smaller farm operations, but they should be considered as a possible means of reducing interest rate risk. And while not all farm balance sheets can be fully immunized, any reduction in duration gap can protect equity from the tide of rising interest rates.

Farm Real Estate Widens Sector Duration Gap

Interest rate risk presents itself in the aggregate farm sector balance sheet as well. By grouping the balance sheet items published by the USDA Economic Research Service into the same classifications used in the previous example, the assumed asset classification durations can be used to calculate the sector's duration gap over time. Given that farm real estate assets have typically made up more than 70% of all farm assets, the long-term nature of farm real estate dominates the sector's asset duration calculation. Since 1960, the average duration of farm assets is 13.4. Of note, there are periods with a slightly higher farm asset duration in the early 1980s and 2000s, when farm real estate assets were 80% of the balance sheet or higher. Since 1960, farm liabilities have averaged a duration of roughly 5.7, with higher periods in the 1980s and 2000s when farmers used a greater mix of long-term real estate financing.

Figure 3. Farm Sector Duration Gap History

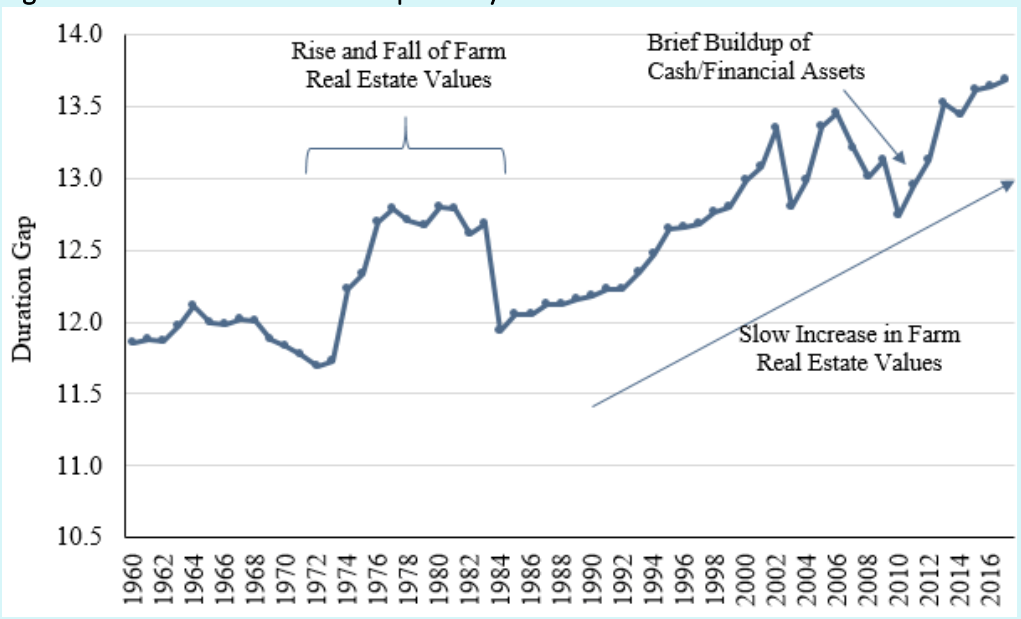


Figure 4. Duration-Implied Farm Equity Compared to Actual Farm Equity

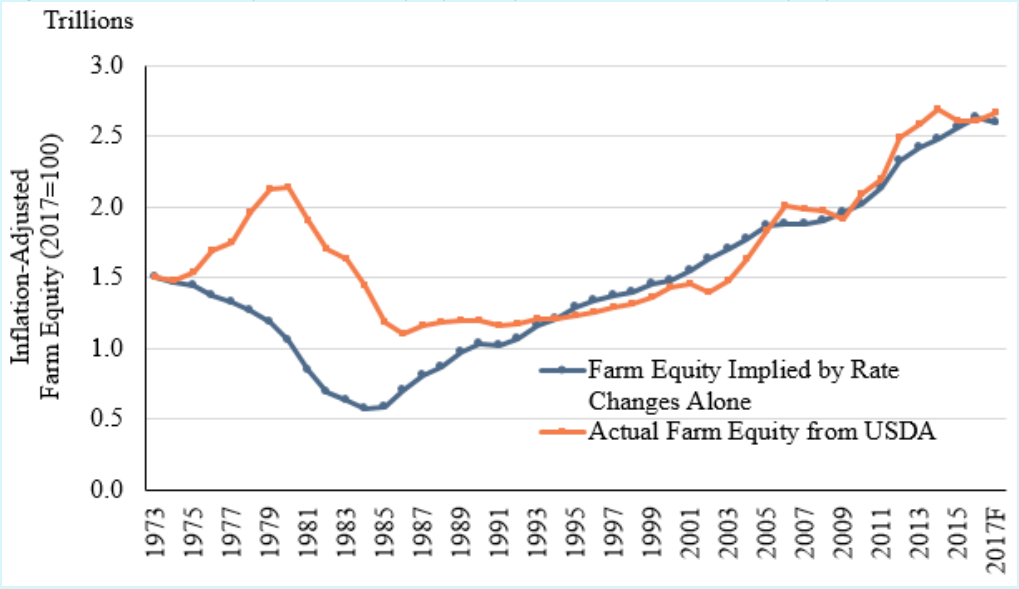


Figure 3 shows the calculated historical duration gap for the sector from 1960 through 2017. The gap has been gradually increasing as real estate has increased as a percentage of farm assets. Two periods stand out as opposing the slow drift: the boom and subsequent bust of the 1970s and 1980s and the years from 2008 to 2012, when high profit levels increased farm operators' cash and short-term financial positions to record highs. In 2017, the farm balance sheet duration gap stands at 13.7; holding

everything else constant, if rates rise by 1 percentage point, this analysis indicates farm equity would fall by $419 billion given the duration gap and initial $3 trillion asset base.

The duration-implied value of farm equity tracks the path of reported farm equity surprisingly well. The durations of all farm assets and liabilities is easily calculated from the values in Table 1. The implied change in equity from a given starting point is the duration gap multiplied by the level of change in interest rates. Using the annual difference between the 5-year moving average 10-year Constant Maturity Treasury rate as a proxy for yield curve shifts, rolling the implied value of farm assets and liabilities forward is a straightforward exercise. Figure 4 demonstrates the results of such an exercise, beginning with 1973 as a base year and letting farm equity float using only the duration gap and the change in interest rates from the prior year. The rapid rise in interest rates in the late 1970s implied a much deeper drop in farm equity than was experienced, but since 1990, the implied equity and reported equity have moved in near-lockstep. This relationship will be worth monitoring if the market yield curve continues to rise.

Coping with High Duration

Understanding the balance sheet impacts of interest rate movements is the first step toward preparing for them. The value of future cash flows is affected by the level of interest rates, and asset and liability values are both functions of the value of cash flows. Since farmers' asset and liability values are both sensitive to interest rate changes, farm equity is also affected by interest rate fluctuations. The scenarios outlined in this article illustrate how the long duration of farm real estate can make it difficult for the farm sector to eliminate its duration gap. Accordingly, farmers' equity is adversely exposed to rising interest rates.

However, farm real estate may not be as interest rate sensitive as its duration suggests. Real estate is a natural inflation hedge, and rate sensitivity varies inversely with inflation sensitivity (Leibowitz, 1992). If interest rates increase in response to rising inflation, farm real estate values may not fall but instead rise, as home prices did in the 1970s. Second, landowners facing a sizable duration gap can always choose to lease out portions of their land holdings to shorten the duration of their portfolios. Leases have fixed time horizons with regular repricing, which gives the cash flows associated with the asset the ability to float with the market and thus the sensitivity to changes in market conditions and interest rates is greatly reduced. Finally, today's lending marketplace offers more widely available and longer-duration loan products than were available during the 1980s. In this article, farm real estate debt was modeled assuming a 15-year fixed rate and 25-year amortization, but farmers have access to 20, 25, and even 30-year loan maturities. A 30-year fixed-rate loan has an approximate duration of 17.7, more generally in line with the land itself. Access to longer-duration debt capital could help protect farm equity in the event of rapidly rising interest rates.

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