Farm Investment and Leverage Cycles: Will This Time Be Different?

By Jason Henderson and Nathan Kauffman

A wave of capital investment has spread throughout the U.S. farm sector in recent years. With booming farm profits, farmers have made a range of real estate investments, building new structures such as grain bins and machine sheds and improving productivity through expanded pivot irrigation and tiling. In addition, non-real-estate investments have soared as farmers purchased new vehicles and upgraded their equipment and machinery. As measured by capital expenditures, farm investment since 2006 has risen at its fastest pace since the 1970s farm boom.

This surge in farm capital investment has raised concerns that farmers may repeat the mistakes of the 1970s, when a wave of capital investment led to an overleveraged farm sector. Historically, farm investment has strengthened as farm booms matured and remained high even when profits began to fade. With shrinking profits, farm enterprises have tapped their wealth to smooth and continue financing their investment spending, leading to expanded farm leverage. U.S. farmers have tended to use farmland, which accounts for 85 percent of farm assets, as collateral for additional farm investments. In short, the "wealth effect"—in which increased wealth fuels increased spending—has been

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particularly strong in the agriculture sector. But if profits decline, some farm enterprises may risk loading up on debt that they cannot service in future years.

Over recent years, in keeping with the pattern of past farm booms, elevated farm profits have enabled farmers to keep leverage ratios near historic lows. But historical trends suggest that the strong wealth effect in the agriculture sector, coupled with low interest rates, could lead to an accumulation of excess debt. This scenario could be a recipe for another financial crisis in U.S. agriculture.

This article explores the historical patterns of U.S. farm capital investment and leverage and considers the prospects for another boom-and-bust cycle if historical patterns re-emerge. Section I examines U.S. farm investment and leverage trends over the past century. Section II analyzes how farm profits, wealth, and interest rates each have influenced the capital investment and financing decisions of farm enterprises. Section III investigates current farm debt trends and how farm debt levels could shift over time.
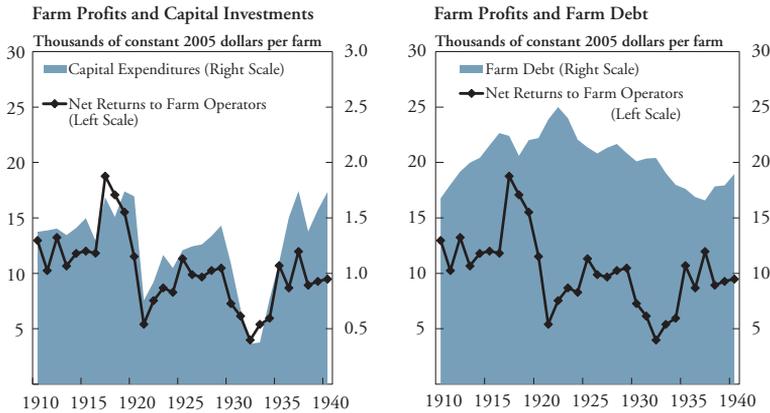
I.   20th CENTURY FARM INVESTMENT AND LEVERAGE CYCLES

Cyclicality is a common feature in agriculture. In the 20th century, the U.S. agriculture sector experienced three cycles of farm profits and investment. During the farm booms of the 1910s, 1940s, and 1970s, profits soared due to surging global demand for agricultural products. Farm investments accelerated toward the end of each boom, as the persistence of high farm prices and profits spurred capital investments. Rising profits and robust investments also set the stage for a new leverage cycle. As each boom faded and profits eroded, farm investment remained elevated and farming enterprises increasingly used debt to finance their investments.

The first cycle: 1910-1940

The U.S. agriculture sector's first investment and leverage cycle emerged during the 1910s. Sparked by rising food demand and a doubling of agricultural exports during World War I, U.S. crop and livestock prices surged and farm profits soared.[1] By the end of World War I, prices received by farmers for crops and livestock commodities had

Chart 1
FARM PROFITS, INVESTMENTS, AND DEBT PER FARM (1910-1940)

Farm Profits and Capital Investments

Thousands of constant 2005 dollars per farm

Farm Profits and Farm Debt

Thousands of constant 2005 dollars per farm

Note: Calculations based on USDA and Federal Reserve data on farm net returns, capital expenditures, and farm debt. Nominal data are deflated by the consumer price index from the Federal Reserve Bank of Minneapolis.

doubled from 1915 levels. In turn, farm profits soared as real net returns to farm operators in 1919 reached $23,500 per farm, or $152 billion for the sector as a whole (Chart 1).[2]

Although farm profits doubled, capital investments rose more modestly, accelerating toward the end of the farm boom. Initially, farmers began to invest in farm real estate in the form of structures such as barns, grain bins, and machine sheds. In 1916 and 1917, spending per farm on structures rose on average by 28 percent per year. Spending continued to rise until reaching a peak in 1919. The mechanization of U.S. agriculture intensified during the war with the adoption of the tractor and other vehicles. In 1917, average farm spending on vehicles, machinery, and equipment jumped 33 percent and expanded through the rest of the decade. During the 1910s, real annual farm capital expenditures for the agriculture sector as a whole reached $10 billion per year in the last half of the decade, more than 10 percent above the first half of the decade.

The acceleration of capital investment, however, did not initially lead to rising farm debt. Real estate debt per farm fell 10 percent from 1916 to 1918. Non-real-estate debt held steady during the war despite major investments in tractors and other machinery. During World War I,

farm capital expenditures accounted for a smaller share of farm profits than earlier in the decade.

The 1910s farm boom quickly faded following the end of the war. In 1921, weak farm exports and a U.S. recession led to a collapse in farm prices and profits.[3] For the agricultural sector, real net returns to farm operators fell 53 percent in 1921, and total real farm capital expenditures dropped by more than half. Farm profits and capital expenditures quickly rebounded, but the gains were not enough to forestall the first farm crisis of the 1900s.
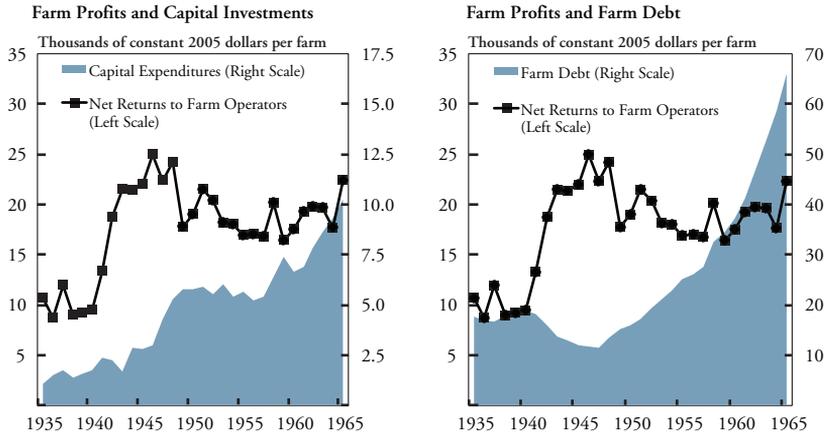
During the 1920s, farm debt and farm bankruptcies soared. With lower farm profits, farmers expanded their debt levels to provide liquidity to their operations. In 1922, farm debt climbed to $25,000 per farm. This expansion of farm debt, however, could not prevent farm bankruptcies. In 1923, farm bankruptcies began to spike. For the next three years, farm bankruptcies were more than seven times higher than the 1920 low, accounting for almost one out of every five bankruptcies in the United States.[4] The Great Depression brought further deleveraging in the U.S. agriculture sector as another collapse in farm profits during the 1930s slashed farm investments and triggered another wave of farm bankruptcies.

The second cycle: 1940-1960

Beginning in the 1940s, as in the 1910s, wartime triggered another profit and investment cycle in U.S. agriculture. With strong demand during World War II, U.S. agricultural exports doubled, farm prices soared, and farm profits reached record highs. Real net returns per farm rose from roughly $7,000 in 1940 to more than $20,000 by 1943 (Chart 2).[5] Robust export activity following the war pushed real net returns per farm to $25,000 by 1948.

Again as in the 1910s, farm capital investments accelerated more sharply during the second half of the 1940s after several years of historically high profits. Initial investments were again concentrated in real estate, with average real capital expenditures on structures and land improvements nearly doubling in 1946. The following year, a wave of non-real-estate investments emerged, with average capital expenditures on vehicles, machinery, and equipment jumping 73 percent in 1947,

Chart 2
FARM PROFITS, INVESTMENTS, AND DEBT PER FARM (1935-1965)

Farm Profits and Capital Investments

Thousands of constant 2005 dollars per farm

Capital Expenditures (Right Scale)
Net Returns to Farm Operators (Left Scale)

Farm Profits and Farm Debt

Thousands of constant 2005 dollars per farm

Farm Debt (Right Scale)
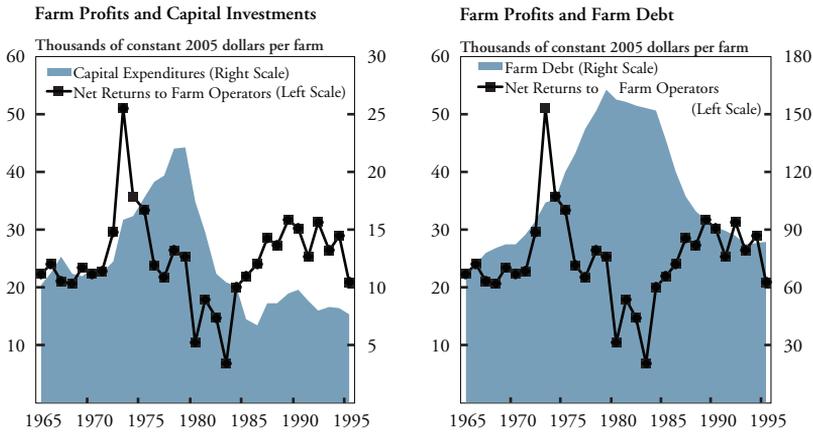Net Returns to Farm Operators (Left Scale)

Note: Calculations based on USDA and Federal Reserve data on farm net returns, capital expenditures, and farm debt. Nominal data are deflated by the consumer price index from the Federal Reserve Bank of Minneapolis.

followed by a 35 percent rise in 1948. By 1949, real annual farm capital expenditures for the agriculture sector as a whole topped $30 billion per year, more than double the levels from 1940 to 1944. During the 1950s, farm capital expenditures remained flat, even while farm profits began to decline.

As in the previous cycle, record high farm profits initially contributed to deleveraging in the U.S. agriculture sector, with farmers paying off their debts. From 1940 to 1945, debt per farm fell 37 percent as real estate debt in particular contracted sharply. Farm debt held steady through the rest of the decade, as rising profits were used to pay for capital investment in vehicles, machinery and equipment. In the 1950s, with lower profits, farmers used more debt to finance persistently high capital expenditures. Farm debt rose 9 percent per year on average between 1950 and 1960, with steady increases in both real estate and non-real-estate debt. In contrast with the previous cycle, however, the rise in farm debt during the 1950s was relatively conservative. Debt ratios remained below their historical averages.[6] As a result, unlike other farm booms, U.S. agriculture did not experience a bust after the 1940s farm boom.

Chart 3

FARM PROFITS, INVESTMENTS, AND DEBT PER FARM (1965-1995)

Farm Profits and Capital Investments

Thousands of constant 2005 dollars per farm

Farm Profits and Farm Debt

Thousands of constant 2005 dollars per farm

Note: Calculations based on USDA and Federal Reserve data on farm net returns, capital expenditures, and farm debt. Nominal data are deflated by the consumer price index from the Federal Reserve Bank of Minneapolis.

The third cycle: 1970s-1980s

After a decade of steady growth, another investment and debt cycle emerged in the 1970s. In 1972, a surge in U.S. exports, fueled in part by the U.S.-Soviet grain trade deal, led to a doubling of U.S. crop prices. Farm profits spiked. In 1973, real net returns to farm operators soared to more than $50,000 per farm, nearly double the previous year's level (Chart 3). Although farm profits retreated quickly, average profits per farming operation during the 1970s were 42 percent higher than in the previous decade.

The spike in farm profits triggered a sharp increase in capital investment that persisted even after profits declined. Starting in 1973, capital investment rose sharply as farmers accelerated their non-real-estate investments in vehicles, machinery and equipment. Farmers also increased their real estate investments in structures and land improvements. Capital spending rose until 1979, when it peaked at $22,000 per farm, double the 1970 level and a full six years after the spike in farm profits. During the second half of the decade, real annual farm capital expenditures for the agriculture sector as a whole climbed to $45 billion, 31 percent above levels during the first half of the decade.
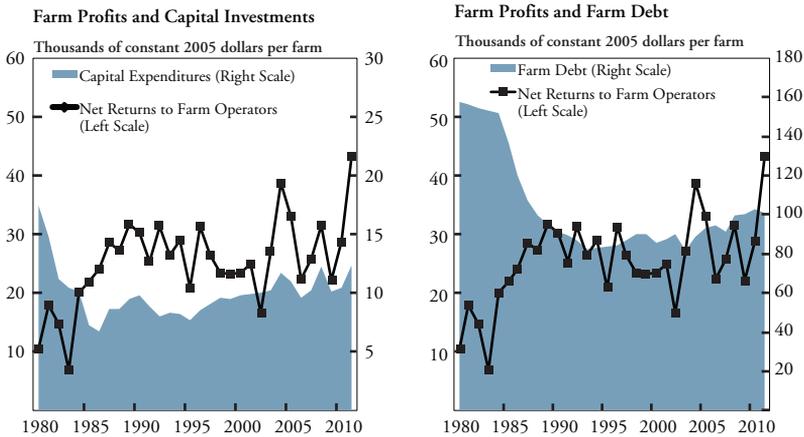
With capital investments rising faster than farm profits, farm debt soared in the late 1970s. The 1973 spike in farm profits initially slowed debt accumulation. Total debt per farming operation rose only by approximately 2 percent in 1974. Yet during the second half of the 1970s, amid shrinking profits, farm debt accumulation intensified. From 1975 to 1979, debt per farming operation rose 9 percent per year, driven by strong non-real-estate debt.

The accumulation of debt in the 1970s coupled with falling farm profits triggered the 20th century's second farm financial crisis.[7] In 1980, U.S. farm profits plummeted as agricultural exports collapsed and farm prices dropped (Duncan). Farmers slashed their spending both on structures and land improvements and on vehicles, machinery and equipment. During the first few years of the 1980s, the decline in capital investments limited debt accumulation. However, the decline was not enough to forestall the farm financial crisis of the 1980s. Another collapse in farm profits during 1983 combined with high interest rates to trigger a series of farm bankruptcies as farmers were unable to service existing farm debts. Even though farm profits rebounded in 1984, the damage was done. In 1985, farm bankruptcies spiked to 2.3 bankruptcies per 1,000 farms, double the record set in the 1930s. From 1985 to 1988, average debt per farming operation fell more than 10 percent annually as lenders wrote off existing debts. Stronger profits, fueled by larger government payments and a collapse in capital investments during the second half of the decade allowed farmers to whittle away their high debt levels over the next 10 years.

The fourth cycle: 2005 through the present

The U.S. agriculture sector appears to be in the initial stages of another profit and investment cycle. Since 2006, a doubling of U.S. agricultural exports and strong bio-fuels demand has underpinned another surge in farm profits. Annual real net returns to farm operators topped $45,000 per farm in 2011 and 2012, their highest level since 1973 (Chart 4). Rising profits have spurred capital investment. According to the most recent available data from the U.S. Department of Agriculture (USDA), real capital expenditures per farm topped $12,000 per year in 2011, their highest level since the farm boom and bust cycle of the 1970s and 1980s. Federal Reserve surveys of bankers specializing in

Chart 4
FARM PROFITS, INVESTMENTS, AND DEBT PER FARM (1980-2011)

Farm Profits and Capital Investments

Thousands of constant 2005 dollars per farm

Farm Profits and Farm Debt

Thousands of constant 2005 dollars per farm

Note: Calculations based on USDA and Federal Reserve data on farm net returns, capital expenditures, and farm debt. Nominal data are deflated by the consumer price index from the Federal Reserve Bank of Minneapolis.

loans to the agriculture sector indicate that capital spending remained strong through 2012.[8] This finding is further corroborated by data from the Association of Equipment Manufacturers, which reported strong tractor and combine sales in 2012 and in the first quarter of 2013.

As in past farm booms, farmers have invested heavily in buildings and new structures. Since 2005, average annual farm real estate investments in structures such as machine sheds, grain bins, and livestock buildings jumped almost 50 percent above 1990s levels. To enhance efficiency, farmers also have invested heavily in land improvements such as irrigation equipment, terraces, tile lines, and other conservation facilities. During the past decade, real capital expenditures per farm on land improvements rose 28 percent from 1990s levels.

Farmers also upgraded machinery and equipment and purchased new vehicles. During the past decade, farmers boosted their real annual capital expenditures on tractors by 40 percent compared with 1990s levels. Farmers also upgraded their other equipment, increasing real annual capital expenditures on "other machinery and equipment" by 5 percent. Tractors accounted for a larger share of farm machinery investments from 2000 to 2011 (26 percent of expenditures) than from 1990 to 2000 (20 percent).

Chart 5

CORRELATION BETWEEN AVERAGE FARM CAPITAL EXPENDITURES AND FARM PROFITS

Correlation coefficient

■ Total
■ Structures and Land Improvements
■ Vehicles, Machinery and Equipment

Farm Profits
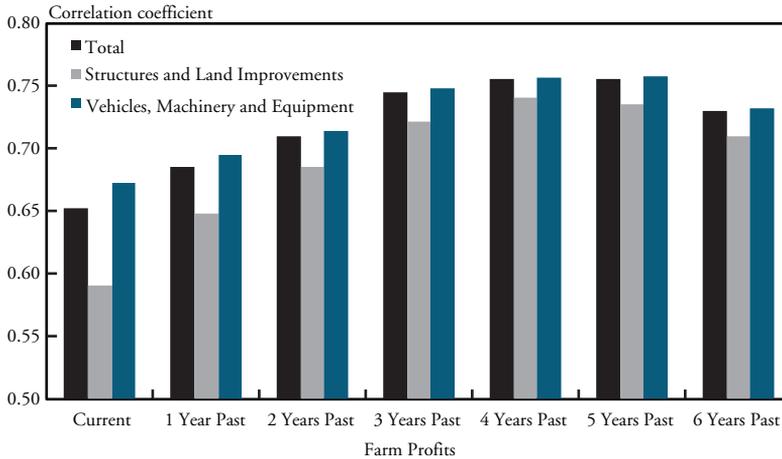
Source: Authors'calculations based on USDA Farm Income and Wealth Statistics.

Although investment has accelerated, farmers appear to have been generally conservative in their investment spending, at least when compared with past farm booms. After adjusting for inflation, average annual farm capital expenditure increases per farm have been lower than 1970s levels.

Current farm capital expenditures account for a smaller share of farm profits than in past farm cycles. Over the past two decades, average annual farm capital expenditures for the agricultural sector totaled approximately 40 percent of average annual returns to farm operators, down from 80 percent during the 1970s farm boom. However, farm capital expenditure data are only available through 2011. Farmers, especially crop producers, earned record profits in 2011 and 2012. The historical correlation between capital investment and past farm profits suggests that, in the current boom, capital investments could strengthen in the future. Farm capital expenditures are more correlated with past returns to farm operators than with current returns (Chart 5). The relationships strengthen over time and, specifically, current capital expenditures are more highly correlated with farm profits in the prior two to five years than with current-year profits.[9] Given the Association of Equipment Manufacturers' report of stronger tractor and combine sales in 2012, farm capital investments may have strengthened since 2011.

II.   INCOME AND WEALTH EFFECTS IN U.S. AGRICULTURE

The relatively slower pace of current farm capital investments compared with the 1970s suggests that this farm boom might be different from past ones. Farmers may be investing less relative to the levels of profit they are earning, even as farm profits reach record highs. Empirical analysis of past farm booms suggests, however, that farm investment accelerates as farm booms mature. Moreover, leverage cycles typically are ignited after farm profits begin to fade.

Investing in the farm

Studies of farm capital investment have found that farm wealth is a fundamental driver of farm investment (Bierlen and Featherstone; Benjamin and Philmister; Penson, Romain, and Hughes; Stock; Alston; Hubbard and Kashyap).[10] Past research has shown that farm enterprises tend to smooth their investments over time (Boumtje, Barry, and Ellinger; Langemeir and Patrick). Thus, during less profitable times, instead of using current profits to finance their investments, farmers tap their wealth and equity to finance their capital spending. Lenders are more willing to lend to farm enterprises with high levels of equity that can be used as collateral for loans.

A regression model is used to explore the relationship between capital spending, farm profits, and wealth. Following Davis and Palumbo's discussion of wealth accumulation of households, farm enterprises are assumed to allocate profits between current investment and retained equity. Thus, parallel to a household's consumption decision rule, farm investments depend on the total resources of the enterprise: profits and wealth.[11] Aggregated across farm enterprises, sector-wide farm investments are identified to be a function of farm profits and farm wealth.

(1) $I_t = f(Y_t, W_t)$

where I is farm investment, Y is farm profits, and W is farm wealth, all measured in real terms.
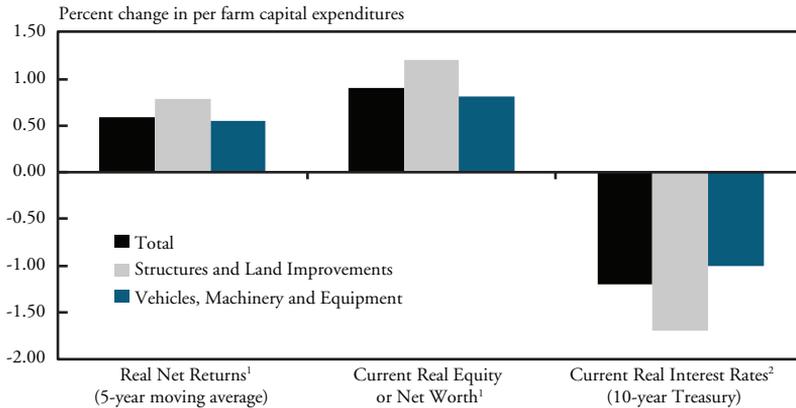
The estimated regression is given by the following equation:

(2) $I_t = f(Y_t, W_t, i_t, t, War)$

where i is the real interest rate and t is a time trend. The model controls for interest rates because they contribute to capital investment decisions

Chart 6

THE EFFECT OF FARM WEALTH, PROFITS, AND INTEREST RATES ON FARM CAPITAL EXPENDITURES

Percent change in per farm capital expenditures

[Bar chart with vertical axis from -2.00 to 1.50. Legend: Total (black), Structures and Land Improvements (gray), Vehicles, Machinery and Equipment (blue). Categories: Real Net Returns[1] (5-year moving average); Current Real Equity or Net Worth[1]; Current Real Interest Rates[2] (10-year Treasury)]

[1] The impact of real net returns and current real equity or net worth is based on a 1.0 percent change in returns or equity.
[2] The impact of current real interest rates is based on a 1 percentage point change in interest rates.
Source: Authors' calculations based on regression results in Appendix 1.

by altering the cost of investment. A dummy variable identifying the two World Wars is also included in the model to account for the nation's shifting focus of production from domestic to wartime manufacturing, which could have limited the supply of farm machinery, equipment, and other capital investments during these periods.[12]

The regression analysis shows that farm capital investments have fluctuated with shifts in farm profits and wealth.[13] Given the correlation between current farm capital expenditures and past net returns to farm operations, a five-year moving average of lagged net returns was used to measure farm profits. The five-year period was chosen because the five-year moving average maximized the explanatory power of the model.[14] Real capital expenditures per farm operation were found to be significantly related to the real net returns to farm operators (Appendix A). A 1.0 percent increase in farm profits per farm was associated with a 0.6 percent increase in capital spending per farm (Chart 6).

The relationship between capital expenditures and farm profits has differed slightly across the real estate and non-real-estate categories. Farm profits had a stronger relationship with real estate investments in structures and land improvements. A 1.0 percent increase in farm profits per farm was associated with a 0.8 percent increase in real

estate capital expenditures on farm structures and land improvements per farm. In contrast, a 1.0 percent increase in farm profits per farm was associated with a 0.6 percent increase in non-real-estate capital expenditures on vehicles, machinery, and equipment per farm.

Higher levels of farm wealth were also found to be significantly related to higher levels of farm capital spending. As with farm profits, a 1.0 percent increase in farm equity per farm was associated with a 0.9 percent increase in total farm capital expenditures per farm. Also as was the case with farm profits, the relationship between farm capital expenditures and farm equity varied across categories of capital investment. A 1.0 percent rise in farm equity per farm was associated with a 1.2 percent increase in real estate capital expenditures on structures and land improvements per farm and a 0.8 percent rise in non-real-estate capital expenditures on vehicles, machinery, and equipment per farm.

The real interest rate on the 10-year Treasury note, when included in a regression of capital spending per farm, is correlated with capital investments on farm structures and land improvements. The correlation reflects that these are relatively long-term capital investments. A 1.0-percentage-point rise in real interest rates was associated with a 1.2 percent decline in per farm capital expenditures. The 10-year Treasury note was found to have a stronger relationship with capital expenditures on structures and land improvements than on vehicles, machinery, and equipment. Given that non-real-estate investments tend to be financed with loans of a shorter maturity, capital investments on vehicles, machinery and equipment might have a stronger correlation with shorter-term interest rates. An alternative regression of non-real-estate capital expenditures on vehicles, machinery, and equipment found that the real interest rate on a 3-month Treasury bill was negatively correlated with farm capital expenditures.[15]

Leveraging the farm

Just as profits and wealth have spurred capital investment, the wealth effect in U.S. agriculture has underpinned a series of leveraging cycles in the sector. The leveraging and debt accumulation was most pronounced during the 1910s and 1970s, when farmland values soared. With higher wealth, especially in farm real estate, farmers used land as collateral for loans on capital investments in the farm enterprise.

As a result, farm debt rose. With today's historically high farmland values and low interest rates, the stage may be set for the accumulation of farm debt.

Over the past century, farm enterprises accumulated debt more rapidly as farm booms matured and farm profits faded. Farm debt patterns followed capital investment. For example, during the farm booms of the 1910s, 1940s, and 1970s, real farm debt rose more sharply at the end of these decades when farm profits started to decline. The initial gains in farm debt were concentrated in farm real estate, which coincided with initial investments in structures and land improvements. Over time, non-real-estate debt increased as capital investments became more concentrated in vehicles, machinery, and equipment.
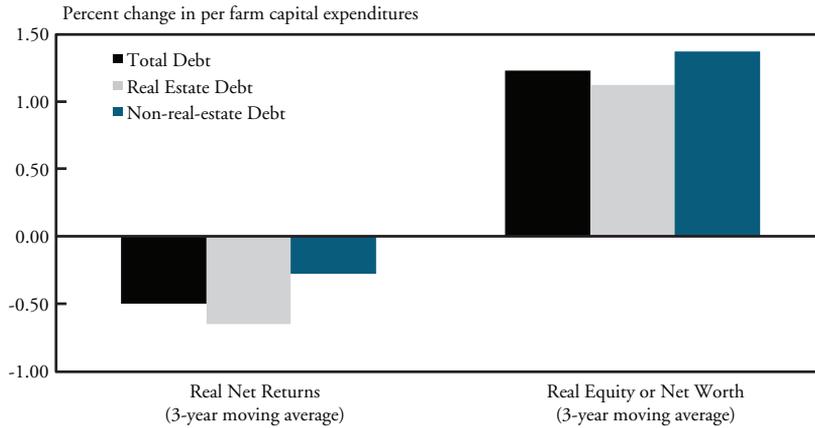
Not surprisingly, farm debt is negatively correlated with farm profits. Similar to farm capital investments, current farm debt has a stronger correlation with past farm profits, suggesting that debt accumulation persists during extended periods of lower farm profits.

Regression analysis exploring the relationship between farm debt and the three-year moving average of farm profits shows that a 1.0 percent decline in farm profits has been associated with a 0.5 percent increase in farm debt (Appendix B).[16] A reduction in farm profits had a stronger association with farm real estate debt than non-real-estate debt. A 1.0 percent reduction in farm profits was associated with a 0.7 percent increase in farm real estate debt, compared with a 0.3 percent increase in non-real-estate debt (Chart 7).

Given that debt accumulation has intensified when profits have declined, financial factors other than profits must be spurring lending activity and loan decisions. Not surprisingly, farm enterprises accumulate debt when wealth levels are high. High wealth levels increase the amount of collateral available to support borrowing by farms. Over the 20th century, farm debt was higher in periods of high farm wealth. In fact, farm debt correlated more strongly with farm wealth than with farm profits. In a regression controlling for profits, a 1.0 percent increase in farm wealth was associated with a 1.2 percent increase in farm debt. The strength of the relationship varied by type of farm debt: farm wealth had a stronger association with non-real-estate debt than with real estate debt. A 1.0 percent increase in farm wealth was associated

Chart 7

MARGINAL EFFECTS OF FARM WEALTH AND FARM PROFITS ON FARM DEBT

Percent change in per farm capital expenditures

■ Total Debt
▪ Real Estate Debt
■ Non-real-estate Debt

Real Net Returns
(3-year moving average)

Real Equity or Net Worth
(3-year moving average)

Note: The impact of real net returns and current real equity or net worth is based on a 1.0 percent change in returns or equity.
Source: Authors' calculations based on regression results in Appendix 2.

with a 1.4 percent increase in non-real-estate debt compared with a 1.1 percent increase in real estate debt.

III. THE OUTLOOK FOR FARM INVESTMENTS AND LEVERAGE

The patterns of past leverage cycles described above suggest that U.S. farm debt could be approaching yet another turning point in the years ahead. Given the strong wealth effect typically displayed in the U.S. agriculture sector, it seems quite possible that farm investment may prove persistent even when profits decline, leading to an accumulation of debt. Long-term projections suggest that, after posting record highs over the past two years, U.S. farm profits are expected to pull back in the future (USDA). At the same time, interest rates could begin to rise in coming years.

The expectation that farm profits will likely retreat over the next decade stems from several factors. After a period of unusually erratic weather, a return to more normal weather patterns may be expected to cause a rebound in U.S. crop production, leading in turn to expanded inventories and reduced crop prices by 2014. At the same time, stronger global crop production and slower growth in crop demand coming

Chart 8
NET RETURNS TO CROP PRODUCTION
(Market Returns Less Variable Costs)

Dollars per acre
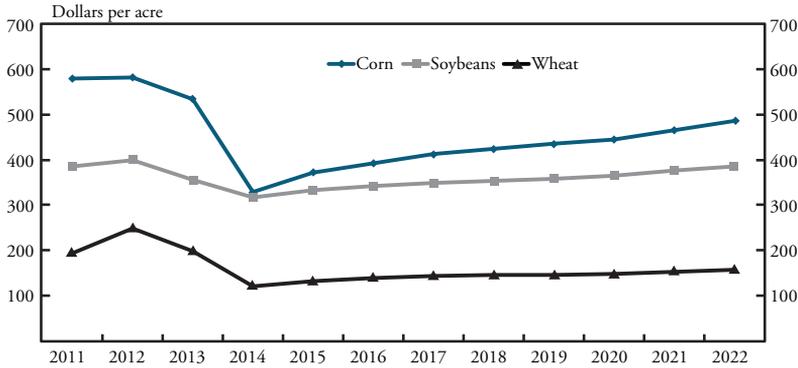
Sources: Westcott and Trostle, Agricultural Baseline Projections to 2022, USDA.

from exports and ethanol production is projected to weigh on crop prices and profits. Annual corn prices, for example, are projected to average less than $5 per bushel over the next decade starting in 2014 (Westcott and Trostle). The USDA projects that net returns for corn production (above variable costs), after averaging almost $600 per acre for the past two years, are likely to fall below $350 per acre by 2014, a decline of 44 percent (Chart 8). Sizeable declines are also projected for wheat and soybean profitability. Taking into account these projections, along with similar forecasts for other types of agricultural production, the USDA projects U.S. net farm incomes to fall in 2014 by 20 percent to 25 percent from the highs forecast for 2013.

The current low interest rate environment may also support debt accumulation. Futures markets suggest that both short- and long-term interest rates could remain near historical lows for some time.[17] Moreover, in December 2012, projections for returns on both 10-year and 3-year Treasuries through 2013 declined (Livingston Survey).

Farmland values are also projected to remain high. A 2012 survey of Indiana farmland investors suggested that farmland prices in five years would be above their current, record highs (Gloy). The survey also found no correlation between the expected price of Indiana farmland and corn prices, suggesting the farmland prices, and ultimately farm wealth, could remain high even if crop prices and profits decline.

If historical patterns hold, these conditions are ripe for the accumulation of farm debt. Coupled with low-interest rates, historically high land values could keep farm investments high, even if profits fall. If capital investments are to remain elevated amid lower profits, farmers will need to use more debt to finance their investments. The patterns of the past would suggest that, in the initial phase of an upswing in capital investment, farms tend to focus on investing in land improvements and structures. If low profits persist and wealth remains high, farmers typically turn to borrowing to finance investments in vehicles, machinery, and equipment, in a second wave of capital investment.

What stops the treadmill of rising capital investments and debt accumulation? The cornerstone for capital investments and debt accumulation is farm wealth. Elevated wealth levels are correlated with increases in both capital investment and debt accumulation. With roughly 85 percent of farm assets concentrated in farm real estate, falling farmland prices and lower wealth levels will most likely be a major factor triggering the next deleveraging cycle in U.S. agriculture.

History has shown that a combination of falling profits and rising interest rates typically drive farmland prices lower. Farmland prices tend to reflect the market's best estimates of the capitalized value of future returns, or income streams—a calculation affected significantly by interest rate expectations. During the 1920s, lower farm profits and higher interest rates pushed U.S. farmland values down 25 percent, with further declines during the Great Depression (Chart 9). During the 1980s, U.S. farmland values fell 40 percent amid declining profits and rising interest rates. Rising interest rates also raise debt service costs and are correlated with lower net farm returns, making it difficult to disentangle which factor—rising interest rates or an extended period of low farm profits—may turn out to be more important in triggering a decline in land values. Either one could be the cause, given that the USDA has projected net farm incomes will fall in 2014 and the possibility that interest rates could rise as the economy gains strength. The combination of lower incomes and rising interest rates could weigh significantly on farmland values and farm assets.

History has also shown that farm booms go bust when leverage ratios are high. During the 1920s, U.S. farm bankruptcies spiked and remained elevated when the debt-to-asset ratio jumped above 20

Chart 9
REAL FARMLAND VALUES AND FARM BANKRUPTCIES
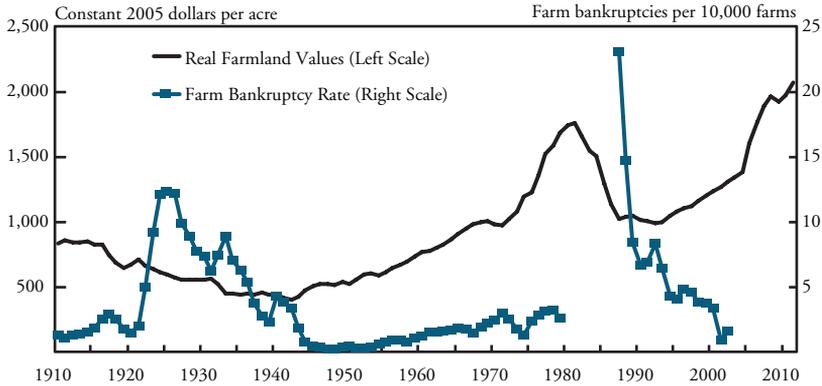
Note: Stam and Dixon do not provide bankruptcy data for 1982-86, or 2003-11.
Sources: USDA and Stam and Dixon, 2004.

(Chart 10). During the 1980s, farm bankruptcies again spiked after the debt-to-asset ratio topped 20.

During these past farm crises, the rise in farm debt ratios was driven by falling asset values. From 1920 to 1923, the jump in the debt-to-asset ratio was driven by a drop in farmland values and a 20 percent decline in farm asset values, as farm debt levels held steady. From 1980 to 1985, the debt-to-asset ratio rose above 20 after farm assets fell by 40 percent and farm debt decline by 15 percent.

During the 1920s and 1980s farm crises, farm debt began to decline only after farm bankruptcies forced creditors to write down debts. An increase in forced sales during the 1920s and 1930s, for example, contributed to a sustained collapse in farmland prices from 1920 to 1940 (Alston; Stam and Dixon). Record high bankruptcies contributed to the large decline in farmland prices during the 1980s. Farm bankruptcies created a downward spiral in farm finances, as forced farm sales increased the supply of land on the market. The resulting decline in farm real estate prices further eroded the value of farm assets and caused yet more bankruptcies in the agriculture sector.

Given the current, record-high farmland values, farm debt ratios are now near historic lows. The USDA projects the 2013 farm sector debt-to-asset ratio will decline to 10.2, driven by a 6.3 percent increase

Chart 10
FARM DEBT-TO-ASSET RATIO AND FARM BANKRUPTCIES
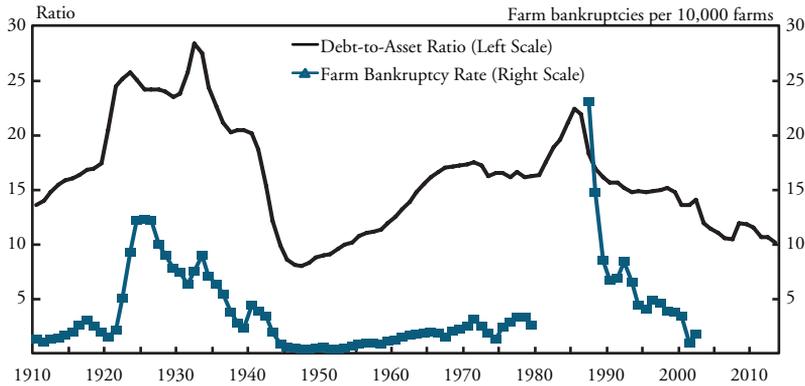
Note: Stam and Dixon do not provide bankruptcy data for 1982-86, or 2003-11.
Sources: USDA and Stam and Dixon, 2004.

in farm asset values and a 1.8 percent increase in farm debt. If the debt-to-asset ratio were to rise to 20 for the farm sector as a whole, the rise would have to be driven either by farm assets' falling sharply or by farm debt's soaring. As an example, assuming no change in farm debt, the value of farm assets would need to fall by 50 percent to push the debt-to-asset ratio above 20 (Table 1). If farm assets were to fall 40 percent, similar to the pattern of the early 1980s, farm debt would have to rise by 10 percent to lift the debt-to-asset ratio above 20. In contrast, if farm assets fell by 20 percent, as in the 1920s, farm debt would need to rise by 50 percent to drive the debt-to-asset ratio above 20.

Although today's farm leverage ratios are historically low, the concentration of farm debt raises the risk of farm bankruptcies even in prosperous times. U.S. farm debt is concentrated in a small segment of farming operations (Briggeman, Featherstone). While average debt-to-asset ratios were similar in both 1979 and 2010, almost 6 percent of Kansas farm enterprises had debt-to-asset ratios above 70 in 2010, compared with only 1.3 percent of Kansas farm enterprises in 1979 (Featherstone). High debt-to-asset ratios raise the risk of farm bankruptcies. The USDA has indicated that when debt-to-asset ratios for the individual farm enterprise rise above 40, the enterprise can become vulnerable to solvency problems (Park et. al). Although farm bankruptcies remain limited, a few high-profile farm bankruptcies of highly

Table 1

U.S. FARM SECTOR DEBT-TO-ASSET RATIO UNDER ALTERNATIVE DEBT AND ASSET SCENARIOS

		Fall in assets (percent change)				
	0	10	20	30	40	50
0	10.6	11.8	13.3	15.1	17.7	21.2
10	11.7	13.0	14.6	16.7	19.4	23.3
20	12.7	14.1	15.9	18.2	21.2	25.4
30	13.8	15.3	17.2	19.7	23.0	27.6
40	14.8	16.5	18.6	21.2	24.7	29.7
50	15.9	17.7	19.9	22.7	26.5	31.8

Rise in debt (percent change)

Source: Authors' calculations based on USDA Farm Income and Wealth Statistics.

leveraged farm enterprises have occurred recently, illustrating how highly concentrated debt levels raise the risk of farm bankruptcies—and the prospect of farm sector busts (Neeley).

IV.   CONCLUSION

The stage is set for another possible cycle of rising leverage in the U.S. agriculture sector. Over the past decade, farmers have increased their production capabilities through capital investments and, as a result, agricultural supplies are projected to rebound. Rising supplies, coupled with higher production costs, are projected to cut farm profits by 2014.

Historically, declines in farm profits initially have not triggered a reduction in capital investments as farmers tapped their wealth to finance and smooth their capital investments over time. That past pattern suggests that, in the current cycle, both real estate and non-real-estate investment by farmers might continue to remain high, even when profits decline, as long as farm wealth remains elevated and interest rates remain low.

Particularly in low interest rate environments, farmers may tap their farm equity as collateral to finance ongoing capital investments, taking on more debt instead of using retained earnings. During the 1920s and 1980s, farmers accumulated debt and many faced bankruptcy when farm profits plummeted, farm land values declined, and interest rates rose sharply.

Today, although current aggregate leverage ratios remain low in the sector, high levels of leverage are concentrated among some farm enterprises. Amid projections of lower farm incomes in coming years, along with high levels of farm wealth and low interest rates, will farmers maintain their working capital or will they leverage their farms? History has shown that significant increases in farm leverage can set the stage for deleveraging cycles and farm busts. Whether the current farm boom simply fades—or busts—will depend on how farmers finance their investments and how far leverage rises.

APPENDIX A

REGRESSION RESULTS FOR U.S. FARM CAPITAL EXPENDITURES

	Model 1: Total Capital Expenditures	Model 2: Capital Expenditures *Structures and Land Improvements*	Model 3: Capital Expenditures *Vehicles, Machinery, and Equipment*
Intercept	-2.080** (0.168)	-3.458** (0.185)	-2.000** (0.18)
Net Returns to Farm Operators 5-year moving average (Log of billions of constant 2005 dollars)	0.595** (0.151)	0.791** (0.166)	0.552** (0.161)
Farm Equity (Log of billions of constant 2005 dollars)	0.907** (0.109)	1.209** (0.12)	0.817** (0.116)
Real Yield on the 10-year Treasury (Percent)	-0.012** (0.003)	-0.017** (0.004)	-0.010** (0.004)
Time Trend	-0.002 (0.001)	-0.006** (0.001)	-0.001 (0.001)
War	-0.173** (0.056)	-0.150* (0.062)	-0.185** (0.06)
Adjusted R-square	0.912	0.916	0.896

*Significant at 0.05 level
**Significant at 0.01 level
 Note: Data in parentheses are standard errors.

APPENDIX B

REGRESSION RESULTS FOR U.S. FARM DEBT

	Model 1: Total Debt	Model 2: Non-real-estate Debt	Model 3: Real Estate Debt
Intercept	-0.541**	-1.445**	-0.397**
	(0.113)	(0.104)	(0.134)
Net Returns to Farm Operators 5-year moving average (Log of billions of 2005 constant dollars)	-0.500** (0.086)	-0.275** (0.079)	-0.654** (0.102)
Farm Equity (Log of billions of 2005 constant dollars)	1.229** (0.067)	1.369** (0.061)	1.122** (0.078)
Real Yield on the 10-year Treasury (Percent)	0.006* (0.002)	0.004 (0.002)	0.007* (0.003)
Time trend	-0.002* (0.001)	-0.003** (0.001)	-0.002 (0.001)
War	-0.011 (0.039)	-0.012 (0.036)	0.004 (0.047)
Adjusted R-square	0.935	0.960	0.883

*Significant at 0.05 level
**Significant at 0.01 level
  Note: Data in parentheses are standard errors.

ENDNOTES

[1]See Henderson, Gloy, and Boehlje (2011) for a summary of past net farm income and land value cycles.

[2]In this article, farm profits, investment, and debt are measured in constant 2005 dollars, deflated with the annual consumer price index. Farm profits are measured as the real returns to farm operators. Farm investments are measured as the real capital expenditures in farm enterprises. All data series are obtained from the U.S. Department of Agriculture (USDA).

[3]See Rajan and Ramcharan (2012) for a discussion of the 1920s farm crisis.

[4]According to the *Historical Statistics of the United States*, farm bankruptcies accounted for roughly 7 percent of total U.S. bankruptcies during World War I.

[5]For the agricultural sector as a whole, total real net returns reached $131 billion in 1943, double the levels in 1940.

[6]According to the authors' calculations, the average debt-to-equity ratio was 0.20 from 1910 to 2012. During the 1950s, the average debt-to-equity ratio was 0.13, increasing from 0.11 in 1950 to 0.15 in 1959.

[7]For a description of the 1980s farm crisis see Freshwater, Peoples, and Hanson.

[8]Farm income and capital spending indexes from agricultural credit surveys of Federal Reserve Banks of Dallas, Chicago, Kansas City, and Minneapolis are available in the *Agricultural Finance Databook* published by the Federal Reserve Bank of Kansas City.

[9]Farm capital expenditures are much more highly correlated with net returns four to five years ago than with net returns two to three years ago.

[10]These studies view investment decisions as being determined by net present value theory or "the q-theory." According to net present value theory, farmers will compare the net present value of the costs and benefits of an investment to decide whether to invest (Featherstone and Goodwin). Under q-theory, the fundamental q is a measure of profit margins associated with an additional dollar of investment and is used to test the role of internal funds in supporting investments (Bierlen and Featherstone).

[11]See Davis and Palumbo for a discussion of life-cycle theory and household consumption.

[12]Equation 2 is estimated using interest rates deflated with the consumer price index and log transformations of annual per farm data on farm capital expenditures, net returns to farm operators, and farm equity. Farm investments are defined as farm capital expenditures based on data from 1910 to 2011, available from USDA. The equation is estimated for total capital expenditures, as well as the two subcomponents: real estate capital expenditures (farm structures and land improvements) and non-real-estate capital expenditures (vehicles, machinery, and equipment). Farm profits are defined as the net returns to farm operators from 1910 to 2011, again based on USDA data. Farm wealth is defined as farm equity.

The data series was spliced using USDA data from 1960 to 2011 and data from 1910 to 1960 obtained from Melichar (1987). The yield on the 10-year Treasury security is used to measure interest rates.

[13]A single dummy variable identifying time of war is included in the regression models. During World War I and World War II, mobilization of the economy for wartime production of tanks and other military equipment could have slowed capital investments in agriculture. The variable War is given a value of 1 during World War I (1916-1919) and during World War II (1941-1945) and zero otherwise.

[14]Initial regressions using individual lagged years of farm profits induced significant levels of multicollinearity into the model structure which resulted in individual explanatory profit variables being insignificant, although the group of profit variables was significant as a whole. A series of regressions were estimated with varying moving averages of farm profits. The use of a five year moving average of farm profits was selected because it maximized the explanatory power of the model.

[15]Use of the yield on the 3-month Treasury bill to measure short-term interest rates limited the analysis to 1920 to 2011. The 3-month Treasury yield was found to be negative and significantly related to total capital expenditures, real estate expenditures on structures and land improvements, and non-real-estate expenditures on vehicles, machinery, and equipment. Alternative regressions analyzing farm capital expenditures from 1920 to 2011 using the yield on the 10-year Treasury note also found that total, real estate, and non-real-estate capital expenditures were negatively and significantly related to longer-term interest rates. The marginal impacts of the 3-month Treasury bill and the 10-year Treasury note were not significantly different from each other.

[16]A series of regressions allowing for variation in the length of the moving average showed that a three-year moving average maximized the explanatory power of the model. However, a five-year moving average of farm profits was used in the analysis, consistent with the approach taken in the analysis of farm investment. Empirical results were consistent across both regression models, regardless of variation in the term length of the moving average used for farm profits.

[17]The FOMC's statement of May 1, 2013, indicated it anticipates that an exceptionally low range for the federal funds rate will "be appropriate at least as long as the unemployment rate remains above 6.5 percent, inflation between one and two years ahead is projected to be no more than a half percentage point above the Committee's 2 percent longer-run goal, and longer-term inflation expectations continue to be well anchored."

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