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The Economics of the Capitalization Rate for Farmland

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Market Report	Year Ago	4 Wks Ago	11/2/18
Livestock and Products, Weekly Average			
Nebraska Slaughter Steers, 35-65% Choice, Live Weight.	125.00	*	115.00
Nebraska Feeder Steers, Med. & Large Frame, 550-600 lb.	181.22	183.29	170.84
Nebraska Feeder Steers, Med. & Large Frame 750-800 lb.	171.89	163.41	162.17
Choice Boxed Beef, 600-750 lb. Carcass.	206.83	204.30	216.67
Western Corn Belt Base Hog Price Carcass, Negotiated	60.85	63.34	56.00
Pork Carcass Cutout, 185 lb. Carcass 51-52% Lean.	78.39	78.25	74.29
Slaughter Lambs, wooled and shorn, 135-165 lb. National.	142.22	136.32	136.14
National Carcass Lamb Cutout FOB.	381.23	381.63	377.17
Crops, Daily Spot Prices			
Wheat, No. 1, H.W. Imperial, bu.	3.23	4.61	4.55
Corn, No. 2, Yellow **Columbus**, bu.	3.13	3.29	3.41
Soybeans, No. 1, Yellow **Columbus,** bu.	8.92	7.42	7.68
Grain Sorghum, No.2, Yellow Dorchester, cwt.	5.59	5.23	5.55
Oats, No. 2, Heavy Minneapolis, Mn, bu.	2.99	3.11	3.26
Feed			
Alfalfa, Large Square Bales, Good to Premium, RFV 160-185 Northeast Nebraska, ton.	157.50	*	*
Alfalfa, Large Rounds, Good Platte Valley, ton.	82.50	102.50	107.50
Grass Hay, Large Rounds, Good Nebraska, ton.	82.50	87.50	87.50
Dried Distillers Grains, 10% Moisture Nebraska Average.	125.50	135.00	135.00
Wet Distillers Grains, 65-70% Moisture Nebraska Average.	42.00	48.50	49.00

*** No Market**

There are three approaches that real estate appraisers use to value real property, namely, the market or sales comparison approach, the income approach, and the cost approach. The sales comparison approach is the primary way that residential real estate is appraised with the cost approach thrown in for good measure. For income producing properties, which includes commercial real estate as well as farm real estate, all three approaches are frequently used. When there are minimal improvements on farmland, the sales comparison and income approaches often provide competing estimates of value that must be reconciled so that an appraiser can render a single opinion of value.

From a financial economics perspective, it is difficult to ignore either approach when valuing farmland. The sales comparison approach confronts the notion that observed sales transactions are the direct result of what a buyer is willing to pay for a farm and a seller is willing to take as compensation for transferring ownership. As a result, it is hard to argue with market determined sales prices. It can be difficult, however, when casually observing farmland transactions, to know all the information that impacted and ultimately resulted in a transaction with an observed price. Appraisers using the sales comparison approach often make numerous adjustments to the attributes of comparable sales to ensure that their opinion of value for a subject property is accurate.

The premise behind the income approach to value is perhaps best understood by noting that one of the most basic property rights is the right of use or enjoyment. In the case of farm real estate, the owner possesses the right to use and enjoy farmland which typically means the right to farm the land and enjoy the income stream that it produces. In this context, buying a farm is analo-

gous to buying the stream of income that the land can provide. The greater the income stream from the farmland, the more a buyer will typically have to pay

An appraiser using the income approach fully exploits the relationship between income and value through the simple capitalization equation given by

$$V = \frac{R}{c.} \qquad \text{Equation 1}$$

Here ***V***is value (per acre or whole farm), ***R*** is the net return to farmland (per acre or whole farm), and ***c*** is known as the cap rate which is short for capitalization rate. The equation itself is a special case of the time value of money equation for the present value of an annuity where the annuity is a constant amount (or growing at a constant rate) in perpetuity.

Typically, ***R*** is estimated as an annual number ,implying that ***c*** is an annual rate. There are at least two ways to estimate ***R*** for a subject property. Since ***R*** is an annual dollar return to farmland, typical yields, prices and expenses for a subject property under typical management and conventional production systems can be estimated to determine the residual return to the landowner. An alternative would be to use a market-based cash rent for the subject property less property taxes and other pertinent ownership costs. Sources of information for estimating the dollar returns to farmland under either approach are readily available and may include farmers, professional farm managers, appraisers, lenders, and extension personnel.

More difficult to estimate is the cap rate appearing in the denominator of Equation (1). In practice, appraisers will often observe the sales price of comparable properties and estimate ***R*** for each comparable. If it can be reasonably assumed that value and price are equal, cap rates can be backed out of Equation (1). For example, a comparable farm that sold for $6,500 per acre with cash rent less property taxes of $250/acre suggests a cap rate equal to $c = {}^{R}/_{V}$ = $250/$6,500 = 3.846%. If the subject property's net dollar return to land is $240/acre, the subject's value is $240/0.03846 = $6,240/acre.

There are more economically robust methods of estimating a cap rate. As noted above, the perpetuity equation itself is applicable only if ***R*** is not growing or, at best, growing at a constant rate. Since the latter is more realistic, let ***c=r-i*** so that $V = \frac{R}{r-i}$.

Stokes (2018) has shown that in this version of the income capitalization equation, ***r*** is the risk-free rate of return and ***i*** is the risk-neutral rate of growth in ***R***. Stokes (2018) also shows the economic equilibrium conditions under which the risk-neutral rate of growth in ***R*** is equal to where ***g*** is the annual natural rate of growth in ***R***, ***m*** is $i = g - \beta(m-r)$ the annual rate of return on a market (i.e., stock) portfolio, and ***β*** is the beta between farmland and the stock market returns.

Putting it all together, Equation (1) can be re-written as

$$V = \frac{R}{r + \beta(m-r) - g.} \qquad \text{Equation 2}$$

Equation (2) is simply an augmented version of the time value of money equation for a growing perpetuity. The net dollar return to farmland, ***R***, grows at the natural rate ***g*** and is being discounted at rate ***r+β(m-r)*** to arrive at value. ***V.*** Notice that in this case, the discount rate is composed of the risk-free rate, ***r***, with a premium added to compensate the landowner for risky ***R.*** The premium is ***β(m-r)*** and represents the excess return from the stock market (i.e. the return above the risk free rate) scaled by beta, which measures the degree to which farmland returns are more or less volatile than the stock market. Higher premiums imply higher cap rates and therefore, lower farmland valuations. It turns out that beta is the ratio of farmland and market volatilities (i.e. standard deviations) scaled by the correlation coefficient between the two asset classes, or $\rho\left(\frac{\sigma_R}{\sigma_m}\right)$.

Therefore, a cap rate for farmland can be expressed as

$$c = r + \beta(m-r) - g, \qquad \text{Equation 3}$$

where

$$\beta = \rho\left(\frac{\sigma_R}{\sigma_m}\right). \qquad \text{Equation 4}$$

Equations (3) and (4) show the basic economic building blocks of a cap rate and it follows that economic or other forces that affect each of the structural parameters will in turn influence the cap rate. More importantly, as the cap rate is affected, so too are farmland values. Factors that increase the cap rate, decrease farmland values while those that decrease the cap rate increase farmland values (see Equation (1)). Table 1 below shows the nature of the relationship between each of the structural parameters in Equations (3) and (4) and cap rates.

Table 1. Structural Parameter Relationship with Cap Rates.

Parameter	Name	Effect on c
r	Risk-free rate of interest	Positive if $\beta < 1$ Negative if $\beta > 1$ Zero if $\beta = 1$
β	Beta	Positive
g	Rate of growth in net returns to farmland	Negative
σ_m	Volatility of stock market returns	Positive if $\beta < 0$ Negative if $\beta > 0$ Zero if $\beta = 0$
σ_R	Volatility of net returns to farmland	Positive if $\rho > 0$ Negative if $\rho < 0$ Zero if $\rho = 0$
ρ	Coefficient of correlation between farmland and stock market returns	Positive

Previous studies by Barry (1980), Irwin *et al*. (1988), Baker (2014), and Stokes (2018) have shown that the beta between farmland in the U.S. and on a more regional basis is probably between 0.12 and 0.20 due to the fact that the correlation between farmland and stock market returns, two disparate asset classes, is very low. Therefore, a low but positive $\boldsymbol{\beta}$ implies that as the risk-free rate increases, cap rates increase which would have the effect of decreasing farmland values. Of all the parameters affecting cap rates, the risk-free rate is likely to have the most significant impact in the near term as interest rates normalize.

In general, if $\boldsymbol{\beta}$ increases due to say, an increase in the volatility of the net returns to farmland, a decrease in stock market volatility, or any strengthening in the correlation between farmland and stock market returns, cap rates would be positively impacted, and farmland values would decrease. Short term market disruptions, such as the recent return of stock market volatility, are not likely to result in an increase in farmland values. However, a more protracted tumultuous stock market could have that effect as dollars move out of one asset class (stocks) to another characterized by physical assets such as farmland.

It turns out that the long run return on the S&P 500 is about 11.5% annually and the rate of growth in the net returns to farmland in the U.S. is likely not more than 1.0% annually. Risk-free rates, as measured by 10-year Treasury yields, have languished near zero for the better part of a decade and are currently around 3.2%. The annual average 10-year Treasury yield in 2016 was 1.84% and in 2017 it was 2.33%. Using this data, shown below in Table 2 are cap rates and farmland values per acre for a range of 10-year Treasury yields and net returns to farmland per acre

As shown, cap rates are positively (and linearly) related to 10-year Treasury yields while farmland values per acre are positively related to the per acre net returns to farmland and negatively related to cap rates. In fact, rearranging Equation (3) shows that the cap rate can be written as

$$c = a + b \times r, \text{where } a = \beta m - g \text{ and } b = 1 - \beta$$

Equation 5

For the data at hand, this implies that the intercept, ***a,*** equals 1.23% while the slope, ***b,*** equals 0.85. Highlighted in Table 2 are the approximate cap rates and farmland values associated with the average 10-year Treasury yields from 2016 and 2017 as well as current yields. For example, a net return to farmland of $250/acre in 2016 (2017) might have been consistent with farmland value of around $9,000/acre ($7,850) while in 2018 it might be consistent with farmland value around $6,300/acre. Of course, farmland net returns of $250/acre in prior years may be very different than $250/acre today due to, for example, different commodity price expectations.

Table 2. Cap rates (*c*) and farmland values per acre (*V*) assuming alternative net returns to farmland per acre (*R*) and 10-year Treasury yields (*r*). Other parameter values assumed are: S&P 500 annual return (*m*) equal to 11.53%, rate of growth in net returns to farmland (*g*) equal to 0.50%, and beta between S&P 500 and farmland returns (*β*) equal to 0.15.

		R								
r	*c*	$150	$175	$200	$225	$250	$275	$300	$325	$350
1.5%	2.50%	$5,989	$6,987	$7,986	$8,984	$9,982	$10,980	$11,978	$12,977	$13,975
1.6%	2.59%	$5,793	$6,758	$7,723	$8,689	$9,654	$10,620	$11,585	$12,551	$13,516
1.7%	2.67%	$5,609	$6,543	$7,478	$8,413	$9,348	$10,282	$11,217	$12,152	$13,087
1.8%	2.76%	$5,436	$6,342	$7,248	$8,154	$9,060	$9,966	$10,872	$11,777	$12,683
1.9%	2.84%	$5,273	$6,152	$7,031	$7,910	$8,789	$9,668	$10,547	$11,426	$12,304
2.0%	2.93%	$5,120	$5,974	$6,827	$7,680	$8,534	$9,387	$10,241	$11,094	$11,947
2.1%	3.01%	$4,976	$5,805	$6,635	$7,464	$8,293	$9,123	$9,952	$10,781	$11,611
2.2%	3.10%	$4,839	$5,646	$6,453	$7,259	$8,066	$8,872	$9,679	$10,486	$11,292
2.3%	3.18%	$4,710	$5,495	$6,280	$7,065	$7,851	$8,636	$9,421	$10,206	$10,991
2.4%	3.27%	$4,588	$5,353	$6,117	$6,882	$7,646	$8,411	$9,176	$9,940	$10,705
2.5%	3.35%	$4,472	$5,217	$5,962	$6,707	$7,453	$8,198	$8,943	$9,688	$10,434
2.6%	3.44%	$4,361	$5,088	$5,815	$6,542	$7,268	$7,995	$8,722	$9,449	$10,176
2.7%	3.52%	$4,256	$4,965	$5,675	$6,384	$7,093	$7,803	$8,512	$9,221	$9,930
2.8%	3.61%	$4,156	$4,848	$5,541	$6,234	$6,926	$7,619	$8,311	$9,004	$9,697
2.9%	3.69%	$4,060	$4,737	$5,413	$6,090	$6,767	$7,443	$8,120	$8,797	$9,474
3.0%	3.78%	$3,969	$4,630	$5,292	$5,953	$6,615	$7,276	$7,938	$8,599	$9,260
3.1%	3.86%	$3,881	$4,528	$5,175	$5,822	$6,469	$7,116	$7,763	$8,410	$9,057
3.2%	3.95%	$3,798	$4,431	$5,064	$5,697	$6,330	$6,963	$7,596	$8,229	$8,862
3.3%	4.03%	$3,718	$4,338	$4,957	$5,577	$6,197	$6,816	$7,436	$8,056	$8,675
3.4%	4.12%	$3,641	$4,248	$4,855	$5,462	$6,069	$6,676	$7,282	$7,889	$8,496
3.5%	4.20%	$3,568	$4,162	$4,757	$5,351	$5,946	$6,541	$7,135	$7,730	$8,324

For comparison, the 2018 USDA estimate of average cash rent for irrigated (non-irrigated) cropland in Nebraska is $238/acre ($150/acre). Assuming property taxes of $80/acre (irrigated) and $40/acre (non-irrigated) and a 2.6% (3.1%) cap rate for irrigated (non-irrigated) cropland yields estimates of $6,077/acre (irrigated) and $3,548/acre (non-irrigated). A lower cap rate for irrigated cropland is justified based on the impact irrigation has on the volatility in net returns to farmland (i.e. smaller σ_R). Lower cap rates overall when compared to current cap rates are justified as 10-year Treasury rates were lower when USDA conducted their analysis. The actual 2018 USDA estimates of value per acre for Nebraska irrigated cropland is $6,150/acre while non-irrigated cropland is $3,550/acre.

Over the near term, it is likely that the most significant structural variable affecting cap rates and ultimately farmland values is the risk-free rate as measured by 10-year Treasury yields. In the equations presented, the risk-free rate of interest forms a sort of base rate of return common to all financial assets with the cap rate for farmland being grossed up by a risk premium specific to the asset class (i.e., $\beta(m-r)$). Even if this risk premium remains constant, the mere fact that the Federal Reserve will likely continue efforts to normalize interest rates implies that cap rates for farmland will increase going forward. *Ceteris paribus*, this will have the effect of pushing farmland values down.

It should be noted that strictly speaking, a cap rate is a return to assets. The numerator of Equation (1) is the net dollar return to farmland before any interest and principal repayment so that how the asset is financed is immaterial to the determination of a cap rate and

therefore, farmland value. Even so, an increase in 10-year Treasury yields will make financing farmland more expensive and therefore negatively affect what potential buyers can afford to pay for farmland.

Lastly, it should also be noted that there are other reasons for purchasing farmland than just the income stream. As a result, it is often observed that farmland values appear to be higher than what strict income capitalization would imply. In many cases, the sales comparison approach to value as well as observed sales prices are higher than income capitalization values implying that buyers are apparently willing to pay for more than just the income stream alone. There are any number of non-monetary reasons for paying more for a farm than income capitalization would suggest such as buying a parcel near currently owned farmland or simply pride of ownership. In addition, Stokes (2018) notes that there may be significant option value embedded in the price of farmland. In this setting, a buyer not only acquires the income stream, but must further compensate the seller for the real option the seller possesses to delay the sale of farmland. The seller's motivation for delaying a sale may be as simple as anticipating a higher capital gain in the future by holding on to the farmland.

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