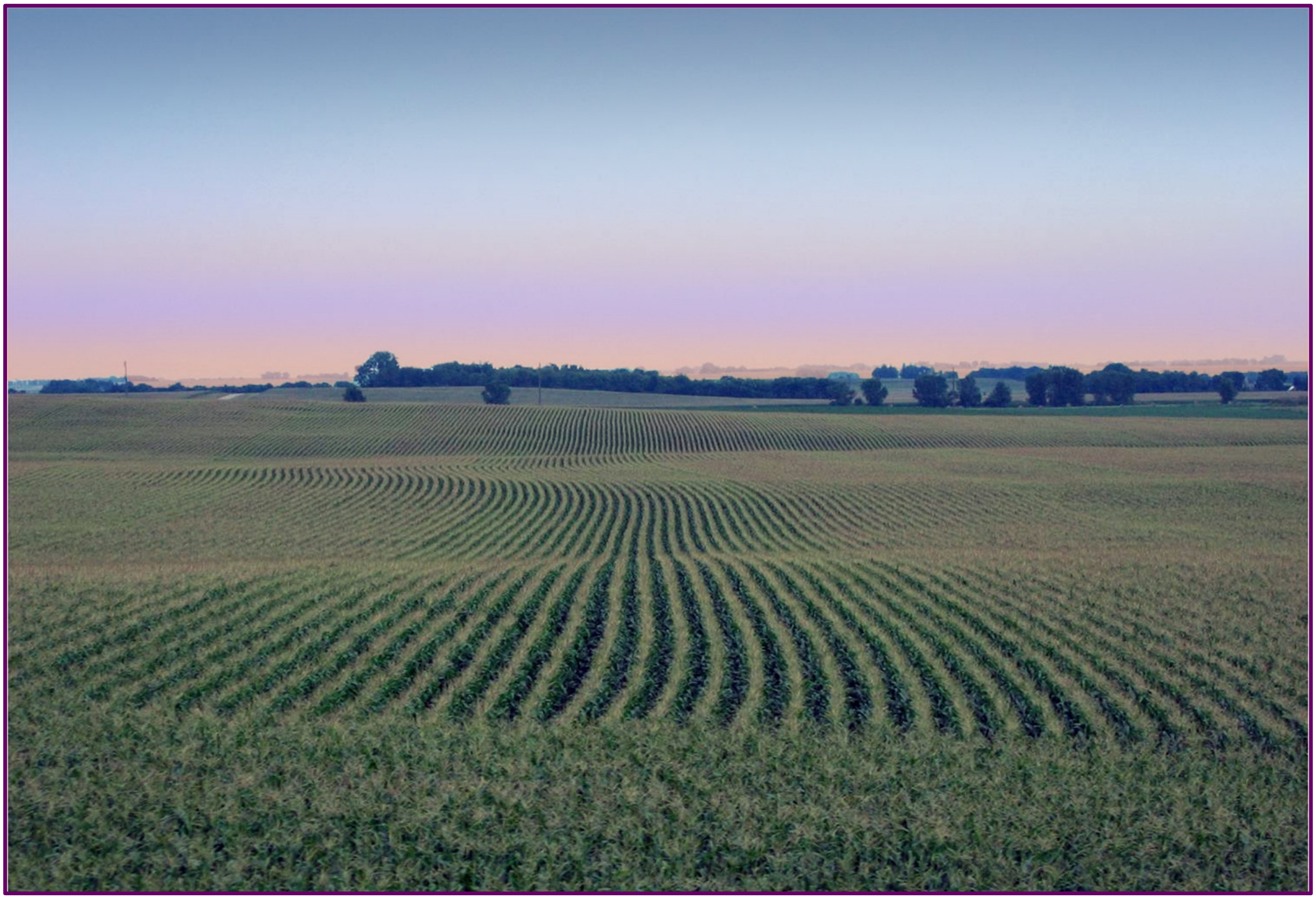
www.AgManager.info



Valuing and Buying U.S. Farm Land with a Consideration of Non-Ag Features

August 2011 (available at www.AgManager.info)

Terry L. Kastens, Professor Emeritus, (785) 626-9000, tkastens@kastensinc.com
Kevin C. Dhuyvetter, Professor, (785) 532-3527, kcd@ksu.edu

Department of Agricultural Economics, Kansas State University

Valuing and Buying U.S. Farmland, with a Consideration of Non-Ag Features

August, 2011
Terry L. Kastens, Professor Emeritus (785-626-9000; tkastens@kastensinc.com)
Kevin C. Dhuyvetter, Professor (785-532-3527; kcd@ksu.edu)

Introduction

The purpose of this publication is to provide background for users of the *KSU-Landbuy.xls* spreadsheet, which is a computer-based tool to help agricultural land buyers and sellers, whether producers or outside investors, make more informed decisions. The background is developed using historical information and economic intuition to develop a mathematical land buying model underlying the *KSU-Landbuy* spreadsheet. Those who desire less intensive understanding can go directly to the spreadsheet. Finally, although it is easier with a computer, all of the mathematics used in this paper can be handled with a pencil and paper and personal calculator. Additionally, the economic understanding and historical rules of thumb uncovered or developed in this paper should be invaluable to anyone wishing to consider a farm land investment – whether or not they use *KSU-Landbuy*.

Farmland purchasing and renting decisions invoke considerable consternation and emotion for agricultural producers and investors. This paper focuses on buying farm land, but also on expected rate of return on farm land investments. A sister spreadsheet (*KSU-Lease.xls*) and associated publication ("Determining Equitable Crop Share or Cash Rental Arrangements," Dhuyvetter and Kastens, 2001) focus on renting crop land. These publications and related decision-aiding spreadsheets are available online at www.agmanager.info.

This paper is written from a principally Kansas perspective. However, Alabama is used as a contrasting state throughout. Also, 39 states in the conterminous U.S. are compared on the basis of a) expected ag and non-ag returns, b) property taxes, and c) the impact of government farm program payments on land values.

Historical Land Values

Land investment decisions depend intimately on projections of the future, and the most reliable projections often are those based on an understanding of the past. Figure 1 depicts historical (1880-2010) farmland values (crop, pasture, and buildings combined) for Kansas and surrounding states using U.S. Agricultural Census data. The Census data were collected by the U.S. Dept. of Agriculture (USDA) in 1997, 2002, and 2007, and by the U.S. Dept. of Commerce prior to that. Land values in each state follow a similar pattern in Figure 1, showing that agricultural land is a broad, not just a local, market. Figure 2, which compares values across three vastly different Kansas counties, makes this clear as well.

Figure 3 shows 1910-2010 Agricultural Census data for land values in three Alabama counties (data before 1910 are unavailable). Sumter Co. (west central AL) produces mainly beef, Houston Co. (southeast corner AL) produces cotton, and Madison Co. (north central AL) produces mainly soybeans. As with Kansas, land values in the three largely different counties follow a similar pattern. However, notice that, relative to Kansas, the three Alabama counties did not appear to experience the large drop in land values in the early 1980s.

Growth Rates

Changes in the value of an investment asset, such as land, often are characterized in terms of annual growth rates. Algebraically, Equation 1 states that the value of some asset at the end of time period *m*, referred to as V_m, is equal to its value at the end of time period *m*-1, i.e., V_{m-1}, as adjusted by the growth rate across year *m*, i.e., g_m:

Equation 1

$$V_m = V_{m-1} * (1 + g_m).$$

For example, V_{m-1} might represent the Kansas land value at the end of year 2010, which is $1250/acre, and g_m might be the annual growth rate expected throughout year 2011, say 3% or 0.03. Then, $V_{2011} = V_{2010} * (1+g_{2011})$ = $1250 * (1.03) = $1287.50. On the other hand, it could be that V_m and V_{m-1} are observed values and you would like to know the implied growth rate. That can be seen by solving Equation 1 for g_m:

Equation 2

$$g_m = \frac{V_m}{V_{m-1}} - 1.$$

After interpolating between Census years, and using annual land values from USDA's NASS (National Agricultural Statistics Service) website beginning in 1949, Figure 4 shows end-of-year Kansas farmland values and the associated annual growth rates derived using Equation 2.[1] Figure 5 shows the same information for Alabama. The figures show substantial variability in annual growth rates and a 131-year (end of 1879 to the end of 2010) mean (i.e., average) growth rate of 3.95% for Kansas, but a much higher 5.08% average growth rate for Alabama. Proportionately speaking, notice again that Alabama's land values did not fall as precipitously as did Kansas values during the early 1980s. The mean growth rates of 3.95% (KS) and 5.08% (AL) shown in Figures 4 and 5 were derived according to:

Equation 3

$$mean\ growth = \frac{1}{131} * (g_{1880} + g_{1881} +, \ldots, + g_{2010}).$$

In real-time prediction of future land values using today's land value as a starting point, the future annual growth rate is often assumed to be constant. Whenever an annual growth rate is expected to be constant across years, say from year *m* to year *n*, the associated value-growth relationship can be depicted as

[1] Note that the Census historically has reported land values as of the end of the year, but NASS reports land values as of the beginning of the year. Thus, the last land value shown in Figure 4, which is $1250, is assigned to the x-axis year of 2010, but is actually the value reported by NASS for January 1, 2011. Note also that revisions following the 2007 Census impacted also the 2002 Census values and so numbers reported in this version of the paper may be different than those reported in earlier versions.

Equation 4

$$V_n = V_m * (1+g)^{n-m} ,$$

where g represents the constant annual growth rate. Using the prior Kansas example, suppose 2010's land value of $1250 was expected to grow at the same annual rate as it had in the past (i.e., 3.95%) through the year 2020. Using Equation 4, the value in 2020 is expected to be $V_{2020} = V_{2010}*1.0395^{(2020-2010)}$ = $1250*1.4731 = $1841.38. Like Equation 2, if V_n and V_m are known, Equation 4 can be solved for g:

Equation 5

$$g = \left(\frac{V_n}{V_m}\right)^{\left(\frac{1}{n-m}\right)} - 1 .$$

For an historical time series of values beginning with value V_m and ending with value V_n, the g calculated from Equation 5 is referred to as the geometric mean of the associated growth series. For the data underlying Figure 4, the 1879 Kansas land value (not shown) was $10.30/acre and the 2010 end-of-year land value was $1250/acre. Thus, the geometric mean was $(1250/10.30)^{(1/131)} - 1 = 0.0373$, or 3.73%. Given an historical series of values, extracting the geometric mean has two advantages over using the mean. First, it is easy to calculate since it depends on only two values, the beginning and the ending value. Second, if a series is plotted that begins at the beginning value (V_m), and which grows each year at the rate of g, it will depict a smooth geometrically growing curve that will exactly pass through the ending value (V_n), which means it is a convenient tool by which to graphically generalize information regarding growth rates. For example, Figures 6 and 7 repeat Figures 4 and 5, only adding a geometric growth line calculated from the geometric mean as described. But, using a geometric mean rather than the mean for a growth series has two important disadvantages as well. First, it is not the statistically expected value for the series, meaning that it may not be the "best guess" for some future unknown growth rate. Second, since it depends on only two values (and the quantity of time between), it may result in an especially poor characterization of the series when the beginning or ending value is an outlier. In practice, when using historical land values to predict some distant future land value based on today's land value and an expected constant annual growth rate over time, we have observed similar forecast accuracies whether the historical mean or historical geometric mean is used as an estimate for future growth. Thus, in real-time prediction, the issue of mean vs. geometric mean is probably not particularly consequential.

It is interesting to note that, while Kansas land value was $10.30/acre in 1879, the comparable value in Alabama was only $3.82/acre. But, the much higher growth rates experienced in Alabama resulted in 2010 land values that were nearly double those in Kansas.

Land Value, Crop Price, and Crop Yield

It is not unusual for farmers and policy makers to note instances of land prices (or other input prices) being "too high" relative to crop prices, indicating that farmers are increasingly being economically squeezed over time. For example, it might be noted that the average U.S. wheat price in 2001

($2.78/bu), was essentially the same as in 1976 ($2.73/bu), yet Kansas "all farmland" land prices were 67% higher ($665/acre in 2001 vs. $398/acre in 1976). However, long term historical relationships indicate a much tighter relationship between crop prices and land values. For example, Figure 8 shows Kansas land values plotted against annual market-year average U.S. wheat prices. Although the annual variability of wheat price is much greater than that of land price, the figure shows similar long-term patterns between the two series. The correlation coefficient, which can range between +1 and -1, routinely is used as an indicator of the strength of the relationship between two series. A value of -1 indicates that two series move exactly opposite of each other; a value of 1 indicates that they move exactly together, and a value of 0 indicates no relationship. Here, the 131-year (1880-2010) correlation coefficient between Kansas land value and U.S. wheat price is 0.90. Interestingly, Figure 9, which compares U.S. wheat price to Alabama land values, showed a relatively high correlation (0.84) as well, despite Alabama not being a wheat state. This is because most crop prices tend to move together over time, and wheat price can be considered to be an index of crop prices in general.

Figures 10 and 11 compare U.S. wheat *yield* to Kansas and Alabama land values, respectively. These correlations are even higher than the ones with wheat price. This hints as to why land values might increase over time even if prices remain flat. Finally, using a hypothetical "wheat revenue" series created by simply multiplying U.S. wheat price by U.S. wheat yield, Figures 12 and 13 show a very strong relationship (correlation = 0.96 for KS and 0.92 for AL) between land prices and wheat revenue. Figures 12 and 13 indicate that crop sales (assuming wheat revenue is a reliable proxy) and land values are strongly related, at least over the long run.

Inflation

Consumers and producers are familiar with the fact that prices of goods generally tend to increase over time. Economists refer to this tendency as *inflation*. For example, a pair of leather work gloves probably costs more today than it did 50 years ago. The observed change in price for the leather gloves could be used as a measure of inflation over the period. Of course, for individual goods, generalizing price patterns over time is more complex. For example, cost-reducing technologies have sharply reduced the cost of long distance phone calls and computers over time. Further, some goods are difficult to compare over time due to technological changes in a good's characteristics. Certainly, given improvements in productivity, reliability, and operational comfort, it would be inappropriate to naively reference the change in price between a new tractor in 1950 and one in 2010 as inflation.

Because of the changing nature of goods over time, economists compute inflation by measuring the change in cost over time for a *fixed* basket of goods. Although they could report the observed cost for the basket of goods over time, economists typically reduce the series to an index by dividing each year's cost by the cost in some particular year (the reference year of interest), and then multiply the values by 100. Thus, an inflation index might be valued at 100 in year 2010 (the reference year) and say 98.74 in year 2009 (as it actually was). In that case, the *rate* of inflation from 2009 to 2010 is (100-98.74)/98.74 = 0.0128, or 1.28%. Put another way, an item with an observed price or cost of $5.00 in 2009 is expected to have a price or cost of $5.06 in 2010, i.e., $5.00 $*$ 1.0128. Thus, the 2009 item is said to have an inflation-adjusted price (referred to as a *real* price by economists) of $5.06 *in 2010 dollars*. Of course, one might also ask, What is the real price, *in 2009 dollars*, of an item with an observed price of $10 in 2010? In that case the answer is $10/1.0128 = $9.87. Note that real prices must always be expressed in terms of some particular year's dollars.

The usual justification for considering inflation in an economic analysis is that decision-makers are not subject to money illusion. That is, if the government were to run the printing presses and suddenly inject twice as much money in the economy, economic behavior would remain the same (people would still buy and sell the same number of items), only observed prices would simply be twice as high.

Inflation can be expressed in terms of an index or in terms of a rate of change in that index over time (i.e., a growth rate, referred to as an inflation rate in this case). Considering inflation in a study of observed price growth rates means that observed price growth rates are comprised of both an inflation rate and a real growth rate. Thus, the observed growth rate in a series from period *t-1* to period *t* (here referred to as g_t) can be considered a mathematical function of the observed inflation rate over the same time period (ir_t) and an unobserved (calculated) real growth rate (rg_t):

Equation 6

$$(1+g_t) = (1+ir_t) * (1+rg_t).$$

Equation 6 can be solved for any of the three measures given the other two. For example, solving Equation 6 for g_t gives

Equation 6a

$$g_t = ir_t + rg_t + ir_t * rg_t,$$

which says that the observed growth rate is the sum of the inflation rate and a real growth rate, plus the product of the inflation rate and the real growth rate. Alternatively, Equation 6 might be solved for rg_t:

Equation 6b

$$rg_t = \frac{1+g_t}{1+ir_t} - 1.$$

As a numerical example, Kansas land values rose from \$1100/acre to \$1250/acre from the end of 2009 to the end of 2010, implying an observed growth rate (g_{2010}) of \$1250/\$1100-1 = 0.1364 = 13.64% according to Equation 2. The observed inflation rate (ir_{2010}) over the same time period happened to be 0.0128 or 1.28% (information source described later). Using Equation 6b with these numbers implies the real growth in land values from 2009 to 2010 was rg_t = (1+0.1364)/(1+0.0128)-1 = 0.1220 = 12.20%. Thus, it can be said that there was 12.20% real growth in land values from 2009 to 2010. Of course, real growth can be positive even though observed (nominal) growth is negative, and vice versa.

It should be noted that the relationship in Equation [6a] often is approximated with the much simpler relationship, $g_t = ir_t + rg_t$, which ignores the often-small $ir_t * rg_t$ term. In the 2009 to 2010 Kansas numerical example just given, this approximation would result in a real growth rate of 12.36% (from 13.64% -1.28%), which is slightly higher than the real growth appropriately calculated (i.e., 12.20%). Generally, from a single-year-of-growth perspective, it probably does not matter much whether one uses the correct relationship described by Equation [6a] or the simpler $g_t = ir_t + rg_t$ one. But, keep in mind that investment analysis often deals with growth rates multiplied over many years; then subtle differences can matter.

Inflation pervades many historical economic value series. For example, Figure 14 depicts the U.S. "wheat revenue" crop income index discussed earlier against an inflation index from 1880 to 2010. The index was calculated from the PCE (personal consumption expenditure) index offered by the Federal Reserve Bank of St. Louis (1947-2010) and a CPI index obtained from the website www.lib.umich.edu/govdocs/historiccpi.html (1880-1947). The correlation of 0.93 shown at the top of Figure 14 confirms the strong visual relationship between the series shown in the figure. Given the strong relationships between wheat revenue and land values shown in Figures 12 and 13, Figure 14 hints that land values also will be highly correlated with inflation. Figures 15 and 16 depict land values against an inflation index from 1880 to 2010, for Kansas and Alabama, respectively. The figures confirm the conjecture that inflation and land values are highly correlated.

As will be described later, because land is often held for long time periods (typically 30 years, according to Rogers and Wunderlich, 1993), optimal land purchase decisions will depend on accurate predictions of land prices, often far into the future. Ideally, it would be useful if the strong relationship between land price and other factors, as shown in Figures 8 through 16, could be used to help forecast land prices. Unfortunately, that typically is not the case because predicting the potential land price causal factors is often just as difficult as predicting the land prices themselves. For example, having an accurate forecast of inflation rates from 1980 through 2010 back in 1978 indeed could have lead to a reasonably accurate prediction of 2010 land value in 1980, when a parcel of land that was to be sold in 2010 might actually have been purchased. But, just like land value projections, making accurate inflation rate projections is difficult for even a few years into the future, let alone 30 years.

Predicting Land Values: Rules of Thumb

In the research underlying this paper, we examined numerous methods for forecasting future land values (especially 30 years ahead) using historical growth rates. We considered short- and long-term historical average and geometric average growth rates for Kansas land values themselves, inflation, and real land values, as well as various combinations of different methods. In an out-of-sample predictive framework, even our best methods resulted in 30-year-ahead land value forecasts that were off by 50% or more on average. More importantly, 30-year prediction accuracy barely improved when we formalized land value predictions in a framework that considered historical inflation rates and historical real growth rates rather than one that included only observed land value growth rates.

It is important to recognize that finding large prediction errors does not preclude a land buyer from making land value projections – indeed he must. It only means that, until evidence of much better forecasts is forthcoming, we see little merit in excessively complicating the land value forecasting procedures in the *KSU-Landbuy* land buying model described later. In short, measures of inflation and real growth rates are not directly used in the *KSU-Landbuy* spreadsheet, but enter only as discussion background to foster an understanding. Further, if a *KSU-Landbuy* user does happen to have access to an inflation forecast he trusts, it is easy for him to construct expected land value growth rates from his expectation of inflation and real land value growth rates – using either the simple approximation of observed growth rates as the *sum* of inflation and real growth rates, or the more correct approach as given in Equation [6a].

Over the 131-year period, 1880 through 2010, the average annual growth in Kansas land values was 3.95%, which is comprised of an average inflation rate of 2.3% and an average real land value growth rate of 1.7% (numbers do not have to add up because of the discussion around Equation [6b] provided earlier – or because of rounding errors). For these data, the 30-year time period with the lowest average annual growth rate was 1911-1940, which saw an average annual growth rate of -0.84%. The highest 30-year period was 1950-1979, which saw an average annual growth rate of 7.76%. Arbitrarily focusing on only the 1951-2010 time period, the average annual growth in land values was 5.1%, which is comprised of an average inflation rate of 3.4% and an average real land value growth rate of 1.7%. Given the foregoing discussion, it seems reasonable (even conservative) to project total future annual Kansas land value growth rates in the 3% to 5% range. Notice that this is a statement about the *total* annual land value growth rate. Thus, when working with more than one growth rate, for example an inflation rate and a real rate (as just described), or an agricultural growth rate and a non-agricultural growth rate, it is reasonable to expect that the sum of the two rates should fall in that 3% to 5% range.

Although there are a number of similarities between Figure 15 (KS) and Figure 16 (AL), there also are important differences. Most notably, Alabama land values have grown at a much higher rate than those of Kansas. Because the same general inflation rate applies to both states, that means Alabama had much higher real growth rates than did Kansas. Also, the 3% to 5% total growth rate expected for Kansas and noted in the preceding paragraph would be inappropriate for Alabama, where the expectation likely would be substantially higher – perhaps in the 5% to 7% range – if the 1951-2010 average growth rate of 6.5% shown in Figure 16 is any guide.

Time Value of Money

Invested money always has an opportunity cost – because it always can be invested elsewhere to earn a rate of return (as in some interest-bearing account). Because competing investments often have expected returns that vary in magnitude and/or in timing, investment evaluation must consider the time value of money. Equation 4 showed how a constant growth rate impacts the future value of an investment given its value at an earlier point in time. Because an interest rate is merely a growth rate, a nearly identical equation can be used to describe the value *n* years in the future (V_n) of a value invested today (V_0 – today is depicted as year 0), with interest reinvested, and given an interest rate *i* (a percentage expressed as a decimal):

Equation 7

$$V_n = V_0 * (1+i)^n .$$

The relationship shown in Equation 7 also can be used to answer the question, What would be the value today of an amount of money expected to be received *n* years in the future? In that case, Equation 7 is solved for V_0:

Equation 8

$$V_0 = \frac{V_n}{(1+i)^n} .$$

Equation 8 states that, given an interest rate of 8%, i.e., 0.08, a person would be indifferent between receiving $100 thirty years in the future and receiving $9.94 today. That is because $100/(1.08)^{30}$ is $9.94. Put another way, an investment of $9.94 earning an annual interest of 8% (assuming the interest is reinvested each year) would grow to exactly $100 in 30 years. Equation 8 depicts a process known as discounting. The value V_n is said to be discounted by a discount factor equal to $1/(1+i)^n$ to arrive at today's value V_0.

Rents

Numerous books and papers have been written about the causal factors underlying land values. Climate, soil quality, interest rates, government payments, and distance to market are a small sample of the numerous factors impacting land value. In the face of the numerous factors impacting land value, many of which are hard to measure, focusing on the most quantifiable ones is necessary in order to make management decisions regarding land investment. One important factor that is easily measurable, yet captures many of the other factors, is expected earnings or rents. Thus, having an estimate of expected rents in the future is important for determining appropriate bid prices for land.

Up to now the discussion has focused on land value growth, or capital gain. But, just as investments in common stocks have two classes of returns, cash returns (dividends) and growth returns (capital gains), so do agricultural land investments. For land, the cash returns are referred to as rents, whether they are actual rents paid by tenants to landowners, or simply the returns assigned to land for owner operators. As with stock market investments, to gain an understanding of how land investments compare to other investments, or of how much a buyer should bid for land, it is necessary to characterize land in terms of *both* cash returns and capital gains. For a more comprehensive discussion of how agricultural land returns compare to stock market investments see "Stock Market vs. Land vs. Farming Returns" (Kastens, 2001).

Agricultural rents often are characterized as rent-to-value ratios rather than as $/acre values because such ratios are directly interpreted as percentage returns just as are the capital gains that have already been discussed. Further, rent-to-value ratios are reasonably stable over time (at least in areas where land values are dominated by agricultural factors rather than non-agricultural factors). For example, the Dhuyvetter and Kastens (2002) paper, "Landowner vs. Tenant: Why Are Land Rents So High?" refers to Kansas non-irrigated crop land rent-to-value ratios averaging approximately 6% per year. Adding that number to an average growth rate (capital gain rate) of around 4% per year implies total returns to Kansas crop land investments averaging around 10% per year.

Rent-to-value often is a quick validation test of land values. For example, suppose the market cash rent for a Kansas crop land parcel is $60/acre annually. If that parcel is offered for sale at $800/acre it likely is a good deal for the buyer – because the rent-to-value is 7.5% (i.e., 60/800) rather than the 6% expected, implying that the denominator (land value) may be "too low" given the income potential of the asset (rent).

Although rent-to-value is an important way to validate land values and to express return on investment, an estimate of the $/acre rent each year in the future is needed in the *KSU-Landbuy* spreadsheet. Typically, current (year 0) market cash rent is known with reasonable certainty by potential land buyers or sellers. Then, rents traditionally were assumed to grow over time at the same rate as land values – at least for predominantly agricultural land. Mathematically, given a constant rent-to-value ratio and a constant growth rate on land values over time, this has to happen. More importantly, in a predominantly agricultural setting, rent is the only factor that can impart value to land. Thus, if rents are not expected to grow over time, neither will land values.

Although the numerical values in this paper change with each new annually-updated version, most of the textual content is simply repeated from year to year. However, for several years now, and at the time of this draft (August 2011), it has become increasingly apparent over the last few years that we should offer a cautionary statement regarding the above discussion about rent-to-value ratios. In particular, non-agricultural forces have been causing land values to grow recently at a much faster rate than rents. So, rent-to-value ratios have been falling rapidly. This means that using an expected constant rent-to-value ratio as an indicator of appropriate land values may no longer be proper, at least if non-agricultural forces continue to dominate the agricultural land market in the coming years. On the other hand, it might be that non-agricultural forces will go away or reverse. If that is true, then the current low (relative to historical standards) rent-to-value ratios may indeed be an indicator of agricultural land that has become sharply overpriced. More on this will follow later in this paper.

Time value of money discounting procedures already described can be used to answer the question, What would I pay today (year 0) for the right to collect a future stream of rents. Assume that the first annual rent will come one year after today (i.e., in year 1) and that its $/acre value is represented as R_1. Similarly, year 2's rent is depicted as R_2 and the Tth year's rent as R_T (*T* for *T*erminal). Using i to represent some relevant interest rate, today's value of the future stream of T annual rents (referred to here as *PVR* for the $/acre *P*resent *V*alue of *R*ents) is

Equation 9

$$PVR = \frac{R_1}{(1+i)^1} + \frac{R_2}{(1+i)^2} +,...,+ \frac{R_T}{(1+i)^T}.$$

Recall that, because buyers and sellers probably are familiar with today's rent (R_0), it often is most appropriate to characterize future rents in terms of today's rent and some annual growth rate, say g. Thus, an estimate of the $/acre rent expected in year T is $R_T = R_0 * (1+g)^T$. Notice that even the first rent actually received (R_1) is depicted in terms of year-0 rent: $R_1 = R_0 * (1+g)^1$. Making these changes reduces Equation 9 to

Equation 10

$$PVR = \frac{R_0 * (1+g)^1}{(1+i)^1} + \frac{R_0 * (1+g)^2}{(1+i)^2} +,...,+ \frac{R_0 * (1+g)^T}{(1+i)^T}.$$

Mathematically, Equation 10 can be condensed to the simpler expression $PVR = R_0 * (d - d^{T+1})/(1 - d)$, where $d = (1+g)/(1+i)$. However, we leave the expression as it is because the fractional numerators on the right hand side of Equation 10 will have meaning in the *KSU-Landbuy* spreadsheet in that they are the cash rents expected over future years and can be viewed to see if they appear reasonable.

Interest Rate i

What is an appropriate value for i, the discount rate, for someone using *KSU-Landbuy*? Although arguments to the contrary can be made, the most appropriate answer is "a market-determined fixed-rate interest rate on long-term land loans." The idea behind discounting is that investments have alternatives. Here, a long-term land loan represents a reasonable alternative investment for at least two reasons. First, an investor using debt to finance land purchases might choose between paying down debt and reinvesting a portion of land's rents into additional land. Second, an investor using equity to finance land purchases might choose to loan money to other investors for their land purchases instead. Thus, land loans and land purchases can be viewed as viable alternatives to each other. Having said that, as will be seen later, *KSU-Landbuy* also will report the internal rate of return for the land investment (i.e., an internally computed value for i) given the various assumptions. And, a potential land buyer can easily compare this expected rate of return to that of other competing investments.

Taxes

In planning land purchases or sales, taxes are important in many ways. First of all, in all states, a real estate tax is levied against land and buildings. For notational purposes, we refer to that tax (dimensioned as $/acre in year 0) as Ptx_0 (for *p*roperty *tax*, but not to be confused with personal property tax, which states might levy against items such as trucks and livestock). Though property tax is expressed as $/acre, rules of thumb often emerge around property tax as a percentage of land values. For example, our estimates of Kansas annual property tax rates have averaged around 0.39% of land values over the last 10 years, meaning that might be a reasonable estimate. On the other hand, Alabama's property taxes have averaged only 0.07% of land values during the same time period. Likely, in Equation 10's expression of *PVR*, property tax is best viewed as a $/acre deduction from year-0 rent. That is, expressions of the form $R_0 * (1+g)^t$ in Equation 10, where t is used to represent any year from year 1 to year T, should be replaced with the expression $(R_0 - Ptx_0) * (1+g)^t$. This assumes property taxes will rise over time at the same rate (g) as rents and land values, which is reasonable given that property tax on agricultural land in the U.S. generally is tied to agricultural use value.

Income tax rates also are especially important in land value analysis. Rents are subject to income taxes and thus recipients do not get to keep 100% of the rents earned. Hence, using *Itx* to denote the relevant *i*ncome *tax* rate (a percentage expressed as a decimal), the after-tax rent earned in year t is $(R_0 - Ptx_0) * (1 - Itx) * (1+g)^t$. Like rent, interest also is a taxable item. That is, both paid and received interest are subject to income taxes. Consequently, if i is used to represent some observed, thus pre-tax, interest rate (e.g., a market-reported 30-year fixed interest rate for land loans), then the i in Equation 10 should be replaced with the expression $i * (1 - Itx)$. Thus, accounting for property and income taxes, Equation 10 is modified as Equation 11:

Equation 11

$$PVR = \frac{(R_0 - Ptx_0)*(1-Itx)*(1+g)^1}{[1+i*(1-Itx)]^1} + \frac{(R_0 - Ptx_0)*(1-Itx)*(1+g)^2}{[1+i*(1-Itx)]^2} + ,...,$$
$$+ \frac{(R_0 - Ptx_0)*(1-Itx)*(1+g)^T}{[1+i*(1-Itx)]^T}.$$

The income tax rate in Equation 11, or *Itx*, should be thought of as a constant (over the time a land parcel is expected to be held) tax rate and typically should include all income-type taxes due on rents. Generally, for sole-proprietor owner-operators, *Itx* should include federal income taxes, state income taxes, and self-employment taxes. Currently (2011), marginal federal income taxes range from 15% to around 35%, with most U.S. farmers falling on the low end of that range. The current self-employment tax rate for most owner-operators is 15.3% before the taxable income deduction equal to one half of the self-employment taxes – implying an effective self-employment tax rate of around 14%. State income tax rates vary substantially across states, but many Kansas farmers fall in the 4% to 6% range. Thus, a typical sole-proprietor owner-operator in Kansas might use an *Itx* value of around 34% (15% federal, 14% self-employment, and 5% state). High-income sole-proprietor owner-operators may not have to pay self-employment tax (except for a 2.9% medicare tax) but would probably see that reduction in *Itx* being offset by higher federal tax rates, still leaving them at an *Itx* rate of around 30% to 40%. On the other hand, corporate owner-operators and landowners who actually rent their land to tenants, are not subject to self-employment taxes and should thus estimate their *Itx* rates accordingly. Although it is possible to contrive examples where the *Itx* rate for rents (numerator of Equation 11) should be different than that used against interest in the discounting term (denominator of Equation 11), we believe that generally it is most appropriate to consider a single *Itx* rate.

Besides property and income taxes, capital gains taxes also are relevant for land investment analyses. That is, when a land parcel is sold, its taxable gain is assessed a federal tax called the capital gains tax. Although there are some nuances (e.g., when depreciable items such as wells or fences are included in the purchase price of land, or when land gets passed to heirs upon death and gets a "stepped up basis"), for *KSU-Landbuy* purposes, the taxable gain on land can be approximated as simply the expected selling price less the purchase price. More discussion around capital gains taxes is included in the next section.

We note that *KSU-Landbuy* does not explicitly allow for costs to the landowner beyond property tax. That is consistent with the idea that managing an agricultural land investment for a landowner is similar to managing other investments, such as stocks and bonds for example. And, such minimal management involvement on the part of a landowner is consistent with the way much land in the U.S. is owned and rented. Yet, some land investors might have a higher cost of management. And, some land parcels might demand routine expenditures on the part of the landowner. Hence, it is important that the *KSU-Landbuy* user accounts for such costs within the current estimate of rent. For example, suppose the current observed market rent on pasture is $20/acre. But, implicit in that market rent is an understanding that the landowner typically must spend $2/acre in fence and water system upkeep. If true, then an investor using *KSU-Landbuy* to evaluate the purchase of such pasture land should insert $18 in the current rent spot, not the $20 observed.

Present Value of a Land Sale

The previous section described the present value of the stream of rents arising from a land investment (*PVR*). As such, it would represent the current value of the right to that future stream of rents, thus an appropriate value at which that right might be traded in an open market. But, a landowner has another important right, which is the right to sell that land at any time. Consequently, an appropriate bid on land also must account for the expected reality or even the possibility of an eventual land sale. Ideally, a land buyer would like to know when (number of years in the future) he or his heirs expects to sell the land. In practice, buyers who expect themselves to be long-term land holders simply insert a value of *T* around 30 years (since 30 years is the typical time period an agricultural land parcel is held by the same owner in the U.S.).

In words, computing the present value of an expected land sale (referred to here as *PVS*) can be described as follows. First, the taxable gain is calculated, which is simply the estimated selling price (*SP*) less the purchase price (*PP*). Using *Ctx* to represent the relevant *c*apital *g*ains *t*ax rate (a percentage expressed as a decimal), the amount of money left in year *T* after the land is sold and capital gains taxes are paid is *SP-Ctx*(SP-PP)*. But, this net money amount will not be received until year *T*, and thus must be discounted back to the present in the manner already described. In short, it must be divided by the same denominator used in the year-*T* rent term of Equation 11. Thus, the $/acre present value of the expected land sale can be computed as

Equation 12

$$PVS = \frac{SP - Ctx * \left(SP - PP\right)}{\left[1 + i * \left(1 - Itx\right)\right]^{T}}.$$

In the forecasting-future-land-values framework discussed earlier, future land values are viewed as the outcome of a current land value growing over time at the annual rate of g. Although PP would be a natural for representing current land value, we intentionally distinguish purchase price and current market value in *KSU-Landbuy* because we want users to be able to judge the economic impact of buying land above or below the market, that is, of “getting good or bad deals.” Thus, we use MV_0 to represent the current (year-0) market land value. Then, assuming the market value of land grows at a rate of g, the selling price can be depicted as $SP = MV_0 // (1+g)^T$. These changes modify Equation 12 as Equation 13:

Equation 13

$$PVS = \frac{MV_0 * \left(1 + g\right)^{T} - Ctx * \left[MV_0 * \left(1 + g\right)^{T} - PP\right]}{\left[1 + i * \left(1 - Itx\right)\right]^{T}}.$$

We note that users of *KSU-Landbuy* must insert a value for current market value. Generally, this value would come from surveyed data on land values in the area, as adjusted by the user to reflect perceived market changes since the date of the last surveyed data, and by differences in quality relative to the “average” land quality in the area of the survey.

Currently (2011), we believe that the effective capital gains tax rates for land held for at least five years range from 5% for those in lower income tax brackets to 15% for those in higher brackets (say, brackets >25%). Thus, many farmer land purchasers probably will use a *Ctx* value near the lower end of that range, while some farmers and many outside investors may need to consider a *Ctx* value near the upper end. Of course, *KSU-Landbuy* is flexible enough for users to insert any value they want for *Ctx*. For example, recognizing that tax policies routinely change over time, some potential buyers might expect capital gains taxes to be much higher by the time their land is eventually sold. Other potential land buyers might choose to insert a *Ctx* value of 0, believing their land will not be sold until they die and their land is passed with a stepped-up basis to their heirs. Finally, state-levied capital gains taxes might apply.

How Much Can I Pay for Land?

The previous sections showed how the present value of a rental income stream (*PVR*) and the present value of an expected land sale (*PVS*) are calculated. Then, the present value of the land investment (referred to as *PVL*) is simply the sum of *PVR* and *PVS*:

Equation 14

$$PVL = PVR + PVS,$$

where *PVR* and *PVS* are taken from Equation 11 and Equation 13, respectively. If each of a buyer’s expectations (inserted into the model by his choices placed into the *KSU-Landbuy* spreadsheet) comes true over time, then purchasing the land for the price determined in Equation 14, i.e., *PVL*, will result in a pre-tax rate of return on the investment exactly equal to *i*. Of course, if the land is purchased at a price less than *PVL*, the pre-tax return will be greater than *i*, and lower than *i* for land purchased above the *PVL* price.

Is should be noted that whether or not land is financed has no impact on a land parcel's expected profitability – because owner equity is assigned an opportunity cost equal to the interest rate on land loans. However, the financing decision does impact risk; investments using more borrowed funds result in exacerbated return on investment (return on equity) numbers for the land investor. Consequently, the *KSU-Landbuy* spreadsheet does allow the user to input his leverage position so that he can see how his various land growth and rate assumptions might impact his return on equity at different leverage levels.

Agricultural Land as a Non-Ag Investment

As noted, a number of rising issues make treating agricultural land investment as solely an investment in farming activities less and less appropriate. For example, near urban areas, the pressure is mounting to secure agricultural land for future development of housing and business sites. Also, the demand for life-style farms and ranchettes is rapidly increasing, sometimes even quite far from urban centers. Additionally, the demand for on-going non-ag uses of agricultural land is increasing as well. Examples include fee-based hunting and recreational or sightseeing outings. Thus, when analyzing land values, considering agricultural land's non-ag potential is becoming increasingly important, even for states that traditionally have been considered predominantly ag states. The upshot to all of this is that traditional farm land investors, such as farmers, may increasingly find themselves out of the market because they cannot find worthwhile farm land investments by considering only expected returns related to farming. This might not be a problem if the only investment they are missing is the one near a city that ultimately will end up not being farmed anyway at some point. However, it could be a problem for farmers trying to compete with other farmers who are taking into account farm land's non-ag features in their land investments and activities. On the other side, careful consideration of farm land's expected farming returns should help non-ag farm land investors, such as real estate developers, view their investments more as a business than as a lottery, which should make them more effective competitors with other real-estate developers. Either way, understanding that agricultural land has ag and non-ag components should increase an investor's comparative advantage over those who view land investment more naively.

Modifications to the Land Buying Model to Accommodate Non-ag Returns

For years, economic researchers have devised ways to price non-market goods. For example, models referred to as hedonic models have been used to value non-market features of land such as "distance to market" or "road accessibility," even when such features are not directly priced in the market. To a certain extent that is our problem here. We observe a land parcel's value that is based partly on its expected ag returns and partly on its expected non-ag returns.

This part of the paper deals with re-constructing our land investment model, based on the base model already developed in Equation 9 through Equation 14, only incorporating additional features that allow it to appropriately consider non-ag components of land investment. Additionally, we wanted the new model to be able to answer the question, What does the model's assumptions imply about ag and non-ag portions of market value? That is, how much of land's current market value is attributed to its ag and how much to its non-ag features? This will be important for validating the model user's assumptions.

In particular, a user would be able to compare the model-derived ag-part of land value to other land parcels he is familiar with that are thought to be more purely ag parcels. Second, he will be able to compare the model-derived ag and non-ag percentages of land's market value with what might be expected given historical data (guidelines for such expectations are provided later in this paper).

Having ways to validate the assumptions in the new land investment model is especially important because, while historical ag-returns information is thought to be readily available, historical information to guide expectations for future non-ag returns is quite sparse. More importantly, despite efforts to the contrary, USDA-collected land value and rent information likely has increasingly become an agglomeration of ag and non-ag information – and the informational contamination probably only will increase in the future. Thus, it is important to have a model where users can individualize their situations, but where some model output can readily be compared to information outside the model.

Our current mathematical model has three additional components over the base model: a) a non-ag rent (year-0 non-ag rent is depicted as RN_0), b) a growth rate assigned to that rent, referred to as *gNr*, and c) a new non-ag growth rate on land value referred to as *gNv*. But, we should note that, in *KSU-LandBuy*, this non-ag growth rate actually is calculated from a user-input ag growth rate and a user-input total growth rate, where the ag growth rate is taken to be the growth expected on agricultural rents. We begin development of the current model by noting that the present value of future rents (Equation 11 in the base model) will now be recast as the sum of an ag present value of rent (*PVRA*) and a non-ag present value of rents (*PVRN*):

Equation 15

$$PVR = PVRA + PVRN\ .$$

PVRA is described by rewriting Equation 11 by replacing R_0 with RA_0, and *g* with *gA*, to make it clear that these are now ag-only variables:

Equation 16

$$PVRA = \frac{(RA_0 - Ptx_0)*(1-Itx)*(1+gA)^1}{[1+i*(1-Itx)]^1} + \frac{(RA_0 - Ptx_0)*(1-Itx)*(1+gA)^2}{[1+i*(1-Itx)]^2} +,\ldots,$$
$$+\frac{(RA_0 - Ptx_0)*(1-Itx)*(1+gA)^T}{[1+i*(1-Itx)]^T}\ .$$

In Equation 16, *PVRA* is the \$/acre present value of the future stream of only agricultural rents, RA_0 depicts the current (year-0) agricultural rent in \$/acre, and *gA* is the annual percentage agricultural growth rate expressed as a decimal. All other terms already have been described in relation to the base model. The present value of the future stream of non-ag rents (*PVRN*) is developed as

Equation 17

$$PVRN = \frac{RN_0 * (1 - Itx) * (1 + gNr)^1}{\left[1 + i * (1 - Itx)\right]^1} + \frac{RN_0 * (1 - Itx) * (1 + gNr)^2}{\left[1 + i * (1 - Itx)\right]^2} +, \ldots, + \frac{RN_0 * (1 - Itx) * (1 + gNr)^T}{\left[1 + i * (1 - Itx)\right]^T},$$

where RN_0 is the expected current rental value in \$/acre associated with non-ag activities (e.g., hunting leases) and *gNr* is the annual percentage growth rate (expressed as a decimal) expected on this non-ag rent. If no non-ag renting activities are expected, RN_0 should be set to 0 in the *KSU-Landbuy* spreadsheet. Of course, the value selected for the non-ag rent growth rate (*gNr*) is immaterial when RN_0 is set to 0. If, on the other hand, non-ag rent is already firmly in place or expected to be so soon, the expected growth rate on those rents probably should be set to the expected inflation rate at a minimum. That is because well-established consumer prices often rise over time with inflation. What probably is more likely is a *gNr* value greater than expected inflation – because the demand for such non-ag activities probably is growing faster than the rate of inflation at this time.

Notice that property tax is not subtracted from rent in Equation 17, unlike in its Equation 16 ag counterpart. Likely that is appropriate given that all or nearly all states in the U.S. no longer tax agricultural land based on its market value, but rather on its "ag use" value. Notice also that the interest rate (*i*), the land holding time horizon (*T*), and the income tax rate (*Itx*) are assumed to be the same for both the ag and non-ag renditions of the present value of rent computations (Equations 16 and 17).

For the new model, the \$/acre present value of the expected future land sale (*PVS*) can be computed as

Equation 18

$$PVS = \frac{MV_0 * \left[(1 + gA) * (1 + gNv)\right]^T - Ctx * \left[MV_0 * \left[(1 + gA) * (1 + gNv)\right]^T - PP\right]}{\left[1 + i * (1 - Itx)\right]^T}.$$

In Equation 18, MV_0 depicts the land's current (year-0) market value, *gA* is the growth rate on ag rents (which we simply declare to be the "ag part" of the growth rate on land's market value since that would make sense in an ag-only investment), *gNv* is the non-ag part of the growth rate on land's market value, and *PP* is the expected purchase price. Notice that the non-ag land value growth rate here (*gNv*) is different than the non-ag rent growth rate (*gNr*) in Equation 17 to allow for flexibility in describing non-ag characteristics of land investment. In practice, *gNv* is a residual calculation in *KSU-LandBuy*; the user provides only an ag growth rate and a total growth rate. The complete model can be specified as

Equation 19

$$PVL = PVRA + PVRN + PVS,$$

where *PVRA*, *PVRN*, and *PVS* are taken from Equations 16, 17, and 18, respectively. Note that Equation 19 depicts a separate present value for each of ag rents and non-ag rents, which is consistent with our goal of being able to show what the model expects for the portion of market value attributable to ag and to nonag features. Thus, having at least those components of land value (i.e., *PVRA* and

PVRN) made explicit will help nail down the division of land market value into ag and non-ag. However, given the theoretical framework of the model, there is no *theoretically* correct way to develop an "ag-only" and a "non-ag-only" present value of the expected land sale whose values would add up to the present value of the expected land sale *PVS*. Part, but not all, of the problem is that we never get to observe an ag-only or a non-ag-only growth rate; rather, what we observe is land value growing by some overall growth rate. In short, *PVS* cannot be *theoretically* disentangled into additive ag and non-ag present value components. But, that should not preclude us from coming up with a reasonable, albeit somewhat arbitrary way for thinking about the question, How much lower would land value be if it were not for its non-ag growth? For example, we might start by calculating an ag-only *PVS* value, referred to as *PVSA*. To do that we would compute Equation 18, only dropping out the non-ag growth term:

Equation 20

$$PVSA = \frac{MV_0 * \left[(1+gA)\right]^T - Ctx * \left[MV_0 * \left[(1+gA)\right]^T - PP\right]}{\left[1 + i * (1 - Itx)\right]^T}.$$

This allows us to compute a hypothetical ag-only *PVL* value, referred to as *PVLA*:

Equation 21

$$PVLA = PVRA + PVSA.$$

That would imply that the proportional share of land's market value that should be assigned to ag, referred to here as *AMVP* (for *A*g *M*arket *V*alue *P*ortion), is simply the relative share that the ag-only-based land present value is of the ag-and-non-ag-based land present value:

Equation 22

$$AMVP = \frac{PVLA}{PVL}.$$

Then, the proportional share of land's market value that is non-ag is simply 1-*AMVP*. It should be noted that this division of land market value into ag and non-ag components is by no means a complete procedure. After all, if there actually were no non-ag growth, relative to Equation 18, market value (MV_0) and purchase price (*PP*) would undoubtedly need to be lowered, which would ultimately lead to an iterative procedure that may or may not be mathematically stable. Thus, Equation 22 should be considered only a crude approximation of ag's share of land market value. Nonetheless, as noted earlier, having a model-based estimate (even a crude one) of land's agricultural market value could be important to validate the model's assumptions. For example, a potential land buyer might find that the model-predicted ag-only market value (i.e., $AMVP*MV_0$) is much lower than what he observes for area land parcels that are essentially "purely ag." Thus, assuming his estimate of market value (MV_0) is not in question, he might adjust his expected non-ag growth (*gNv*) downward to give him more believable results; in particular, by adjusting his total growth (*g)* downwards.

Historical Land Returns, Property Tax Rates, and Ag and Non-ag Growth over Time

Among other things, the *KSU-Landbuy* spreadsheet requires its users to insert an expectation for future ag and non-ag growth rates in rents and future total growth rates in land values. To aid their selection of such growth rates, we have attempted to extract historical growth rate information by analyzing state level historical information on land values, land rents, and taxes.

State level annual land values, cash rents, and property taxes used in this historical data analysis were taken from *Farm Real Estate Values* (86010), *Farm Real Estate Taxes* (92002), *Cash Rents for U.S. Farmland, 1963-1993* (90025), USDA (1997, 1999), *Agricultural Land Values and Agricultural Cash Rents* (PLR-BB), and *Farm Real Estate Values, Rents, and Taxes*. Data from 39 states considered to be agriculturally relevant are used here. New England states, New Jersey, Maryland, and Delaware were intentionally excluded from the analysis, as were Alaska and Hawaii. The rent-to-value ratios (*RTV*) used in this research were computed as cash rent ($/acre) for non-irrigated crop land divided by the non-irrigated crop land value ($/acre). Commensurate measures for crop land were used for states not distinguishing irrigated from non-irrigated crop land, and for two states (Arizona and Nevada), crop land values and rents are reported only for irrigated land, thus that is the *RTV* used there. Later in this paper, we discuss the ag-only value of crop land, as well as the component of land value attributable to government farm program payments. Historical per-acre farm program payment information is only available on an all-crop land basis. Consequently, in those discussions, we apply the *RTV* series against all-crop land values, rather than against only non-irrigated crop land. We believe this is appropriate because irrigated and non-irrigated *RTV* series are similar in most states. Moreover, for most states, the all-crop land values are either exclusively or heavily dominated by non-irrigated land values.

The basic data set used here for investment returns ranges from 1951-2010, but with rent and rent-to-value information available also for 2011. Note that, at the outset of this paper, January 1 reported land values were assigned to the prior year, i.e., December 31, to make them compatible with earlier land value surveys and to allow a growth rate calculation in the year it occurs. Thus, January 1, 2011 reported land values are associated with 2010 when we speak about a land value for some particular year. But, rent-to-value ratios are associated with the year in which they were reported. So, rent-to-value in 2011 is the cash rent for the calendar year 2011 divided by the January 1, 2011 land value. In most cases (typically, 1967-2011), rents and *RTV* could be calculated directly from the data. In some cases (typically, 1960-1966), rent-to-value reported for all farm real estate was used directly as an estimate of non-irrigated crop land rent-to-value. The largest data deficiency was in the 1950s, when none of the states reported rents. In 1960, for the 24 states where *RTV* could be calculated, the average *RTV* was 8.07%. To allow for some carryover of the post-WWII land boom, and the associated expected reduced *RTV*, we arbitrarily considered the average or expected *RTV* to be 7.0% in 1950, and incremented the value up by 0.1% per year through 1959. For two other years, 1995 and 1996, the across-states average *RTV* could not be reliably calculated because only two states reported values. For those two years we simply interpolated between the average calculated for 1994 and 1997. The end result was an *expected RTV* series ranging from 1951 through 2011.

Although the *expected RTV* series was used to "fill in" missing state-year values as needed, it could not be used directly since states have intrinsically different *RTV*'s due to different taxation policies among other reasons. In particular, we considered an average (across years) differential between a state's reported (actually, calculated from reported rents) *RTV*'s and the same-year *expected RTV* values. This differential was added or subtracted from the *expected RTV* series for missing years. Because the differential itself may change across time, for example, in a state with rapidly rising land values due to non-ag land components, we used the 1960-1980 average differential for states containing at least two reported rents during that time, else we used the 1960-2011 average differential. After each missing *RTV* was filled in, we re-calculated the across-states average *RTV* for each year 1951-2011, and graphically show those data in Figure 17.

The cyclical pattern of *RTV* is clearly shown in Figure 17. For example, *RTV* was at a cyclical low in 1981, just as land values peaked. That is, the high land value growth rates experienced in the 1970s induced ownership of land that could not be economically justified without continued high growth rates. Then, as the land market crashed in the early to mid-1980s, farmers would pay a "premium" to rent land rather than own it, wishing to avoid the risk of falling land values associated with ownership. Also, land lenders and investors were becoming conservative during this time because of equity positions in land that had deteriorated. The overall downtrend, and more specifically the current (1990s on) downtrend, shown in the figure likely is due to agricultural land being valued ever more for its non-ag features, meaning agricultural rents as a portion of land values will fall. That said, the trend has been fairly flat in the last few years, likely due to a) economically favorable conditions for farming the last five years and b) economically unfavorable conditions for non-ag components of the U.S. economy. Taken together, these conditions mean less demand for ag land for non-ag purposes and more demand for ag use, ultimately leading to higher rent-to-value ratios than otherwise would prevail.

Generally, land values, unlike cash rents, were reported in the 1950s, meaning annual land value growth rates could easily be calculated for the total time period of interest. Land value growth rates are calculated from January 1 to January 1 and associated with the first January 1. Thus, the annual land value growth rate associated with 2010 is the percentage change in land value from January 1, 2010 to January 1, 2011. Cash rents are reported as of January 1 but are for the year just beginning. Thus, they pertain to the years in which they are observed. For the mathematics, we assume that rents are received at the end of the years in which they are observed. Thus, 2010's cash rent is assumed to be obtained by the landowner on December 31, 2010. Further, the *RTV* calculated for some particular year can be considered the cash part of land returns for that year, only expressed as a percentage return on investment (similar to a stock dividend).

In our development of the *KSU-Landbuy* model and spreadsheet, we depicted an ag growth rate (gA) and a non-ag growth rate (gNv) rate on land value. In the historical data we observe only an overall growth rate on land value (depicted here as simply g). In an additive growth rate framework, it would be true that $g = gA+gNv$. Though it does not result in largely different results as already noted, the more correct and consistent way to handle multiple growth rates is in the multiplicative fashion shown in Equation 6 and in the numerator of Equation 18. Thus, whatever values we estimate from the historical data for gA and gNv, it must be true that $(1+g) = (1+gA)/\!/(1+gNv)$, where g is the observed proportional change in land's market value from one year to the next. A year-specific observed growth rate pegged to year t, thus throughout or "over" the tth year, can be computed as $g_t = MV_{t+1}/MV_t - 1$, because land's year-t reported land value is as of January 1 that year, and hence the growth rate is from year t to year $t+1$.

Assuming, as we did in the *KSU-Landbuy* model, that the growth on agricultural rents and the ag growth rate for land values are one and the same, then an estimate of gA can be derived from the historically observed growth in agricultural rents. Thus, assuming that historically reported cash rents have been *agricultural* rents (as opposed to including rents tied to non-ag activities), a year-specific value for gA (i.e., gA_t) might be calculated as $gA_t = R_t/R_{t-1} - 1$, where R_t is the observed cash rent in year t. Note that the time subscripts (t) for rents are different than for land values due to rents occurring December 31 and values January 1. Then, gNv_t can be calculated by using g_t, i.e., $gNv_t = (1+g_t)/(1+gA_t) - 1 = (g_t - gA_t)/(1+gA_t)$. Though such mathematical steps may be necessary from a historical research perspective, in practice it probably is easier to simply assess an expectation for growth rate of ag rents (thus the ag growth component of land values) and another assessment of total land value growth. In that scenario, the expected non-ag growth rate on land values would simply fall out of the mathematics given the other assumptions, as currently is done in *KSU-LandBuy*.

Using the historical data, we calculated rent-to-value ratios on an "after property tax is paid basis," and assume that all observed historical rents are in fact ag rents and not non-ag rents (which we assume are 0 in our data). Then, these values are averaged across 1951-2010 for each state and reported in the *Ag Rent* column (the first data column) of Table 1 at the end of this paper. These values are to be interpreted similarly to stock dividends. That is, they represent the expected agricultural cash return to ag land in the respective states, expressed as a percent of market value. It should be noted however, that using these long-term averages as expectations for future ag rents may be less than appropriate in the future because ag *rent-to-value* ratios are expected to decline over time given that land's market value likely will reflect a growing non-ag component (increasing the denominator in the rent-to-value ratio). Consequently, the second data column of Table 1 shows the after-property-tax rents, again as rent-to-value ratios, associated with only 2011. As expected, the 2011 *RTV* is lower than the average 1951-2010 *RTV* for every state. For the reasons noted, the 2011 *RTV* is likely a better indication of future *RTV*, than is the 1951-2010 average. Note that lower *RTV* in 2011 relative to the 1951-2010 averages does not imply that ag rents in $/acre are expected to decline. On the contrary, we would expect those rents to rise at the ag growth rate.

The third data column of Table 1 shows average after-property-tax rents associated with the 1951-1972 period. Discussed in more detail later, these rates are the capitalization rates associated with capitalizing ag rents into the agricultural component of land values. The pre-1973 period was picked somewhat arbitrarily. First, we wanted to pick a relatively early time period, where land values were still more reflective of farming activities rather than non-ag activities. Second, 1973 began a time period of very high inflation rates in the U.S. economy in general and the ag economy in particular, a time period associated with rapidly rising land values that probably distorted long-term *RTV* numbers.

The fourth data column of Table 1 shows calculated property taxes as a percent of land values for 2011. If these numbers were added to the 2011 after-property-tax *RTV* numbers in the second data column, the result would be a pre-property-tax (or observed) *RTV* series for 2011.

Property tax rates (percent of market value; tax-to-value) by year and state were available through 1995 from the data sources listed, but most reliably through 1993. Since that time, reliable data have been especially scarce. In earlier versions of this paper we used a number of assumptions to basically extend this tax-to-value series. But, the further we get away from the mid 1990s and the more we see non-agricultural forces impacting land values, especially in some states, the more important it is we estimate property taxes from only the agricultural component of land value (i.e., the rent) rather than the market value. That is because, as noted earlier, all states now attempt to levy property tax on agricultural land based on its "agricultural use" rather than on its market value, with most of them making such transitions during the 1980s. Hence, beginning with the 2006 version of the paper, we changed the way we estimate property taxes, going back to 1994. After considering various alternative time periods, we decided to use the 1984-1993 time period for constructing a reliable average tax-to-rent ratio by state. This average tax-to-rent ratio was then used against reported agricultural rents in years after 1993 to determine expected $/acre property taxes, and ultimately to get back to a tax-to-value number that varies by year for each state, typically falling in recent years due at least in part to increasing non-agricultural influences. To smooth a few sharp breaks in our series from 1993 to 1994, we assigned to 1994 the average of the tax-to-value ratio for 1993 and 1995. The upshot of this change in property tax estimation technique is that most tax-to-value ratios in recent years are somewhat lower than we may have reported for those same years in earlier versions of this paper.

As noted, over the last few decades, each state used in this study has adopted a "use-value" property tax rate policy, which essentially bases taxes on only the agricultural value of ag land, and not its market value. The consequence is that 2011 property tax rates are nearly universally lower than corresponding 1951-2010 average property tax rates – when computed as a percent of land's market value. This also means that 2011 property tax rates likely provide more accurate expectations of future property tax rates than do 1951-2010 average rates, and hence the reason for depicting them in Table 1. For exposition, Figure 18 shows average 1951-2010 and 2011 property taxes by state. Note that, across all states and years 1951-2010, property taxes averaged 0.70% of land value. In 2011, property taxes averaged only 0.37%. It should be mentioned that some state and sub-state regions (especially near urban areas) have very large property tax breaks for land that is classified agricultural – leading to near- or sub-zero rents in those areas. Although this should not distort the output of *KSU-Landbuy*, certainly such agricultural rents would not necessarily be representative of the land's agricultural productivity.

As discussed above, we also computed ag and non-ag growth rates from the data that are comparable with the *gA* and *gNv* terms in the model developed earlier. More specifically, for each state and for 1951-2010, a $(1+gA_t)$ series, a $(1+gNv_t)$ series, and a $(1+g_t)$ series were computed using the procedures already discussed. Then, the geometric mean of each of these series was computed by state. Then, after subtracting 1 and multiplying by 100 to convert the values to percentages, the state-specific "expected" *gA* and *gNv* values are reported in Table 1's *Ag Growth* and *Non-ag Growth* columns, respectively. Finally, the *total growth* column in Table 1 reports state-specific total growth.

With a slight "to make additive" modification to the *Ag-Growth* and *Non-ag* series of Table 1, Figure 19 depicts a visual representation of the historical total returns to land by return type and by state, ranked by non-ag growth. This "to make additive" modification was required in the graphing exercise to make the calculated growth returns (from the geometric mean framework) additive while making them still come out to the overall expected total returns (the average adjustment of this type was 0.071 percentage points). Figure 20 shows the same information as Figure 19, only with the states ranked by total return, and with a stock market benchmark (dividends-inclusive S&P returns).

It should be noted that Figures 19 and 20 are long-run (1951-2010) average agricultural land returns, masking the fact that, over that 60-year period, non-ag impacts on agricultural land returns have been increasing, and especially so in recent years. So, such figures should be used especially cautiously as guides for expected returns in the future, particularly for the breakouts between ag and non-ag returns. To demonstrate this, Figure 21 shows the same information as Figure 19, but for only years 2006-2010 (states ranked by non-ag growth; negative return components have been set to zero for graphing). Notice how non-ag returns dominate during this recent time period. Notice also that some states' positions in the non-ag growth ranking have changed considerably.

As pointed out, the non-ag returns shown in Figure 21 are considerably higher than those of the broader time period of 1951-2010. Naturally, one must wonder about the speculative nature of such higher returns, and whether appropriate words of caution should be expressed. One way to consider this is in the context of comparing the 2006-2010 time period to another earlier 5-year period, say 1976-1980, which is now known to have been highly speculative and a harbinger of tough economic times to come in the early 1980s. Figure 22 shows the same information as Figures 19 and 21, only for that 1976-1980 period.

Several comparisons between Figure 22 and Figure 21 are worth noting. First, in the 1976-1980 period, total average returns (20.7%) were considerably higher than in 2006-2010 (9.6%), which were even lower than the overall returns in 1951-2010 shown in Figure 19 (11.2%). This points to the considerable inflationary pressure experienced in the 1970s. Second, it appears that the ag growth (11.3%) was especially high during the 1976-1980 period relative to the other figures, suggesting that the increased total returns were very much due to economic events happening to agriculture at the time, implying that land returns would be sensitive to problems in agriculture as well. In short, inflation and agricultural profits were driving up agricultural rents, which were driving up land values in the 1970s. This contrasts sharply with the 2005-2010 period of Figure 21. Now, agricultural rents have been growing at a more modest 4.4% and it is non-ag growth that dominates in many states. So, landowners likely should be more concerned with economic events outside of agriculture, say perhaps with the overall economy, or perhaps with the housing market, than with agricultural events. Also, if economic pain is to come to landowners in the near future, it is more likely to visit those states less dependent on agriculture this time around, in sharp contrast to the economic pain of the early 1980s, which was heavily tied to agriculture. Yet, it does not appear that the 2006-2010 period is associated with especially excessive total returns. So, unless we continue to see rapid run-ups in land values in the next few years, perhaps landowners should not be particularly worried, especially if they are mostly involved in those states most heavily tied to agriculture.

Agricultural Market Value of Agricultural Land

As noted, agricultural land market values reflect both agricultural and non-agricultural activities. Further, in the model development section it was noted that a benchmark series is desirable that depicts the ag and non-ag percentages of market values – to compare with the agricultural market value portion of land value (*AMVP*) calculated in the *KSU-Landbuy* spreadsheet. The last data column of Table 1 reports these benchmark values for 2010. Computational procedures are discussed below.

If agricultural land values were reflections of purely agricultural activities, average or expected rent-to-value ratios could be used along with observed $/acre rents to compute land's agricultural value, which would be the same as its market value. For example, a 6% rent-to-value rate, along with a cash rent of $60/acre, would imply an agricultural land value of $1000/acre (because 60/0.06 = 1000). A problem arises in that what we observe is a *market* capitalization rate (i.e., the rent-to-value series) but we do not directly observe a comparable *agricultural* capitalization rate. To resolve this, as described earlier, we use the average 1951-1972 *RTV* numbers as our agricultural capitalization rates. The after-property-tax version of this series is reported as the third data column (*Ag Cap Rate*) in Table 1.

To better understand the *Ag Cap Rate* and it's relationship with *AMVP*, it is useful to consider an example; we use Alabama. Alabama reported a crop land value of $2350/acre for January 1, 2011 (assigned to year 2010 in our database) and a 2011 cash rent of $51/acre, implying a 2011 *RTV* of 2.17% (0.0217), which is 51/2350. Alabama's 2011 property tax rate was assumed to be 0.07279%, leading to a 2011 after-property-tax *RTV* of 2.10% (0.0217 - 0.0007279 = 0.0210). This number is reported in the second data column for the Alabama row of Table 1. Such after-property-tax *RTV* numbers were calculated for each year for Alabama, with the 1951-1972 average of this series being 8.03%, and reported as Alabama's *Ag Cap Rate* in Table 1.

Since the *Ag Cap Rate* reported in Table 1 is an after-property-tax rate, it must be used with an after-property-tax cash rent. Multiplying Alabama's 2011 property tax rate of 0.07279% by its January 1 land value of $2350/acre results in property taxes of $1.71/acre. Subtracting this amount from the 2011 cash rent of $51/acre results in an after-property-tax cash rent of $49.29/acre. Then, dividing this value by the 8.03% *Ag Cap Rate*, results in a value of $613.82, which is assumed to be the agricultural component of the $2350 land value. Thus, Alabama's 2011 agricultural market value percentage (*AMVP*) is around 26.12% (because 5613.82/2350 = 0.2612). This value is reported as 26.12 in the rightmost column of the Alabama row of Table 1. Figure 23 ranks the 2010 *AMVP* values by state from lowest to highest.

In this paper we have described two ways to compute an *AMVP* number for a land parcel. Both methods are used in *KSU-LandBuy*. The first approach centered around Equation 22, computing *AMVP* from expected non-ag growth and non-ag rent (inputs in *KSU-LandBuy*). The second approach, discussed immediately above, computes the agricultural component of market value by capitalizing the after-property-tax rent (rent and property tax, each in $/acre, are inputs in *KSU-LandBuy*) using the state-specific *Ag Cap Rates* in Table 1. If a *KSU-LandBuy* user inputs 0 for non-ag growth and 0 for non-ag rent, *AMVP* calculated by the first method will always be 100%. That is, it makes no sense that a land parcel would possess non-ag value if no future non-ag growth or non-ag rent is expected. On the other hand, the second method of computing *AMVP* may reveal a value greater than or less than 100%, even when 0 non-ag growth and 0 non-ag rent are input in the spreadsheet. Ideally, for a well-thought-through market-based land purchase, the two methods should result in similar *AMVP* values. But, in practice, we believe many farmer-purchasers of land, to take a conservative position, will underestimate expected non-ag growth or non-ag rents. That is, such *KSU-LandBuy* users would find that they have to increase their expectations of non-ag growth or non-ag rent in order to get the two *AMVP* values calculated in the spreadsheet to look similar.

Government Program Part of Agricultural Land Values

It is well known that a large part of government farm program payments are merely capitalized into land. That is, farmers bid up cash rents when they get more government payments, and the rise in rents induces a rise in land values. The interesting question regards how much agricultural land values might fall in the absence of government program payments. Clearly, those states with greater dependence on crops that are associated with farm program payments would be larger losers in this scenario. On the other hand, those states whose land values are based relatively more on non-ag features, would not be harmed as greatly by the absence of government farm programs.

In its simplest form, government farm program payments can be considered as comprising a portion of the overall agricultural cash rent paid by farmers. Thus, the usual rent-to-value returns can be divided between a production part and a government program part. Figure 24 shows these breakouts by state and averaged across 1951-2010. In the figure, states like New Mexico, Texas, and South Carolina, as well as a number of the southern states, stand out as states where the agricultural rents have been highly dependent on government payments. Figure 25 presents total returns to land (rents and growth), only dividing the returns between "true" ag returns (ag rent, which is the production component to rent, plus ag growth) and those based on either non-ag features or on government payments. The figure's bars, which are ranked based on portion of total returns coming from ag, suggest that western states such as OR, WA, and NV, but also a number of Corn Belt states, would fare the best in a hypothetical scenario where both government programs and non-ag demand for land disappeared (perhaps because they do not depend too much on government program crops). But, keep in mind that the numbers shown in the two figures are historical (1951-2010) ones. Recently, non-agricultural growth has increased for many states and especially for some particular states. So, one should make such inferences only after considering the earlier discussion around Figures 19-22.

Figure 26 breaks the 2010 crop land market values into three components: an ag production part, a non-ag part, and a government payments part. Because some states have relatively high 2010 land values, this graph makes it appear that government payments are not particularly important for land values. That is, the top portion of each bar represents the dollar part of land value contributed by government payments, and is the maximum amount that would be expected to come off of land values if government payments suddenly were stopped. A closer look at the figure reveals that some states have a large part of their land values contributed by government payments. In fact, Figure 27 presents similar information, only in percentage terms, and makes this clear because it ranks the states according to expected percentage drop in land values in the absence of government payments. Though North Dakota was one of the higher states on the basis of total returns to land (see Figure 20), it is clearly one of the losers in this hypothetical scenario – with land values expected to drop around 31%. But, the Great Plains states also were clear losers, each of them dropping around 22% or more in land value (Kansas would drop around 24%). Several of the southern states were also losers, most notably LA, TX, and MS. Yet, other southern states, such as FL and GA would fare much better, in part because a larger portion of their land values is not dependent on agriculture.

For a map-based rendition of the story presented around Figures 23-27, the reader is directed to our website, www.agmanager.info (click on farm management and then on land). The maps make the regional implications quite clear. But, to foster discussion around the impact of government payments on land values, we must ask the question, Would land values really fall that far if government payments suddenly went away? A number of observations would suggest otherwise. First, based on observing agricultural land auctions, it becomes obvious that known future government payments for specific land parcels are not fully capitalized into the land's selling price. In particular, land with especially low or 0 expected government payments does not sell as low as it "should" based on capitalization theory. Similarly, land with especially high government payments does not sell as high as it "should." Likely, this is a direct reflection that tenants do not fully modify their rents to reflect expected government payments, perhaps because landowners and tenants are not that calculating on a parcel-by-parcel basis, or perhaps because they do not believe in their permanence. Secondly, multi-year rental contracts would preclude immediate adjustments of rents to changes in government payments, even if tenants or landowners desired to do so. Thirdly, if the non-ag portion of land values continues to grow, this would offset a portion of the reduced value associated with the elimination of government payments. Finally, it is likely that large and growing farms have "excess" profits relative to average farms, and these are the farms renting much of the land.

Unfortunately, the academic research varies greatly in its attempt to uncover the actual portion at which government payments have been or currently are capitalized into land values, even on average across the U.S. But, very crudely it does seem that 50% might be an appropriate number to work with; certainly it is less than the 100% assumed in Figure 27. So, using that 50% number, the short bars at the top of Figure 27 would all shrink exactly 50% (if land were capitalized at 70%, the bars would shrink by 30%, and so on).

Economies of size, one of the items listed as potentially reducing the portion of government payments capitalized into land values, merits further discussion. For example, Dumler's Risk and Profit 2005 Conference paper at www.agmanager.info (click on programs) provides evidence that large farms can weather the demise of government programs much better than smaller farms. That is, these large farms might become more aggressive bidders when they particularly need to be, as would presumably be the case in the farm consolidation that likely would increase following the demise of government subsidies.

We also looked at this issue in the context of our 10-year farm management factors study that we routinely update (see “Management Factors: What Really Matters?” at www.agmanager.info; see also “Dynamics of Change: Must I Grow My Farm?” at the same website). That study examines two factors distinctively related to size, one is relative size of your farm and the other is relative portion of land being rented (“relative” means compared to similar farms in the area raising similar crops with similar practices). The study measures profitability of these two size-related factors independently of the various other factors that drive farm profitability. Note that we use the non-linear (i.e., quadratic plateau) version of the model discussed in that management factors paper to assist in the analysis here – even though the result appears quite linear.

Figure 28 examines the case of a typical north-central Kansas farm in 2008 (the last year in the 10-year study updated in 2009), growing from its existing size of 1151 acres to a size 10 times as large, only holding its portion of rented land constant as it grows. We assumed a base crop land rent of $52.75 in 2008, which was an acres-weighted average of $52.00/acre (dryland) and $90.50/acre (irrigated). But, we also assumed that this market rent of $52.75 was 10% more than the average farm in the area could afford. Thus, the average 1151-acre farm in the area would need to pay only $47.95/acre in order to break even. We assumed further that the farm a) earned $14.46 per tillable land acre in government payments annually (estimated from K-State’s Farm Management Guides in 2008 for various crops), b) had an effective government payment limit of $100,000 annually, c) rented 65% of the crop land it operated and this does not change as the farm grows (thus, it expands with 65% rented land and 35% owned land), and d) that government payments are capitalized at 50% (i.e., only half of the $14.46 government payment is allowed to impact rents and land values). Figure 29 is identical to Figure 28 except that it assumes that the entire expansion occurs with rented land (ends up renting 96.5% of operated land at full size). The two figures depict the magnitude of economies of size in Kansas farming, and show that loss of government payments can be offset by such size effects – despite a rather restrictive effective payment limit of only $100,000 that we assumed for expository reasons.

Figures 30 and 31 are identical to corresponding Figures 28 and 29 only that a mere doubling of farm size is shown in order to better see the tradeoffs between farm size and the potential loss of government payments. In Figure 30, where expansion involves 35% owned land, it can be seen that a 1607-acre farm without government payments can just afford the market rental rate of $52.75. This represents a farm expansion of about 40% from the 1151-acre average farm. But, recall that a portion of this expansion (actually, about the first 16%) was required by assumption in order to just afford the market rent with government payments. In Figure 31, where the entire expansion occurs with rented land, a 1486-acre farm (a 29% farm expansion) without government payments can just afford the market rental rate. Although not shown in the figures, we also can compute comparable numbers associated with an assumption that government payments are 100% capitalized into land. In that case, the Figure-30 farm would need to expand from 1152 acres to 1881 acres in the absence of government payments (a 63% expansion) in order to afford the market rental rate of $52.75. The farm expanding using only rented land would need to grow to 1707 acres (a 48% expansion) in order to afford the market rent. All in all, it does appear that assuming that farm expansion can offset the loss of government payments should be reasonable. So, we conjecture that, if government program payments disappear, farm consolidation could easily keep land values and rents from falling precipitously. Of course, this is not to say that social adjustment problems would not arise from such consolidation.

Trends Over Time from the Data

To generalize information from the growth rate and rent calculations from the data, we estimated simple linear time trends using statistical regression by state across the 1951-2010 time period. The average predictions from these models for a number of variables are reported as Figure 32. The figure clearly shows ag growth rates and rent-to-value ratios declining over time and non-ag growth rates increasing over time. As noted earlier, we certainly would expect ag rent-to-value ratios to fall over time given that land values are increasingly reflective of non-ag investment features (the $/acre land value denominator in rent-to-value is rising faster than the $/acre rent numerator). This does not mean that rent-to-value is useless as a benchmark – in fact it often has been our most important benchmark when helping investors think through their potential land purchases – only that the benchmark itself may need to be lowered over time.

Figure 33 shows the same information as Figure 32, only showing the time trends additively and after properly prorating any negative predicted non-ag growth values to the ag growth and rent-to-value lines. There does appear to be a slight downtrend in total land returns over time. However, Figure 34, which shows the 39-state average total land returns by year, suggests that it may be difficult to make sweeping generalizations about the expected total returns to ag land over time. In Figure 32 we noted that we would expect rent-to-value to fall over time. What is not immediately clear in that figure is why ag growth (i.e., growth in rents) has fallen over time. Likely, this is due to at least two reasons. First is that our linear trend is backed by $/acre rents that rose rapidly in the 1970s as noted in the discussion around Figure 22, due especially to rising agricultural profits and inflation at the time. So, it should not be surprising to see growth in those $/acre rents (i.e., ag growth) fall from such high levels. Secondly, given reasonably flat or slightly downtrending total returns as shown in Figure 33, coupled with the known-to-be-increasing non-ag growth, it must be the case that the sum of rent-to-value and ag growth (i.e., growth in rents) must diminish over time mathematically. Unfortunately, how this expected drop in the combined rent and ag growth "should" be apportioned between the two returns is not immediately clear. But, it would seem reasonable that both returns would diminish together as they together make up a shrinking portion of the total returns over time.

Growth in Ag Rents

Earlier in this paper, we described the various research procedures used to uncover reliable historical measures of ag, non-ag, and total growth rates in land values. But, it also was suggested that the ag portion of land value growth rates should be assigned the same value as the growth in ag rents – because the rents reported by USDA-NASS are specifically *agricultural* rents. That is, there would be little reason to consider the ag growth rate of land value to be anything different than the growth in $/acre ag rents. Thus, beginning with the 2004 version of *KSU-LandBuy*, users are being asked to more explicitly consider the growth in ag rents. Also beginning with the 2004 version of *KSU-LandBuy*, users are asked to input *total* land growth rather than the non-ag component. Then, the non-ag growth in land is simply calculated from the other two measures (ag growth and total growth). Additionally, starting in 2004, *KSU-Landbuy* allows the user to input different growth rates by land class, for example, pasture vs. crop land. Hence, there is some motive to acquire a better understanding of growth rates in rents.

To better understand expected ag growth rates, Figure 35 and Figure 36 show, to the extent that reliable data are available, historical rent trends for Kansas crop and pasture land, respectively. Short-term geometric growth paths are shown in the figures, along with the $/acre rental values and associated average growth rates for the short- and long-run. Given what was noted earlier about rents growing "excessively" fast in the 1970s due to inflation and high farm profits at the time, we probably would not recommend using the full 1967-2011 period average as our expectation for the future. Rather, we would suggest being somewhat more conservative. In particular, we would suggest a weighted average of the long-term (1967-2011) average and the 20-year short-term (1992-2011) average. Thus, we would suggest an expected ag growth rate of 2.64% (i.e., 0.75*3.00% + 0.25*1.58%) for Kansas non-irrigated crop land and 2.57% for Kansas pasture land. At least that is how we have approached recommendations in recent years. But, if grain demand continues to drive rents considerably higher, it might be that the long-term (1967-2011) rent growth is a better predictor of future growth.

By way of contrast, and because they represent a neighboring state, Figures 37 and 38 present the same information as Figures 35 and 36, only for Nebraska. Using the same rationale as was used for Kansas above, for Nebraska we would suggest the following expected ag growth rates: non-irrigated cropland, 4.89%; pasture, 2.65%. Interestingly, growth in Nebraska crop land rental rates has been considerably higher than in Kansas. But pasture rents have grown at rates similar to Kansas, especially over the last couple of decades.

Brief Conclusion

This paper provided a somewhat detailed analysis of the background behind the *KSU-Landbuy.xls* spreadsheet for analyzing land purchases. That spreadsheet is an ongoing project for the purpose of meeting the needs of land buyers and sellers in their land transactions. As such, it may continue to see further development and refinement over time. The idea of incorporating non-ag features of land investment into the land purchase decision is still somewhat new in *KSU-Landbuy*. Thus, this part may continue to see changes in the future. At this point, our theoretical development of the "agricultural portion of land value" is still crude and our *Ag Cap Rate* somewhat ad hoc. Thus, the reported *AMVP* benchmarks in Table 1 should be viewed cautiously when used as expectations for differences in land parcel prices due to differences in their being more or less purely ag. For example, we know that general inflation of land values will come in as declining ag and increasing non-ag, which may not be entirely appropriate. Hopefully, over time and as we get more feedback from users, these values can be estimated with greater accuracy so that decision makers can rely on them with ever more certainty. On the other hand, the core components of the *KSU-Landbuy* spreadsheet have been around for some time now and are quite reliable – many users have reported successful land purchases made with earlier versions of this spreadsheet. We have no reason to think that will change with the added features of more recent versions.

As an important reminder, most of the calculations, numbers, and figures shown in this paper are related to statewide averages and not to individual land parcels. Yet, *KSU-LandBuy* is designed to be used for making informed purchases and sales of individual parcels. Clearly, expectations for individual parcels can depart substantially from statewide averages. For example, besides the usual land quality attributes of a given parcel being different from average, the parcel also may have vastly different expected government program payments, non-ag income, and growth potential.

References

Agricultural Land Values and Agricultural Cash Rents (PLR-BB). Online. Various issues. http://usda.mannlib.cornell.edu/reports/nassr/other/plr-bb/ (verified 14 October 2003).

Bankrate.com. Website for income tax rates verified in August 2006.

Cash Rents for U.S. Farmland, 1963-1993 (90025). Online. http://usda.mannlib.cornell.edu /usda/ (verified 21 May 2002).

Durst, R., and J. Monke. "Effects of Federal Tax Policy on Agriculture." *Agricultural Economic Report No. 800*. Food and Rural Economics Division, Economic Research Service, U.S. Department of Agriculture. Online. http://www.ers.usda.gov/publications/aer800/ (verified 21 May 2002).

Dhuyvetter, K.C., and T.L. Kastens. 2001. "Determining Equitable Crop Share or Cash Rental Arrangements." Available online at http:/www.agmanager.info.

Dhuyvetter, K.C., and T.L. Kastens. 2002. "Landowner vs. Tenant: Why Are Land Rents So High?" Updated August 2002. Available online at http:/www.agmanager.info.

Farm Real Estate Values (86010). Online. http://usda.mannlib.cornell.edu/usda/ (verified 21 May 2002).

Farm Real Estate Values, Rents, and Taxes. Online. http://www.ers.usda.gov/publications/ ah712/AH7121-4.PDF (verified 21 May 2002).

Farm Real Estate Taxes (92002). Online. http://usda.mannlib.cornell.edu/usda/ (verified 21 May 2002).

Website of Federal Reserve Bank of St. Louis (source of PCE deflator and stock market data), verified August 2006.

Historical Tax Rates." Online. http://www.korpios.org/resurgent/TaxTimeline.htm (verified 21 May 2002).

History of Federal Individual Income Tax Rates. Online. http://www.taxplanet.com/library/ oldtaxrates/oldtaxrates.html (verified 21 May 2002).

Kastens, T.L. 2001. "Stock Market vs. Land vs. Farming Returns" Revised Oct. 2001. Available at www.agmanager.info.

Kastens, T.L. and K.C. Dhuyvetter. 2006. "Dynamics of Change: Must I Grow My Farm?" Updated July 2006. Available online at http:/www.agmanager.info.

Kastens, T.L. and K.C. Dhuyvetter. 2006. "Management Factors: What Really Matters?" Updated July 2006. Available online at http:/www.agmanager.info.

Rogers, D., and G. Wunderlich. *Acquiring Farmland in the United States*. AIB-682, U.S. Dept. Agr., Econ. Res. Serv., Sept. 1993.

U.S. Department of Agriculture, 1997 Census of Agriculture. *Agricultural Economics and Land Ownership Survey (1999)*" Table 53. Taxable Land and Buildings and Real Estate Taxes for States. 1999 [online] http://www.nass.usda.gov/census/ (verified 14 October 2003).

U.S. Department of Agriculture, National Agricultural Statistics. *Agricultural Land Values Final Estimates 1994-1998*. Statistical Bulletin Number 957, March 1999 [online]. http://www.usda.gov/nass/pubs/histdata.htm (verified 21 May 2002).

Walraven, N.A. *Agricultural Finance Databook.* Board of Governors of the Federal Reserve System, Wash D.C., 1st qtr 02.

Table 1. Historical Land Return Values by State

state	1951-2010 aft-prop-tx *Ag Rent* % of value	2011 aft-prop-tx *Ag Rent* % of value	1951-1972 aft-prop-tx *Ag Cap Rate* percent	2011 *Property tax* % of value	1951-2010 *Ag Growth* gA as %	1951-2010 *Non-ag Growth* gNv as %	1951-2010 total growth g as %	ag mkt value 2011 *AMVP* % of value
KS	5.81	3.24	6.64	0.28	3.49	1.26	4.79	48.79
AL	5.33	2.10	8.03	0.07	4.73	2.15	6.98	26.12
AR	6.11	2.49	7.61	0.14	3.96	1.82	5.85	32.72
AZ	2.51	0.33	4.83	1.61	4.83	1.66	6.57	6.86
CA	4.26	1.17	5.76	0.22	2.90	2.62	5.59	20.28
CO	5.65	2.37	7.10	0.24	4.23	1.82	6.12	33.39
FL	2.26	0.57	3.30	0.16	5.35	2.84	8.34	17.44
GA	4.89	1.34	8.02	0.22	5.25	2.71	8.11	16.66
IA	5.86	3.04	6.35	0.40	4.57	1.28	5.91	47.90
ID	6.82	4.20	8.36	0.39	4.11	1.11	5.27	50.23
IL	4.76	2.66	5.33	0.50	4.76	1.19	6.00	49.93
IN	5.48	2.90	6.26	0.26	4.66	1.36	6.09	46.38
KS	5.81	3.24	6.64	0.28	3.49	1.26	4.79	48.79
KY	6.10	3.09	8.26	0.14	4.21	1.60	5.88	37.38
LA	5.01	3.19	6.12	0.16	4.37	1.06	5.48	52.10
MI	3.51	1.25	5.46	1.32	4.73	1.51	6.31	23.00
MN	6.23	3.81	7.23	0.41	5.06	1.11	6.23	52.64
MO	6.52	3.46	7.20	0.14	4.94	1.31	6.31	48.14
MS	6.73	3.66	9.24	0.18	4.87	1.42	6.36	39.64
MT	6.52	3.43	8.04	0.30	4.14	1.39	5.59	42.69
NC	4.31	1.48	7.32	0.28	3.81	2.34	6.24	20.19
ND	7.19	4.58	7.80	0.38	5.09	0.95	6.09	58.68
NE	6.42	4.20	6.85	0.70	5.01	0.78	5.83	61.33
NM	4.35	3.80	6.03	0.23	4.65	0.69	5.37	62.95
NV	5.32	4.01	6.88	0.25	4.41	0.88	5.33	58.31
NY	3.73	1.08	5.26	0.81	4.05	2.26	6.41	20.59
OH	4.15	2.16	4.84	0.34	4.50	1.37	5.93	44.68
OK	4.46	2.21	5.29	0.16	3.55	1.46	5.06	41.77
OR	5.65	4.22	7.09	0.78	4.77	0.81	5.62	59.46
PA	1.93	0.61	3.22	0.45	4.49	2.29	6.89	18.85
SC	3.76	1.18	5.89	0.16	4.01	2.49	6.61	20.13
SD	6.83	3.85	7.85	0.48	5.06	1.16	6.28	49.06
TN	6.06	2.16	9.08	0.18	3.72	2.24	6.05	23.76
TX	3.47	1.44	5.12	0.28	3.53	1.91	5.51	28.06
UT	3.45	1.97	4.91	0.26	3.67	1.49	5.22	40.23
VA	3.86	0.82	6.60	0.18	3.44	3.17	6.72	12.39
WA	6.80	5.37	8.51	0.63	4.19	0.66	4.88	63.06
WI	5.12	1.87	6.94	0.64	4.60	2.03	6.72	26.91
WV	4.31	0.77	6.65	0.03	2.59	3.53	6.20	11.54
WY	6.16	1.49	7.68	0.11	3.80	2.73	6.63	19.34
39-state average	5.07	2.50	6.64	0.37	4.31	1.70	6.09	36.76

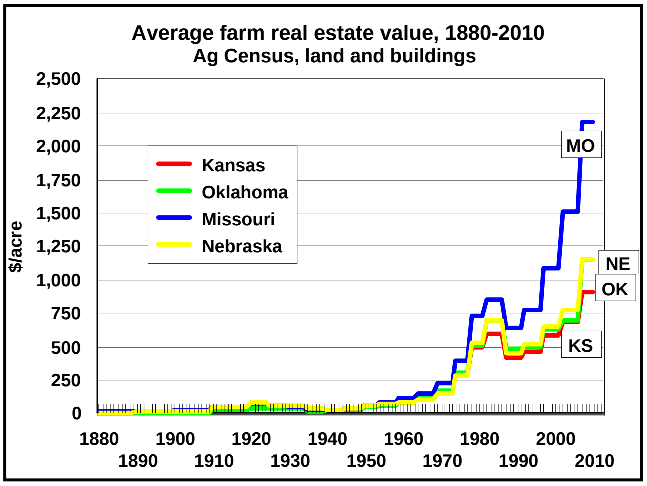


Figure 1

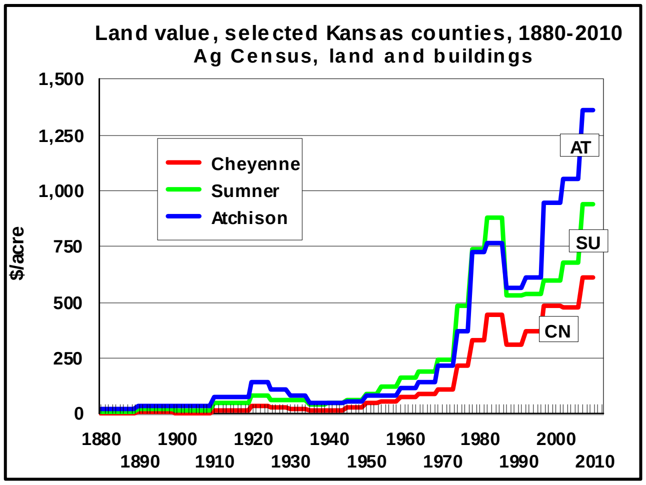


Figure 2

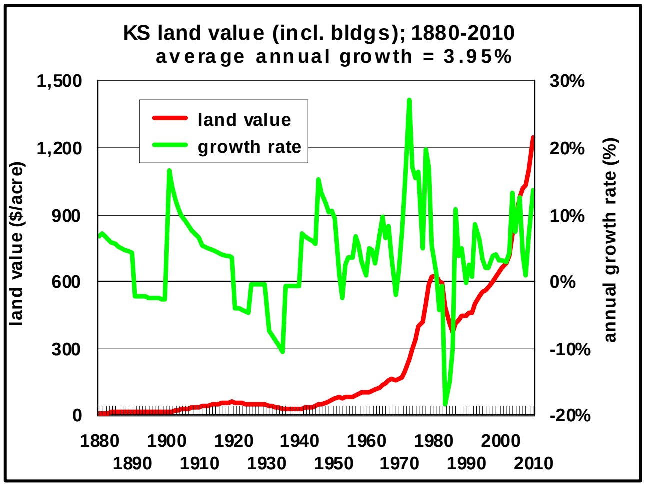


Figure 3

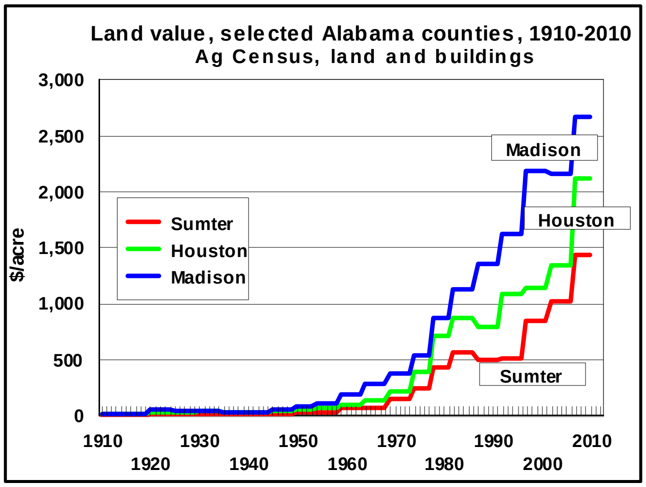


Figure 4

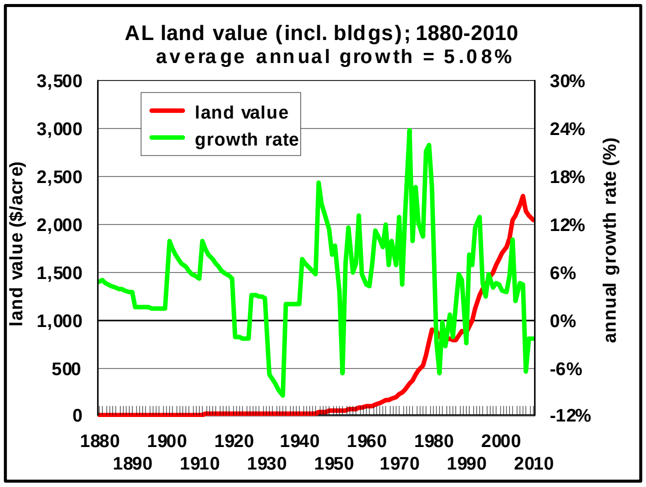


Figure 5

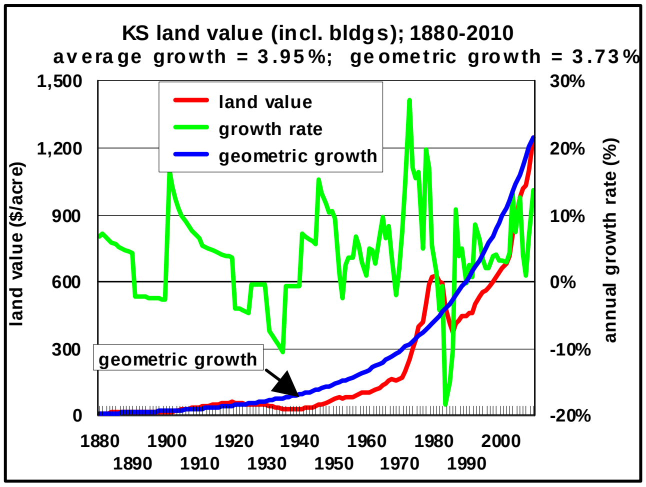


Figure 6

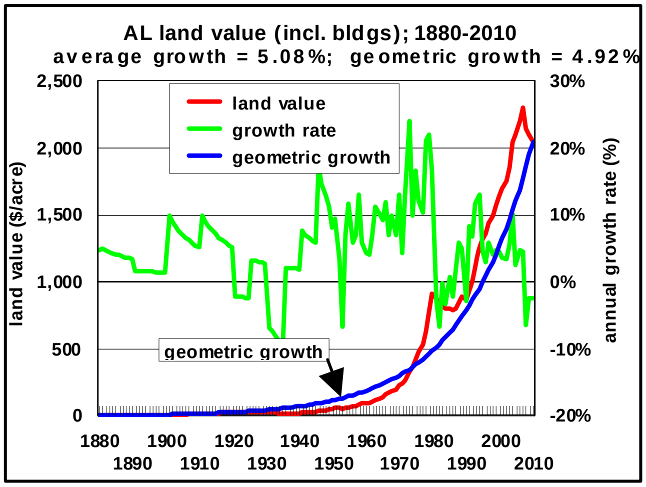


Figure 7

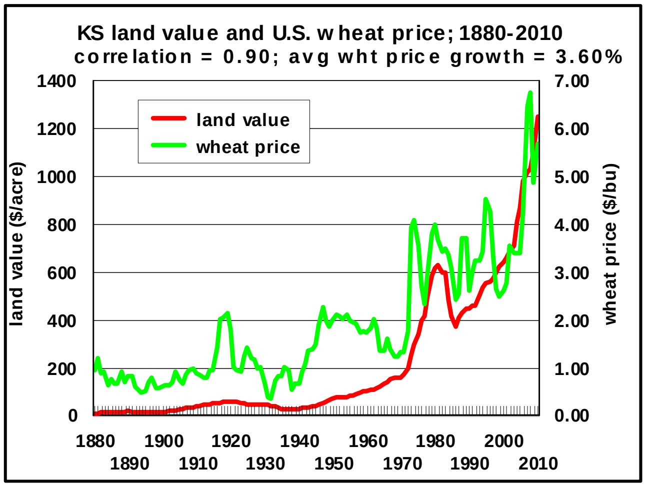


Figure 8

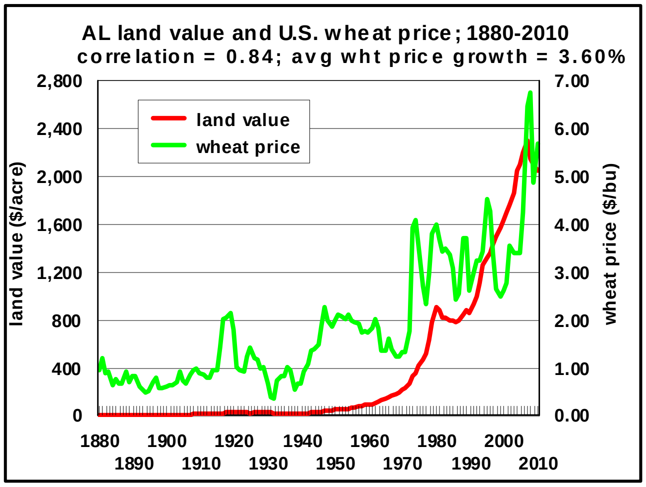


Figure 9

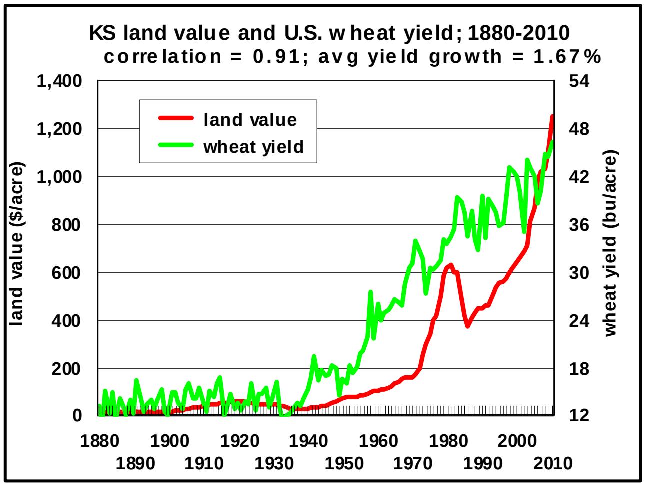


Figure 10

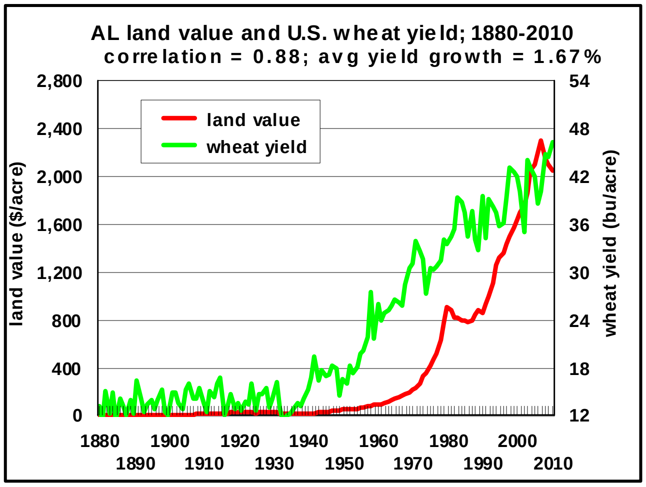


Figure 11

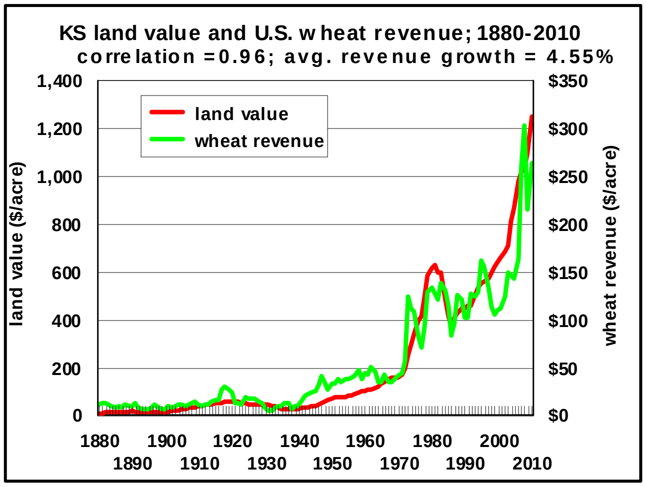


Figure 12

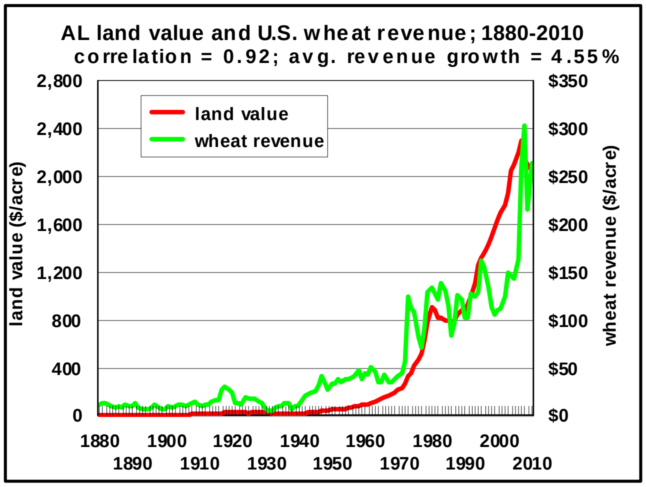


Figure 13

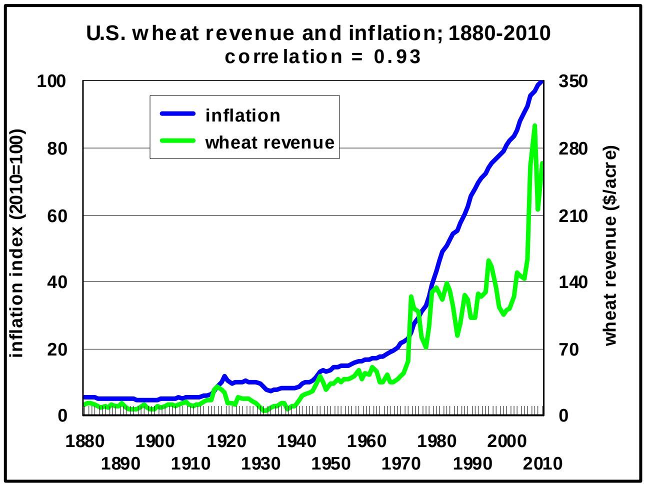


Figure 14

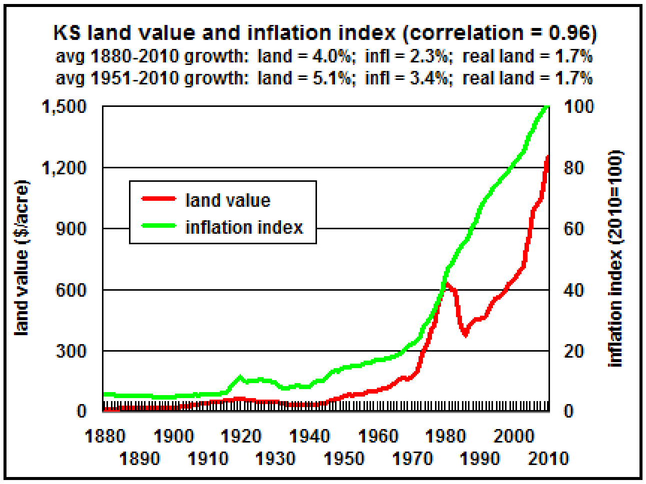


Figure 15

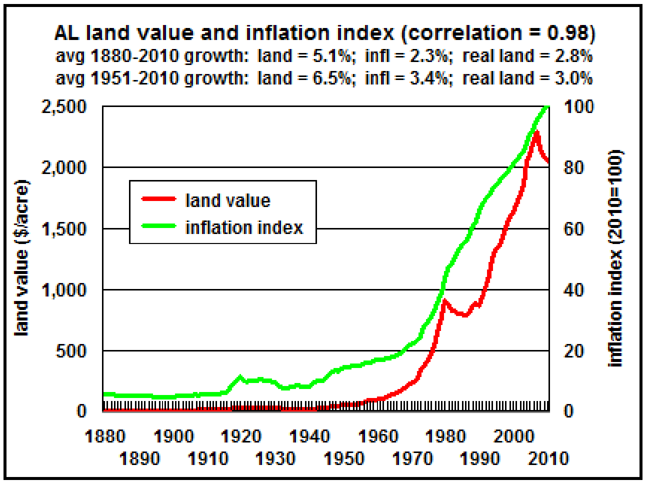


Figure 16

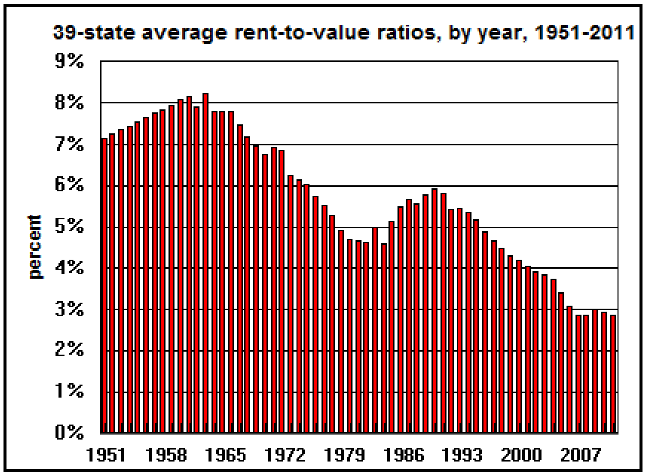


Figure 17

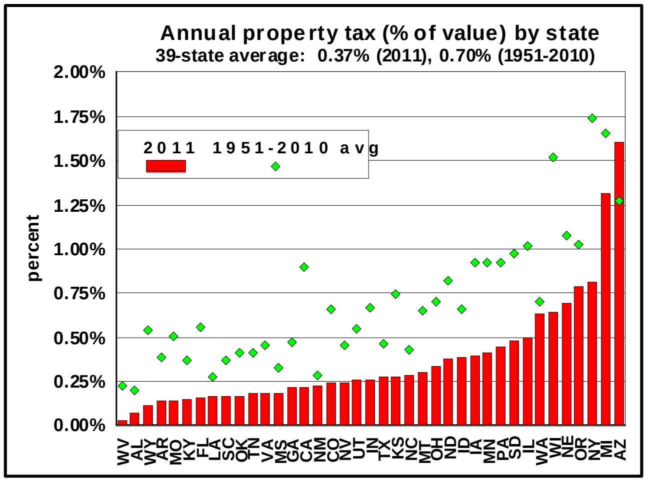


Figure 18

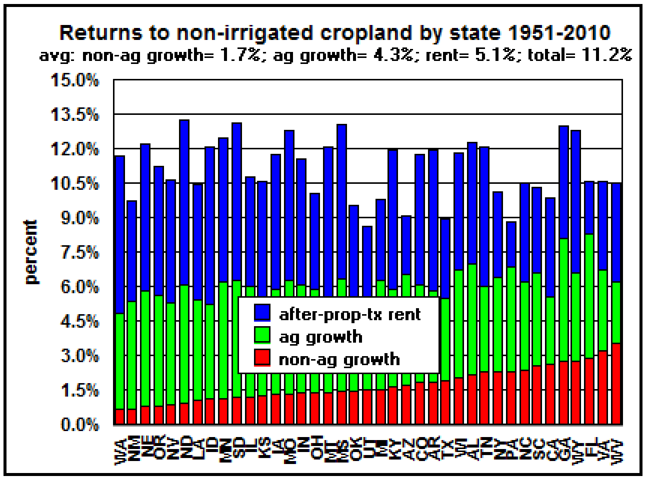


Figure 19

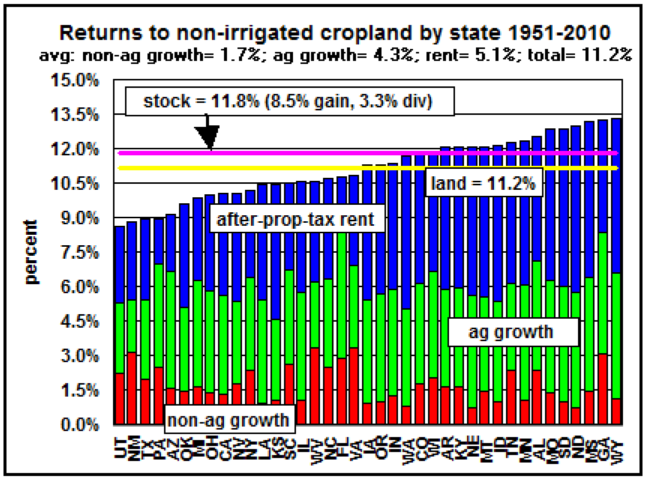


Figure 20

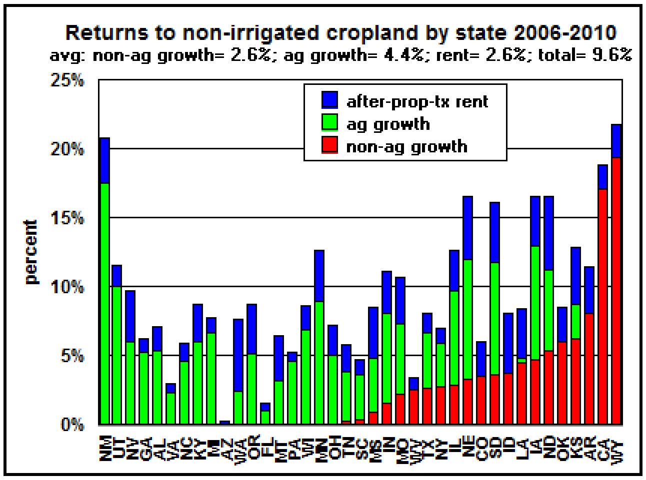


Figure 21

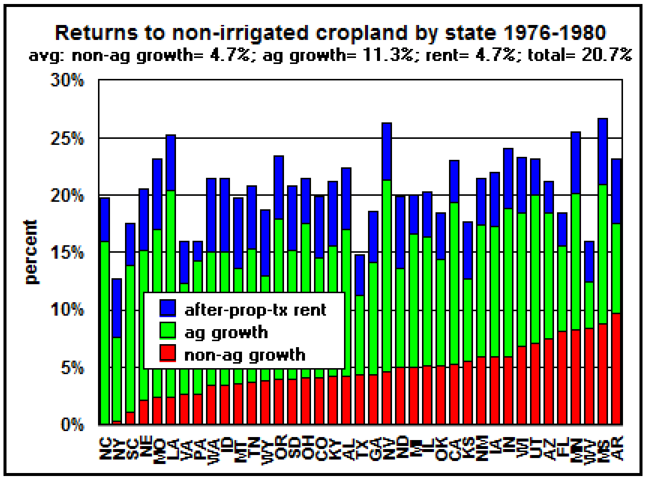


Figure 22

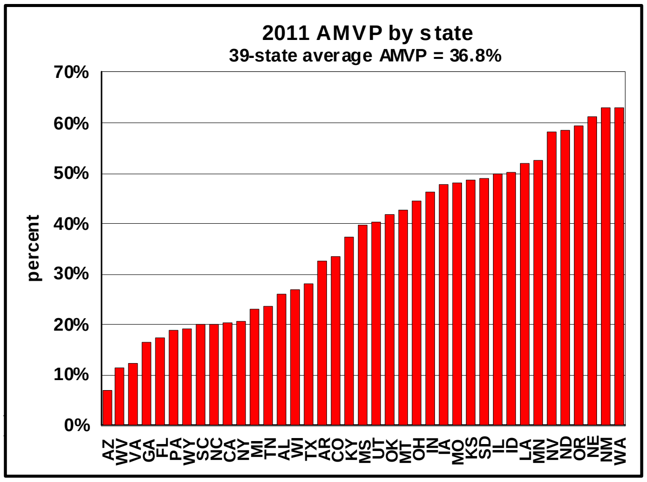


Figure 23

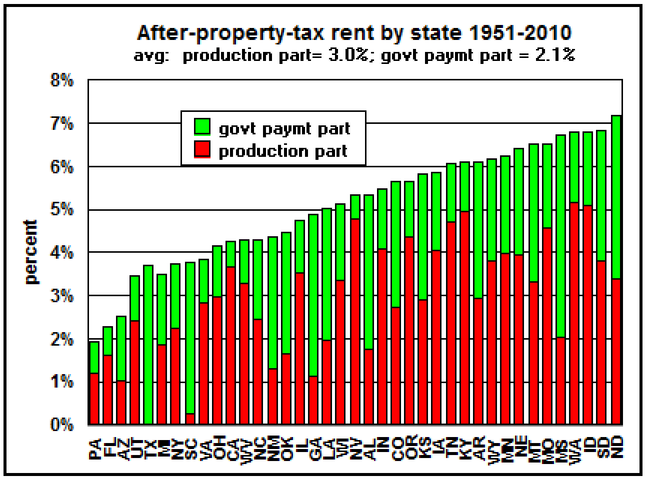


Figure 24

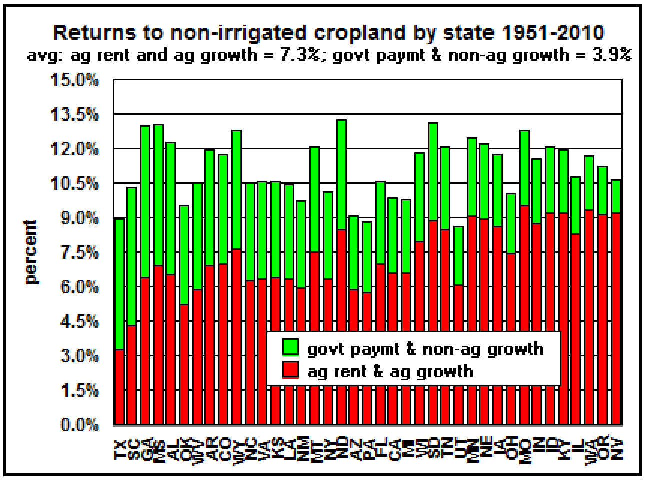


Figure 25

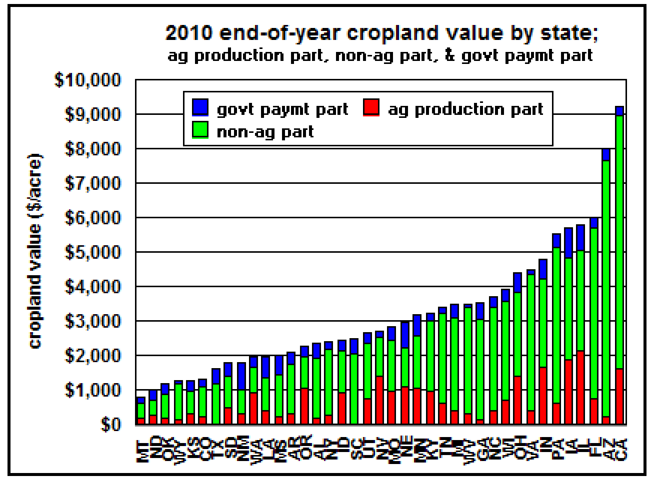


Figure 26

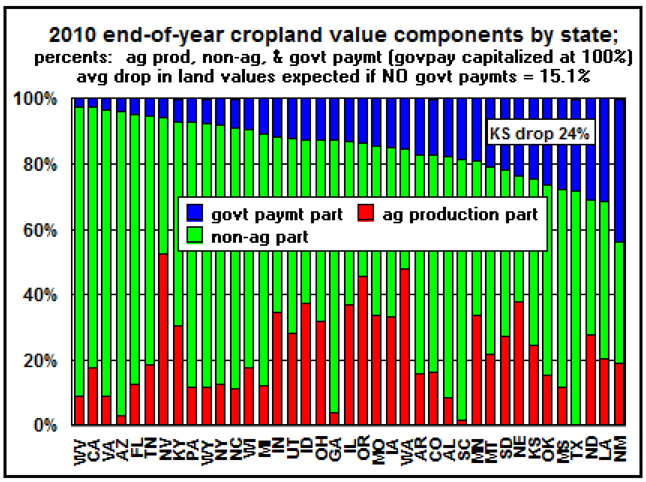


Figure 27

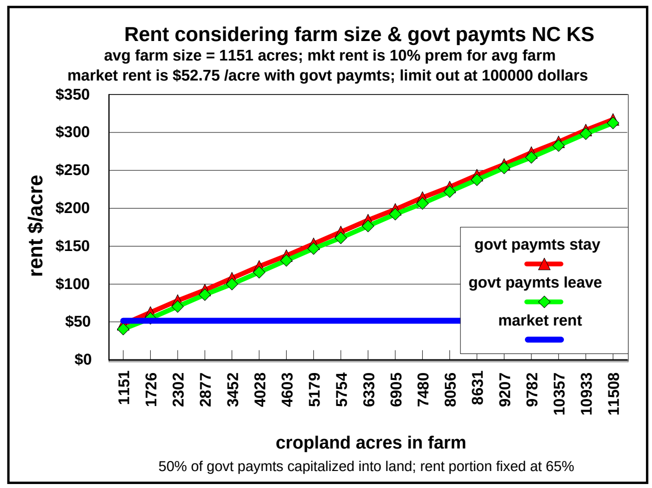


Figure 28

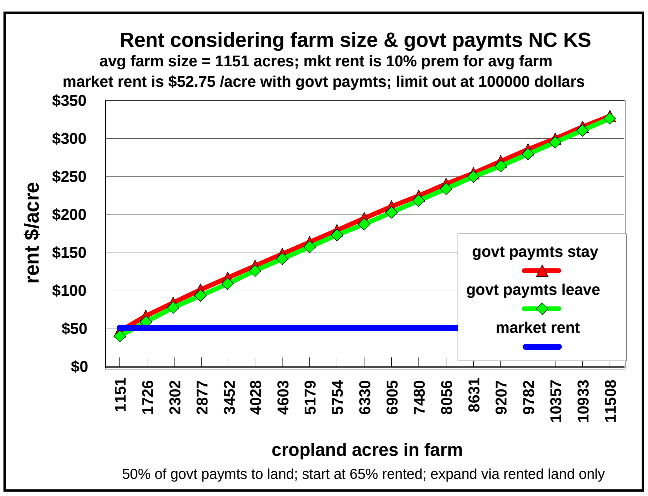


Figure 29

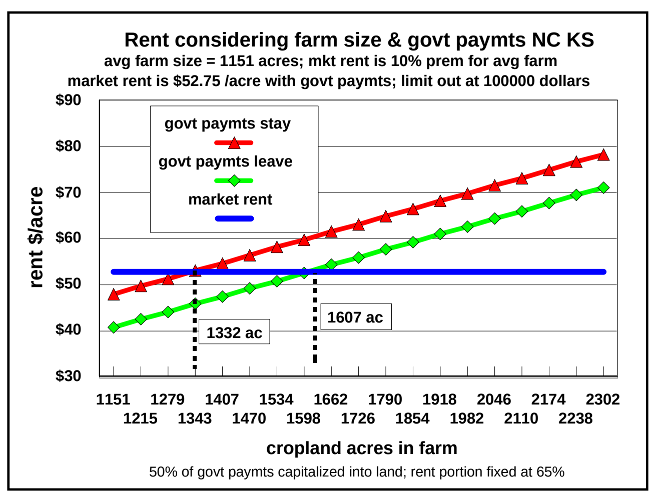


Figure 30

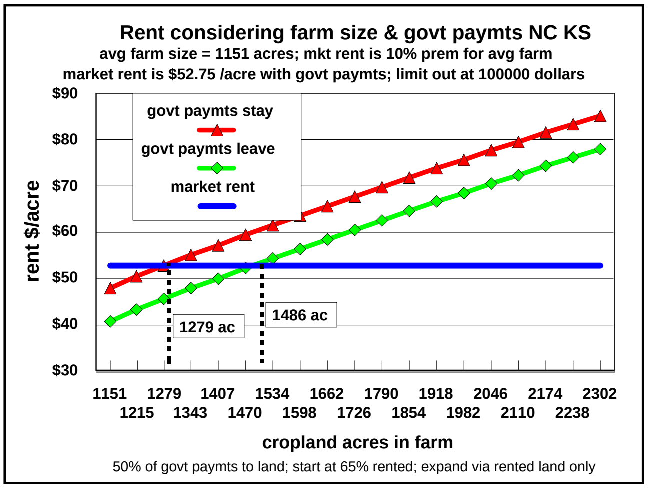


Figure 31

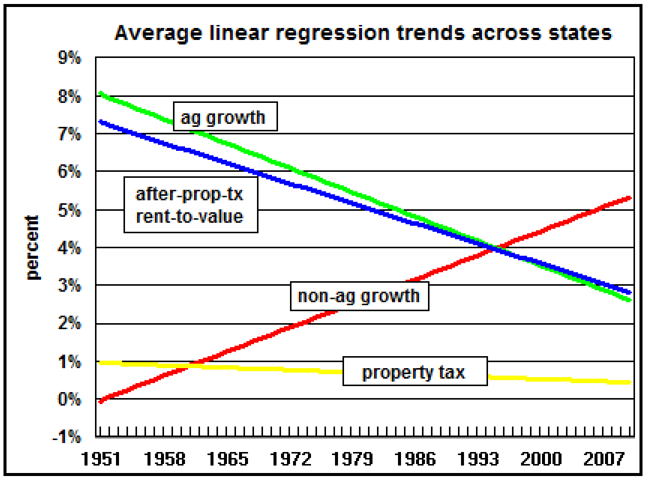


Figure 32

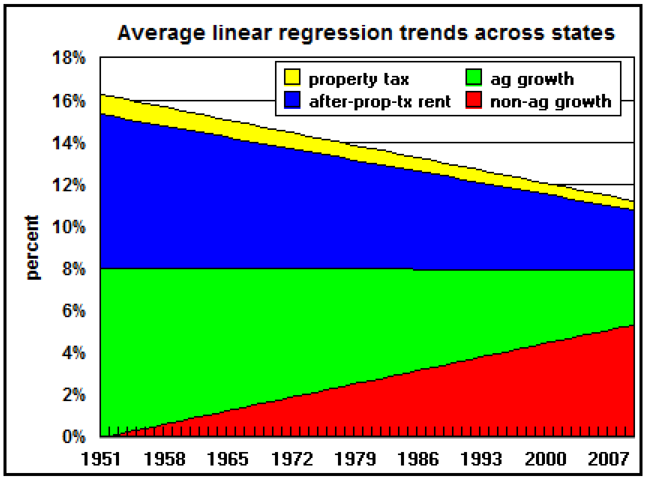


Figure 33

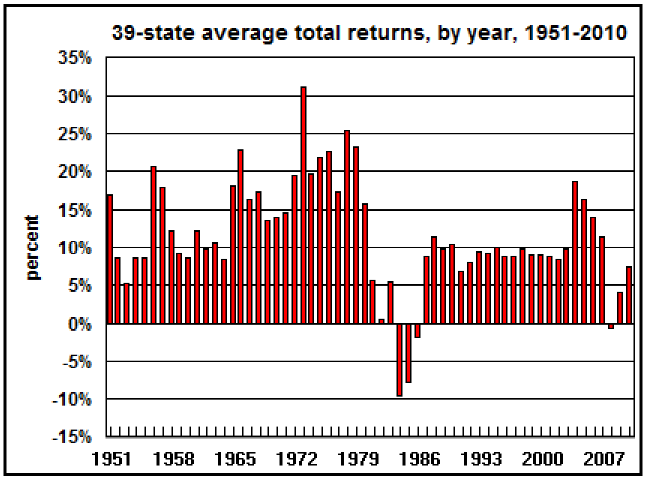


Figure 34

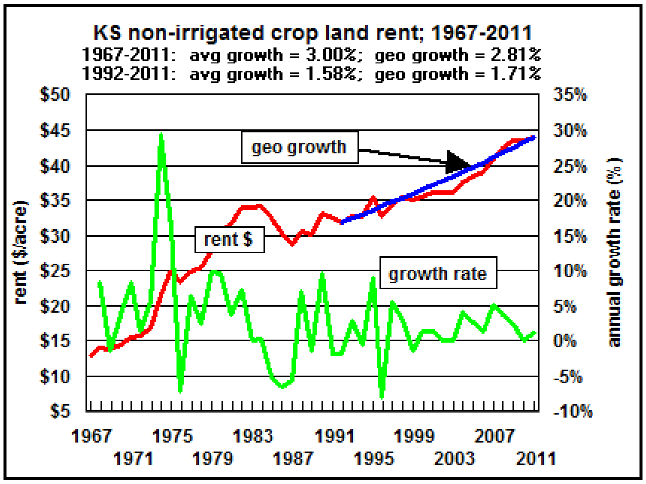


Figure 35

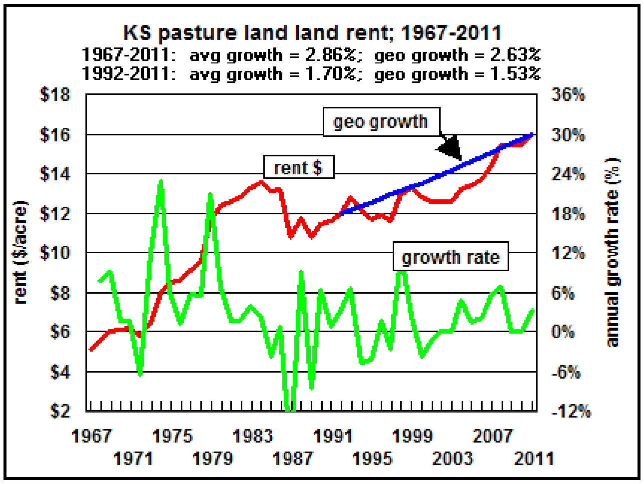


Figure 36

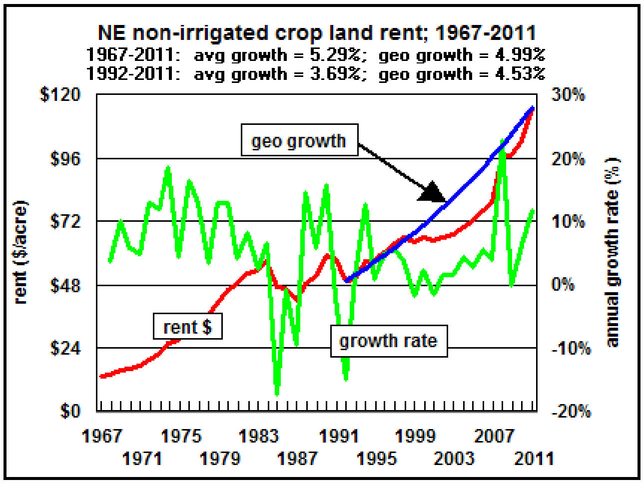


Figure 37

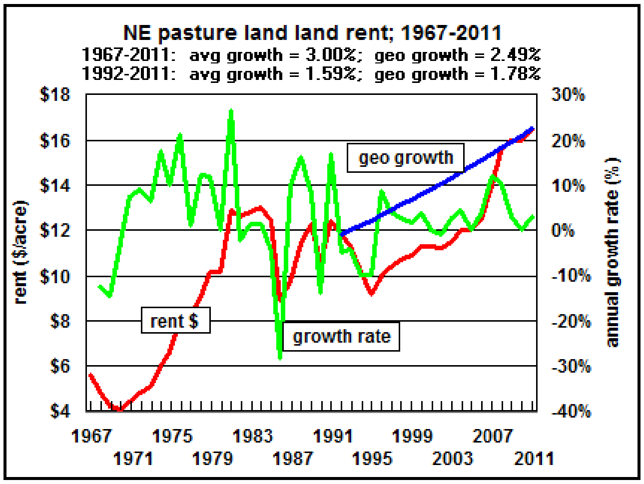


Figure 38