Where is Commercial Ag Going?

contains two papers prepared for ongoing web and in-person presentation on the topics of economies of size and trends in commercial agriculture

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Abstract

As with managers in other industries, farm managers are exposed to economically-driven trends or forces that can profoundly impact their businesses. They routinely must assess the characteristics, persistence, and implications of those trends, as well as how their businesses should or will react to them. In their strategies, managers can choose to either ignore, resist, or participate in current business trends. We identify five such trends: 1) increasing consolidation, 2) rapid technological change, 3) greater connections to the non-agricultural world, 4) increased requirement of paperwork and computer work, and 5) more reliance on people with specialized skills. On average, tomorrow's farms will have ever larger equity requirements, ever larger debt requirements, and ever larger labor requirements. It will become more difficult to use off-farm wages to "save one's way" to acquisition of a farming business. It will be more difficult to avoid becoming a manager of people or a manager of other people's money. One-generation farms, where the business dies with the owner, likely will become less important in tomorrow's commercial agriculture. In their place will be multi-generation farms, where those involved will embrace the idea that they are only employees of a business that started before them and will go on after them, farms that are not static but rather target growth, farms that do not confound personal goals such as being out of debt in old age with business goals such as growing the business while maintaining a suitable debt-to-assets ratio.

Dynamics of Change: Must I Grow My Farm?

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Abstract

On average, tomorrow's farms will have ever larger equity requirements, ever larger debt requirements, and ever larger labor requirements. It will become more difficult to use off-farm wages to "save one's way" to acquisition of a farming business. It will be more difficult to avoid becoming a manager of people or a manager of other people's money. One-generation farms, where the business dies with the owner, likely will become less important in tomorrow's commercial agriculture. In their place will be multi-generation farms, where those involved will embrace the idea that they are only employees of a business that started before them and will go on after them, farms that are not static but rather target growth, farms that do not confound personal goals such as being out of debt in old age with business goals such as growing the business while maintaining a suitable debt-to-assets ratio. Using both objective and subjective assessment, this paper seeks to improve understanding of historical and expected trends in commercial agriculture, especially as they relate to size and growth.

BACKGROUND

Futuristic thinking or "futurism" typically entails a discussion about really cool things that might happen in the distant future. Futurism typically is pleasurable in the sense that daydreaming is pleasurable – causing the mind to wander and wonder. This paper is not so much about futurism as it is about the nearby future, that which we must consider in our lifetimes, and that which might demand painful decisions today. As such, we wish to consider mainly that which is scientifically and statistically highly probable given our understanding of the past and by extrapolating historical trends forward, trends that have been driven by strong economic forces.

More than ever, today's farms are driven by the sometimes conflicting and sometimes synergistic goals of profitability and lifestyle. It is not our intent to extol one goal over another, but rather to help farm managers better achieve their goals through a better understanding of the underlying economic principles driving farms historically and today. As such, our story is about what we believe will make *some* farms profitable in the future, specifically those farms that actually will remain in commercial agriculture. In that regard, pursuing the strategies discussed in this paper may very well be risky for many individual farms. Those individual farms, consciously or unconsciously, undoubtedly will choose to reduce or eliminate their involvement in commercial agriculture. Regardless, all holders of agricultural wealth, whether that wealth be in dollars or in human skills, should benefit from a better understanding of the economic choices they face, choices that point to opportunities to increase wealth and/or personal happiness.

ECONOMIES OF SIZE

One economic concept that has been especially important in shaping production agriculture over the last century or two is economies of size (EOS). EOS is best thought of as a driving economic force behind businesses getting larger over time. The basic idea is that per unit costs of production fall as a business gets larger. The impetus for EOS arises from firms having some costs that are variable and some costs that are fixed. Per unit *variable* costs might rise or fall with increased production, but per unit *fixed* costs fall with increased production as fixed costs are spread over more units.

EOS might also be associated with selling price. For example, larger businesses might obtain higher prices for the items they produce and sell. EOS can be associated with a firm or an industry, as in "production agriculture has economies of size," or even with an individual asset, as in "a tractor has economies of size." EOS can be viewed pessimistically, as in "I have to get my business larger just to survive," or optimistically, as in "If I grow my business, my per unit cost will fall and I will be more profitable." Regardless, EOS has been the driving force behind many modern businesses. Few industries have been unaffected as most have much larger businesses today than in the past.

Economists regularly discuss economies of size, economies of scale (we consider scale and size to be the same for all practical purposes), and economies of scope. Economies of scope considers that it might be profitable to expand a business into other activities, those thought to be synergistic. For example, it might be profitable for a food processor to expand into food production or food retailing. Also, many Kansas farms routinely diversify their farms in an attempt to capture economies of scope, for example, operating a cow-calf enterprise along with a cash-grain enterprise. In one sense, economies of size is about specialization and economies of scope is about diversification. But, the two economies are often inversely related. That is, a diversified farming operation may find conflicting demands on its labor during critical times of the year, say if it is (or should be) focusing on calving cows when it is (or should be) planting crops. We believe that economies of size will be a more important force for farms than economies of scope over the next few decades, and thus this paper essentially ignores scope and focuses on size instead.

Is EOS for real?

Economists regularly debate the reality of EOS, with the following opposing questions. Is there really an economic advantage to growing one's business? Or, do successful managers simply re-invest their profits in what they know best, causing researchers to observe a positive correlation between size and profitability? Likely, there is a degree of truth in both sides of the argument. Many farm owners do simply reinvest their profits causing their farms to grow. Even Walmart, the king of size, might be viewed as simply capitalizing on a successful retailing/wholesaling style. On the other hand, there clearly must be an advantage to size in the meat packing business.

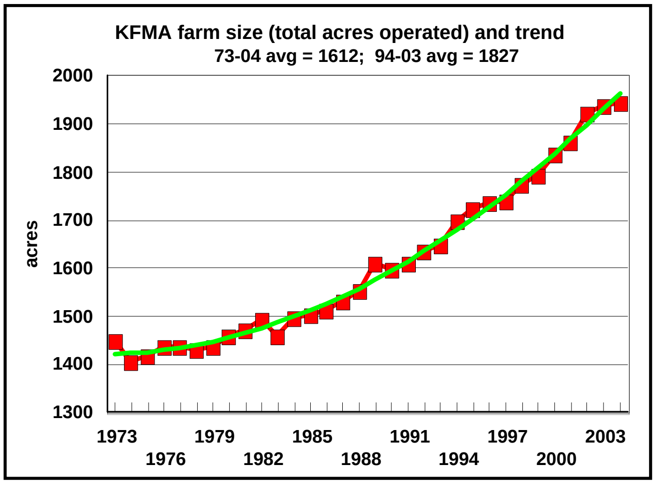

Figure 1

Otherwise we surely would see numerous small packing plants rather than a few high capacity ones. That argument surely goes for most businesses today. Using farming as an example, does not the fact that we have observed farms in general getting larger over time indicate that there must have been EOS related to farming the last century or so? Questioning further, would we not see some large farms operating many smaller tractors rather than fewer larger tractors if there really had not been EOS over the years? Figure 1 shows how Kansas Farm Management Association (KFMA) farms have grown over the 1973 to 2004 period. Of course, that trend has been in place for decades and decades. Interestingly, the trend line in the figure shows that there is a tendency for farm size to have been increasing at an increasing rate over time. That suggests that EOS and farm size issues have been becoming ever more important over time.

Figure 2, showing 1999 machinery investment per acre by farm size for a KFMA sample of wheat farms, depicts one example of what might cause EOS. In particular, assuming machinery investment per acre is a reasonable proxy for machinery costs per acre, or at least the part that might indicate EOS, it is easy to see that larger farms have less investment per acre on average, hence lower costs per acre. However, note that many small farms also have low machinery investment per acre. But, the converse is not true. That is, the figure shows no large farms with especially high machinery investment per acre. The point is that EOS is an average phenomenon. It does not imply that small farms cannot be low cost, only that *on average*, they are higher cost.

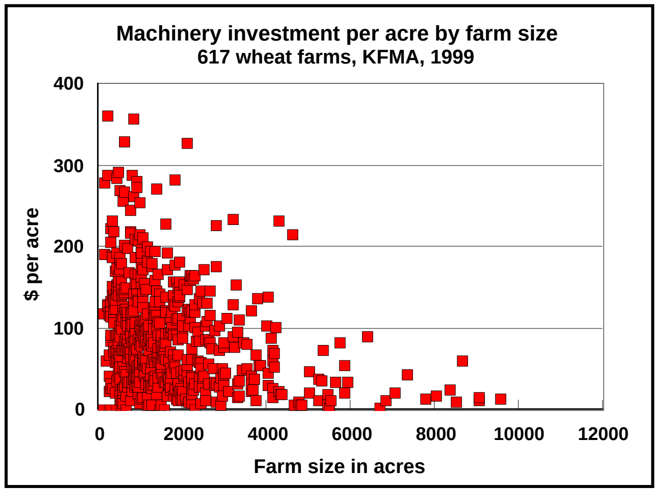

Figure 2

One way to scientifically examine the existence of EOS is to test whether there is a positive relationship between size and profit after other management factors have been accounted for. We have examined this several times over the last several years, with the most recent report, *Management Factors: What is Important, Prices, Yields, Costs, or Technology Adoption?*, examining over 800 Kansas farms from 1995 through 2004 (at www.agmanager.info). Figure 3 shows graphically the impact of various management factors according to that study. In particular, it shows that farms in the high third (1 standard deviation) size-wise had a profit advantage of $13.20/acre over the average-sized farm in their respective regions of Kansas (the state is divided into six KFMA geographical areas). It is important to note that this $13.20/acre was *after* accounting for a number of traits that are more directly impacted by management, for example the ability to lower costs, the ability to get higher yields, or even the

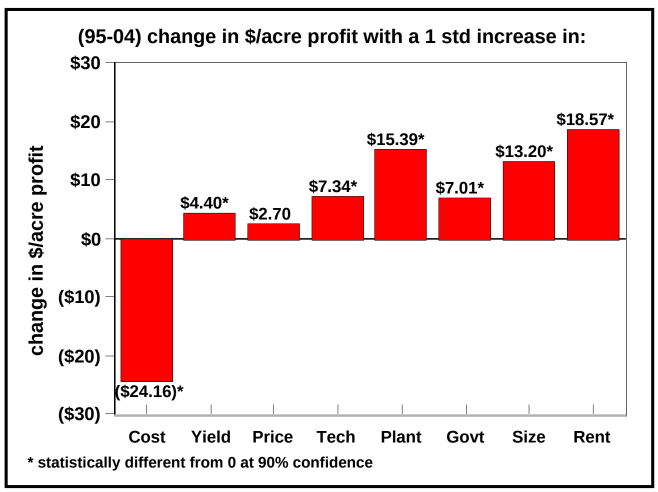

Figure 3

willingness to take on more risk (risk impact not shown). Thus, this study shows that, even for farms that are already good managers by other measures, there is a profitability benefit associated with farm size.

In short, we believe that EOS is for real, that it can be documented using both intuitive historical assessment as well as by scientific research. Given that, the discussion should turn to further describing and quantifying EOS, so that farm managers can make better EOS-related decisions in their businesses and plan for the future more accurately.

Why are larger farms more profitable?

Figure 3 showed that, at least for a sample of Kansas farmers in recent history, EOS is an important factor impacting farm profit. Figure 2 showed that one reason farming might have EOS is that some per unit costs, for example those associated with machinery investment, are less for larger farms, at least on average. Other research studied Kansas farms over the 1973-2003 time period, considering how characteristics of large, medium, and small farms have changed over time. In this study, the approximately 2000-2500 farms in the KFMA were split into three different categories each year according to the total dollars of capital managed by the farm. Capital managed includes all owned assets as well as the value of rented assets (such as land). Each third had the same number of farms, but the same unique farms did not comprise the same third each year. However, because a farm does not typically change its size dramatically from year to year, each size category would have predominantly the same farms in one year that were in it the year before, and so on, meaning that differences in characteristics across farm size are not merely random occurrences. The "through 1999" part of this research was reported in the paper *Financial Update, Risk & Profit, and Outlook*, (Kastens and Featherstone), and presented at the 1999 Risk & Profit Conference in Manhattan, Kansas.

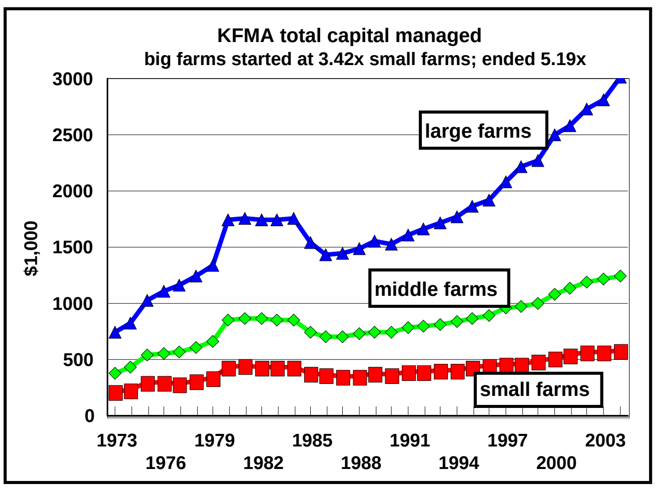

Figure 4

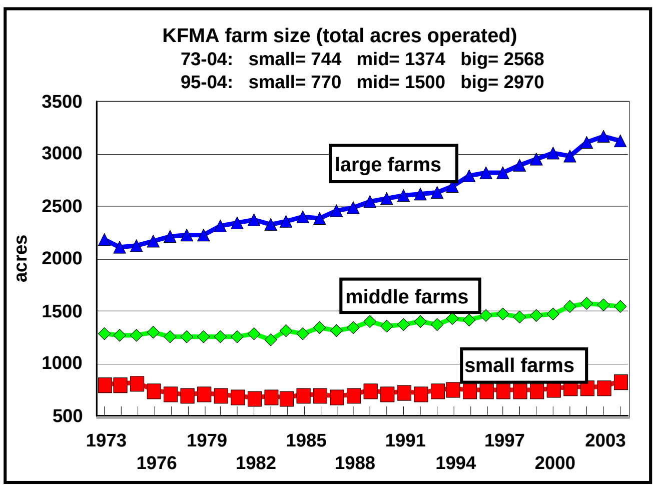

Figure 5

Figure 4 shows the total capital managed, on average, across the three farm size groups. Though the groups were sorted on capital managed, figure 5 shows the total acres operated by the different size groups. Similarly, figure 6 shows another size measure, gross farm income, for the different size groups. In all three figures it is immediately apparent that, over time, the larger farms are growing faster than the mid-sized farms which are growing faster than the small farms. Those differences are especially apparent for the large farms compared to the mid-sized farms. Once again, this suggests size issues probably are becoming more important over time rather than less important.

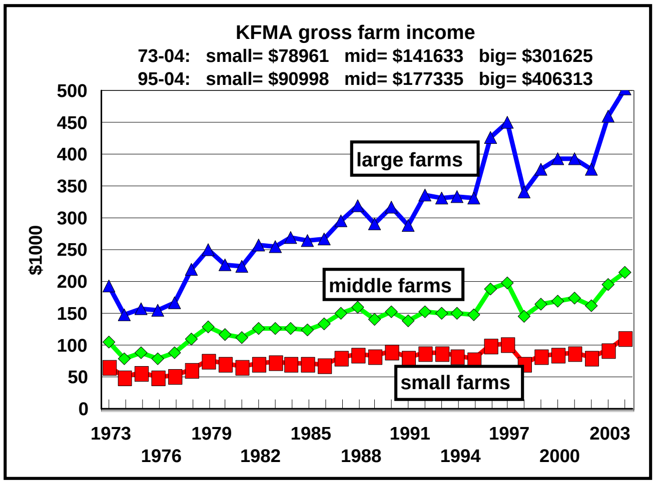

Figure 6

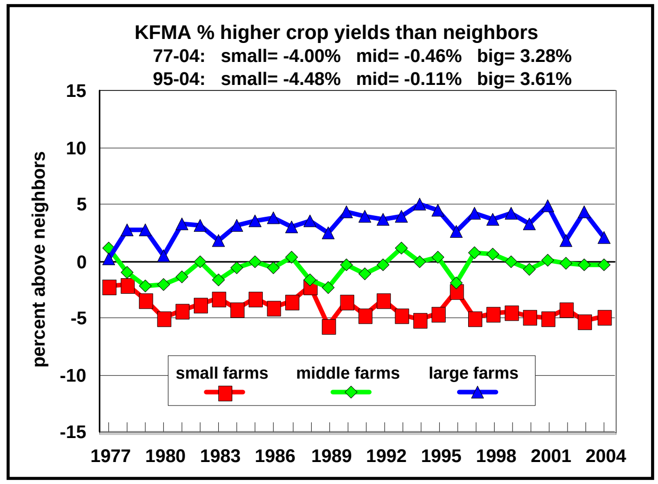

Figure 7

Figure 7 depicts crop yields as a percent of county average crop yields. Relative to smaller farms, the large farms acquire higher crop yields and there is a slight tendency for the disparity between the different farm sizes to have widened over time. Figure 8 shows farm crop costs as a percent of regional average crop costs. In this figure, the disparity across groups is most important when comparing small to mid-sized farms, with the small farms having much higher costs. Once again, the disparity between the three groups appears to have grown over time.

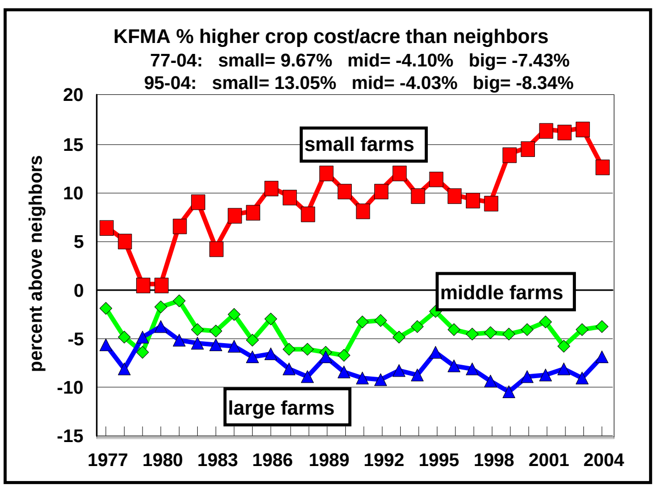

Figure 8

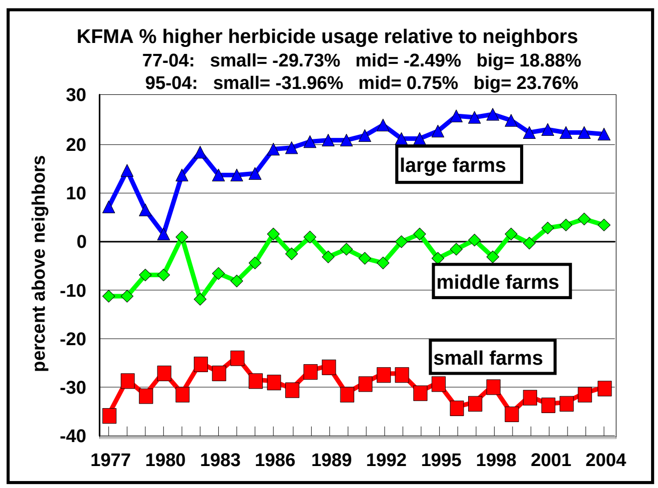

Figure 9

Figure 9 considers the management trait of technology adoption. In this case, the technology considered is less tillage and the measure is relative herbicide expense. In studies of several years ago we had measured this technology by a "years ahead of neighbors," and the result was always the same: larger farms are much faster adopters of this technology. Now, with the current measure it is interesting to note that, while large farms continue to spend more on herbicides, the large farms line has flattened out in recent years. We are not sure why this is but one possibility is that larger farms get better prices on herbicides and may continue to use ever more herbicides over time but that our dollar measure does not capture that. Figure 10 may provide a more revealing measure of technology adoption across farm size, in particular the technology of increased planting intensity (e.g., less fallow ground in western Kansas and more double-cropped soybeans in eastern Kansas). This figure clearly shows a growing disparity between large and small farms in terms of this technology, especially in the last 15 years. In general, we believe that larger farms adopt new profit-increasing technologies faster than smaller farms, which is often related to the fact that they can spread fixed costs associated with adopting a new technology over more acres.

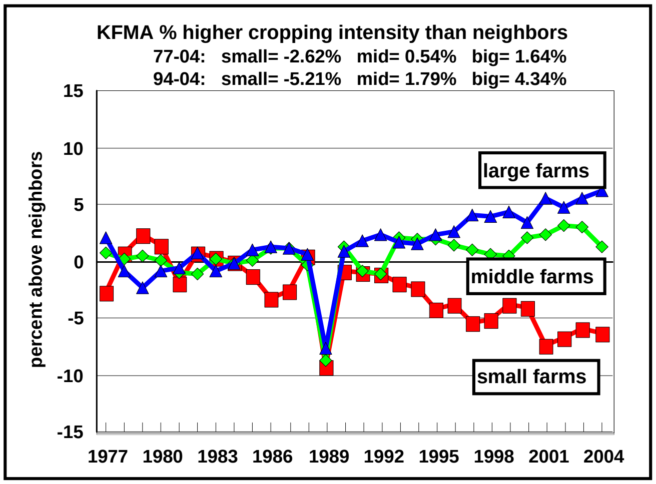

Figure 10

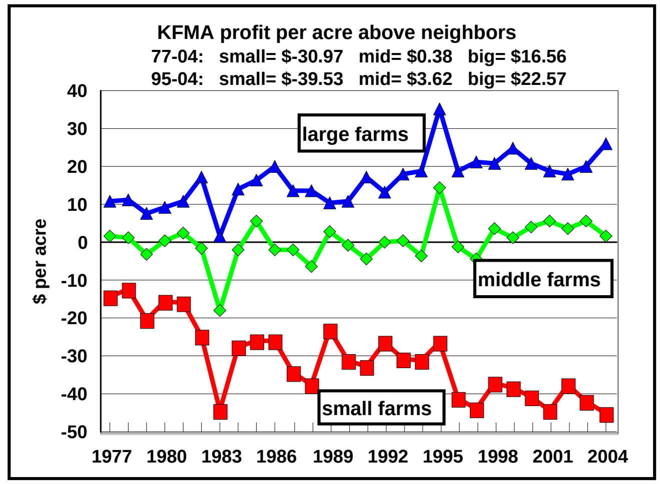

Figure 11

Finally, figure 11 shows the per acre relative profit for the three farm size groups across time. Clearly, the larger farms have tended to be more profitable over time, which suggests getting higher yields, having lower costs, and being a faster adopter of technology, along with being larger, has contributed positively to farm profitability. Like the other related figures, figure 11 shows that differences in profit across farm size have exacerbated over time, once again suggesting that issues of farm size are becoming more important each year.

Although all management traits we examined in our various research projects have not been depicted in the figures shown, our work leads us to conclude the following, at least on average. Relative to smaller farms, larger farms 1) have sharply lower costs, 2) get somewhat higher yields, 3) get slightly higher prices, 4) produce crops more intensively (e.g., more double-crop soybeans in eastern Kansas, less fallow ground in western Kansas), 5) are much faster adopters of new technologies, and 6) are substantially more profitable.

Another disclaimer for EOS

Around figure 2 it was noted that many small farms have machinery investment that is lower than many large farms. Figure 12 continues with the idea that “you do not have to be large to be profitable.” It shows the same three lines as figure 11, but the graph’s scale has been changed to allow accommodation of +/! one standard deviation lines. Statistically, the range bounded by +1 standard deviation and !1 standard deviation should capture approximately 2/3 of the observations. Here, for a given farm size class, the bounding lines have the same marker as the underlying average line, but no connecting lines. Thus, for example, the average profit for the large farms across time is shown as triangles with connecting lines. The +1 standard deviation bounds are shown with triangles but not connecting lines, and so on. Statistically, it can be said that we are 67% confident that a random large farm will fall between the upper group of triangles and the lower group of triangles. The point to this figure is that the bounding ranges all overlap each other substantially, which means that many large farms are unprofitable and many small farms are profitable.

The disclaimer offered through figure 12 is to ensure that farms do not excuse their unprofitability by saying they are too small to be profitable. Likewise, figure 12 should make it clear that being a large farm does not imply a right to profitability. Put another way, just because a person inherits a large farm does not mean it will be run profitably. Of course, such a poor managing heir might "eat up his or her equity" for decades, giving the illusion of success. In that case, that poor managing heir would be better off selling the farm's assets and investing the equity elsewhere, or simply renting it (at least the land part of the assets) to a farmer with better management capabilities.

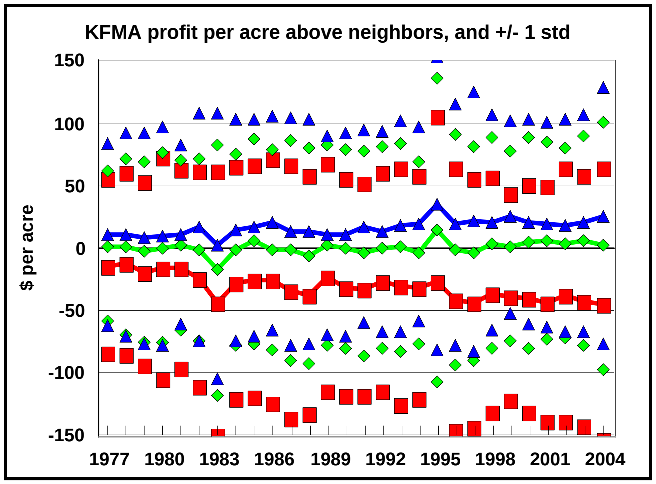

Figure 12

What about growth? A 1992-2001 study

Up to now, much has been said about farm size and little about growth in farm size. In particular, how important is it that a large farm continues to grow? Similarly, is it better to be an average-sized farm that is growing faster than normal or a large farm that is not growing at all? The problem is complicated by the fact that, even on average, farm size is not static. That means that even to remain an average profit farm requires some growth. Put another way, large farms that are not growing become average farms and then small farms over time. Similarly, small farms that are growing faster than normal become mid-sized farms and then large farms over time. Hence, the problem becomes a dynamic one, with time being the dynamic.

To quantitatively measure the various impacts of growth, a few years ago we re-visited the Kansas management factors study behind numbers like those shown in figure 3, only the study at that time used data from 1992-2001. In particular, that re-examination added a component of growth. We considered two measures of growth, paralleling two farm size measures: 1) the number of main crop acres (owned or rented), where main crops are considered to be wheat, corn, milo, soybeans, and alfalfa, and 2) the number of dollars of total capital managed. For a given farm, we calculated the 10-year (9 growth periods) constant percentage change in size needed to get a farm from its observed size in 1992 to its observed size in 2001, which is the geometric mean of growth. Of course, some farms had negative growth over the study period and others positive growth. The average annual growth rate (across the approximately 1,000 farms' individual growth rates) on main crop acres was 1.30%. The comparable growth on dollars of capital managed was 4.05%. Due partly to inflation, it should not be surprising that capital managed growth should outpace a measure of physical farm size such as main crop acres. Henceforth, because it is probably a more intuitive measure, we considered growth to be that measured on main crop acres.

It should be noted that our data were subject to what is referred to as survival bias. That is, to be included in our study, a farm had to be present in the data base all 10 years of the study. A small number of farms likely exit the KFMA program because of low profitability (going broke). Although we do not know for sure, these farms probably have reduced or negative growth rates as they liquidate assets in an attempt to ward off impending financial disaster. Hence, our data might have missed some farms that had especially low growth rates, suggesting that our reported average growth rate could be slightly biased upwards. On the other hand, a number of farms likely exit the KFMA program because they outgrow it, meaning that the traditional "family farm" type of record-keeping and analysis services offered by the KFMA no longer meet the business needs of farms that have become especially large. We believe this because in some parts of Kansas the KFMA program contains few if any of the extremely large farms we know to exist in those areas. Depending on the frequency and magnitude of these situations, it could be that the average growth rates reported are actually biased downwards.

In our growth study, rather than simply considering profit to be a function of a number of variables (like figure 3) where growth is just another variable, we considered instead that profit arises in a two-stage process. First, we said profit is directly a function of cost, yield, price, government payments, and risk. The conceptual profit model is:

[Eq. 1] profit = *f* (cost, yield, price, government payments, risk),

where each of the variables are considered to be relative measures (profit, cost, government payments, and risk are relative to their respective KFMA regional averages; yield and price are relative to county averages). Then, we considered each of the Eq. 1 right-hand-side variables, in turn, to be a function of the more directly managed variables: speed of technology adoption (i.e., less tillage), farm size, planting intensity, percent of acres that are rented rather than owned, and growth. As an example, Eq. 2 depicts the conceptual model for cost (similar expressions were used for yield, price, government payments, and risk):

[Eq. 2] cost = *f* (speed of less-tillage adoption, farm size, planting intensity, percent of acres rented, growth),

where each of the variables are again considered to be relative measures. Although not shown, the numerical rendition (empirical model) for each of the equations in the analytical framework were estimated using actual data from the approximately 1000 Kansas farms with 10 years of information for each farm, along with ordinary least squares statistical regression.

As just one example, the numerical analysis framework just set forth allowed us to consider how growth impacts cost which impacts profit, and so on. More importantly, we considered model-predicted changes over time. That is, growth in one year impacts farm size the next year. Finally, our models allowed a direct change in cost and yield to be considered. That is, not only do technology adoption, farm size, planting intensity, percent of rented acres, and growth impact cost, but other things (e.g., better machinery management), which have not been explicitly included in the model might also impact cost. We consider these by simply inserting a direct change in cost, not only the change in cost calculated by the model based on changing variables like technology adoption, etc.

One simple question that can be answered in our analysis is, Has growth been higher or lower for larger farms than for smaller farms? The answer is larger farms have faster growth. For the largest third of the farms (sorted on crop acres), the average growth rate was 2.82% annually over the 1992-2001 period. The comparable rate for the mid-sized third was 1.57% and for small farms it was -0.49%. A second simple question that might be interesting is, Do more profitable farms have higher growth rates than less profitable farms? The answer, not surprisingly, is that more profitable farms have faster growth. In particular, the most profitable third of the farms had a growth rate of 2.75%, followed by 2.06% and -0.90% for mid-profit and low-profit farms, respectively.

To better understand the dynamics of farm size and growth, we used our models to simulate situations of interest. Figure 13 simulates a typical farm, only with 0 growth, comparing it to the average farm (recall that the average farm had 1.30% growth). The second title line in the figure indicates that, for the simulated farm, no outside adjustments to cost or yields have been made, the farm is neither ahead nor behind the average farm in regards to technology adoption (tech 0yr), planting intensity is 77% (percentage that planted crop acres is of total crop land acres), which equals that of the average farm, and the farm rents 62% of its crop land, which also equals that of the average farm. Thus, the simulated farm is everywhere average except in terms of growth. In the figure, "Years in future" represents end-of-year time points, as in December 31. Thus, the year-0 farm size shown in the figure represents the farm size at the start (January 1) of the first year (year 1) in the profit analysis.

Relative to the average farm that is growing at 1.3% annually, the simulated farm in figure 13 loses more and more profit over time. Although not shown graphically, that loss of profit over time is principally because farm size and farm growth are associated with higher crop yields and lower costs. Since the simulated farm "becomes smaller and smaller" over time relative to farms that are growing, its relative yields fall and its relative costs go up over time. The underlying word story can be made quite complex, but part of the story is simply that a farm that fails to grow finds itself unable to adopt and benefit from the myriad cost-reducing (thus profit-enhancing) technologies routinely available to farm managers.

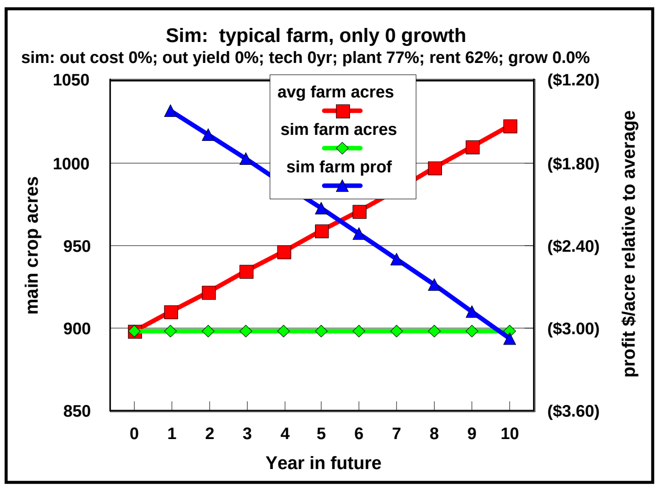

Figure 13

Figure 14 shows the results of simulating a "good big farm," which we are assuming to be one that is one standard deviation higher than the average farm for size, yield, less tillage adoption, planting intensity, percent of acres rented, and growth, whereas it is one standard deviation lower than average for cost. To devise a farm that fits these criteria we had to insert an "outside" cost reduction of 9% and an "outside" yield increase of 8%. These insertions, along with the cost and yield changes induced by the management factors of less tillage adoption, planting intensity, percent rented, farm size, and growth, would bring the total cost reduction and total yield increase for the simulated farm up to the one standard deviation mark. Intuitively, recall that such "outside" measures are to accommodate those management characteristics we know to be there but for which we lack the explicit data needed for accurate quantitative measurement. Hence, the simulated farm is one that starts at around 1550 acres of main crop acres rather than the 900-acre starting point for the average farm. It has an annual growth rate of 7.6% rather than the 1.3% growth for the average farm. It is 42 years ahead of the average farm for our measure of less-tillage adoption. It has a planting intensity of 94% (average farm is around 77%), and a renting percentage of 89% (average farm is 62%). The profit implications for the simulated good big farm from figure 13 are large. The farm finishes year 1 with a profit that is $44/acre above the average farm, and due to the impact of rapid growth, ends up 9 years later at a profit that is around $64/acre above the average farm.

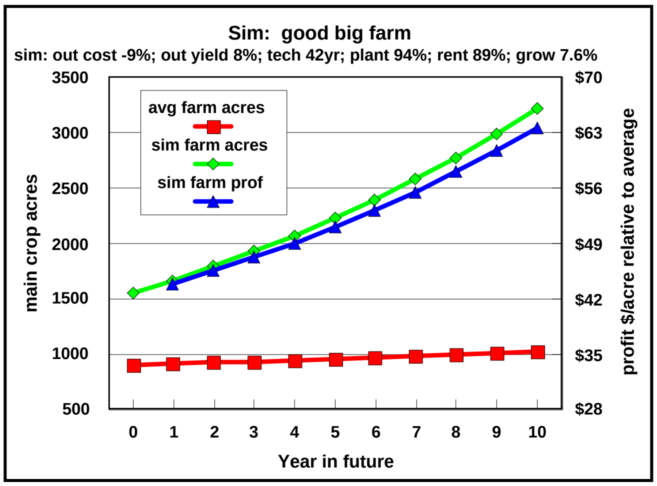

Figure 14

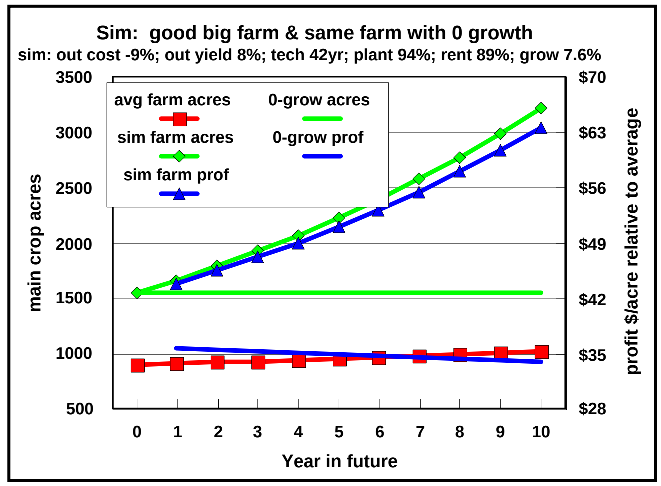

Figure 15

Figure 15 is identical to figure 14 except that it adds two lines without markers to represent the same good big farm, only with 0 growth. With 0 growth, this good big farm finishes year 1 with around $36/acre profit and ends up 9 years later at under $34/acre profit. In this simulation, the difference between $64 and $34 per acre is the contribution of large growth (i.e., growth that is one standard deviation above average growth, or equivalent to the typical farm in the “fastest growing third” of farms).

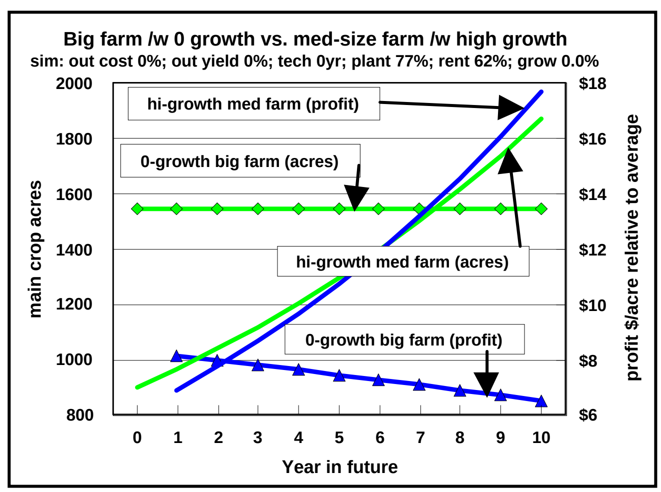

Figure 16

One question that should be of interest is whether it is better to be a big farm that does not grow or an average-sized farm with high growth. Figure 16 helps answer that by comparing a 0-growth big (1550 main crop acres) farm with an average-sized farm that has high growth, where high growth is considered to be the +1 standard deviation amount, which comes out to a 7.6% annual growth rate. In the underlying simulation, other measures of interest are considered to be average for both farms. The figure shows that the 0-growth big farm finishes year 1 with a small advantage to the hi-growth average-sized farm ($8.17/acre for the big and $6.91/acre for the average-sized farm). Note that both farms have year 1 profit above 0, indicating that they are both better than an average farm with average growth – at least starting out. One gets the benefit through size and one gets the benefit through growth. On the other hand, that small comparative advantage for the 0-growth big farm quickly turns to a comparative disadvantage over time as the average-sized farm grows at a fast rate and eventually overtakes the 0-growth farm in size. At the end of year 10, the 0-growth big farm's profit had dropped to $6.52/acre whereas the hi-growth farm that had started smaller ended up with a profit of $17.70/acre. From this it is clear that the impact of growth on profitability should be considered in a farm's plan for the future.

Is there EOS even for really large farms, or does EOS turn to dis-economies of size?

From previous research, figure 17 shows real (i.e., inflation-adjusted) machinery costs for Kansas wheat farms from 1986-1995 as an indication of EOS. The smooth line in the graph is a statistical generalization of the data. But, focusing on the data points themselves, rather than on the smooth-line statistical generalization (which, by construct, was not allowed to increase with farm size), it does not appear that there is a tendency for per acre machinery costs to rise at some sufficiently large farm size – they tend to keep getting lower with increased farm size.

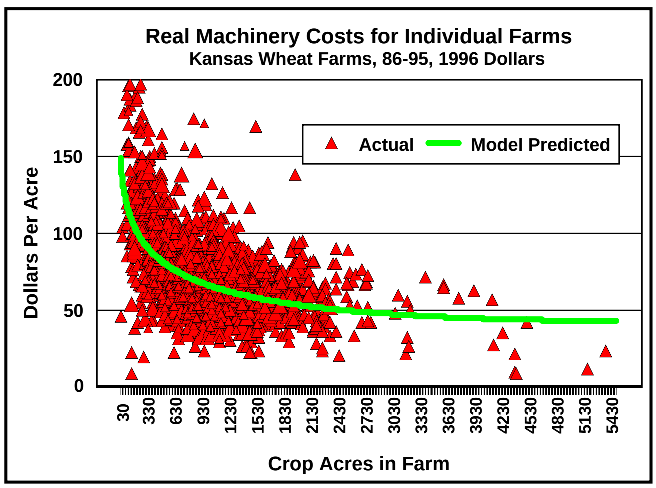

Figure 17

Statistically, since we do not get to observe many very large farms, it is difficult to definitively answer the question set forth. There simply are too few observations to make statistically strong statements about EOS at especially large farm size. For example, in this research conducted in 1996 we did not get the chance to observe Kansas wheat farms over 10,000 acres. As always, such issues could be confounded by survival bias. That is, farms that tried to get especially large without sufficient management skills probably went broke and are no longer among the observed data. Nonetheless, it would seem that a few observations (each triangle represents one farm one year), in figure 16 would show high cost coupled with large size if dis-economies of size actually prevailed at large farm size. All in all, it is probably safe to say that, if dis-economies in farming do exist, they probably occur at larger farm sizes than commonly believed.

One important potential dis-economy of size associated with farming is government program payment limitations. Depending on how a farm is structured, and on how much a farm's ownership and management is willing to share ownership and management with others, at some farm size, payment limitations can become true impediments to a farm becoming ever larger. Other potential impediments to growth are social features that end up having economic consequences. Poor family conduct, or squabbles among business owners, arising from size can lead to divorce and business breakups. On the other hand, it is not known whether such possibilities are more or less likely for larger farms compared to small farms. The point is that with larger size there is more to lose and hence more thought should be given to such social features of EOS.

What about niche farming? Do we really need to get on the EOS bandwagon?

It is often believed that niche farming is a way to circumvent or neutralize the forces of EOS. Certainly, there are opportunities to profit from niche farming rather than pursuing EOS in traditional farming. But, such opportunities likely are not especially prevalent, meaning that the risk associated with pursuing a perceived niche for a particular farm might be unacceptable. More importantly, for most niche operators, ignoring EOS is probably wrong if profit is the underlying motive. That is, EOS likely exists among niche farming businesses as well – since most niches become commodities over time.

As one example of EOS in a niche business, consider organic farming. Except in the case of a small segment of farmers and consumers who value the time spent in farmers' markets, it is unlikely that today's rise in demand of organic crops will ignore EOS. For example, Farm Journal (mid-Feb. 2000) reported that Andy Grant, a 1500 acre organic producer in Colorado does not think he is "big enough" to ensure success. Or, as in the words of Newsweek (Sep. 30, 2002) touting the merits of a 6000 acre California organic farm, "...[organic] sales are expected to top $11 billion this year. Could dusty neighborhood co-ops sell that many wormy little apples? Well, no. That was the old organic. The new organic is all about bigger farms, heartier crops, better distribution and slicker packaging and promotion. Conglomerates as big as Heinz and General Mills are now launching or buying organic lines – and selling them in mainstream supermarkets." Clearly, successful organic farms (traditionally believed to be a niche market) of the future would be wise to consider EOS.

EOS for niche markets or farming businesses may not always be manifested in farm size as measured by merely acres. Consider pharmaceutical crops ("farmaceuticals," or "pharming," or "biopharming"), which involves "growing" health-related drugs by using high-tech genetic engineering of traditional crops such as corn. Lengthy communications in 2001 with Lon Crosby, who heads a technology consulting company in Iowa, revealed that, ultimately, pharmaceuticals will probably be safely produced only in a highly controlled environment. For example, an irrigated field of pharmaceutical corn would probably be 1) contained in a high chain link fence, 2) encircled with 24-hour video surveillance cameras, 3) miles from other non-pharmaceutical corn fields, and 4) harvested with a stainless steel combine with extensive air filtration devices (for the operator's safety). Moreover, the storage, handling, and transport of the corn to the processing facility would be fraught with additional expensive safety requirements. A *Farm Futures* January 2005 article confirmed the stringent requirements, noting that "One planter and combine are dedicated solely for use on the pharmacrop plots. Afterwards they are cleaned and locked in a steel storage building. Combine clean-out is a two-day ordeal..." Moreover, that same article indicated that only 44 acres of biopharming crops were raised in the U.S. in 2003.

In the biopharming scenario just discussed, the purchase cost or rent of the land would be a very small part of the total business investment, and given the numerous constraints, it is highly likely that a pharmaceutical producing company would own and operate the required corn producing land itself. For this niche, the EOS comes from the total equity or investment required per acre of land. That is, only a large company would be willing to take the risk and make the necessary business investment. Finally, even if it were feasible for traditional farmers to enter this niche through something more than being an employee, the total numbers of farmers aided by this niche likely would be quite small. That means, as in the case of an organic farming niche, that the risk for a single producer pursuing this niche probably would be unacceptable.

How do the features of EOS change across farm size?

As noted earlier, EOS is principally due to spreading fixed cost over more units of production. Starting from a small farm, as a farm grows it first takes advantage of spreading the fixed cost associated with labor. Essentially, the farm operator becomes more fully or more efficiently employed. Secondly, as a farm grows it begins to take advantage of larger machines in its lineup of machinery. Larger machines are less expensive to purchase on a per unit of capacity basis than are smaller machines. For example, the purchase price of larger tractors is less per horsepower than it is for smaller tractors. Figure 18 builds on the research behind figure 17 by showing machinery costs with and without labor. The per acre labor cost is the difference between the two lines in the figure. It is easy to see from the figure that the per acre cost of labor falls dramatically as a farm grows from 100 to 1000 acres. But, beyond some size, say 2000 acres, the per unit labor cost is nearly constant, indicating that EOS associated with labor has essentially run its course. Nonetheless, total cost per acre continues to fall at larger farm size.

Although figure 18 does not expressly show it, there is a practical limit to the size of tractors and other machines (at least for now). Similarly, due to the cost associated with timeliness of operation (typically, weather risk), there is a practical limit to the number of hours a machine can be operated during a season. In short, at some size, a farm has to add to the number of machines as it grows, just as it has to add to the number of laborers as it grows. Thus, at some point, the EOS associated with machine size probably runs its course just as does the EOS of labor.

Although we do little to quantify them in this paper, there likely are a number of other EOS features besides those associated with machine size and labor. First, it is likely that the fixed cost of management can be spread over many more acres, even after exhausting machine size and labor EOS. For example, it seems reasonable to assume that the time spent in crop marketing, hybrid and variety selection, or in ensuring compliance with government farm programs at the local Farm Service Agency, can easily be spread over many acres. Second, quantity price discounts on crop inputs or farm machinery probably continue to mount, even for ever larger farms.

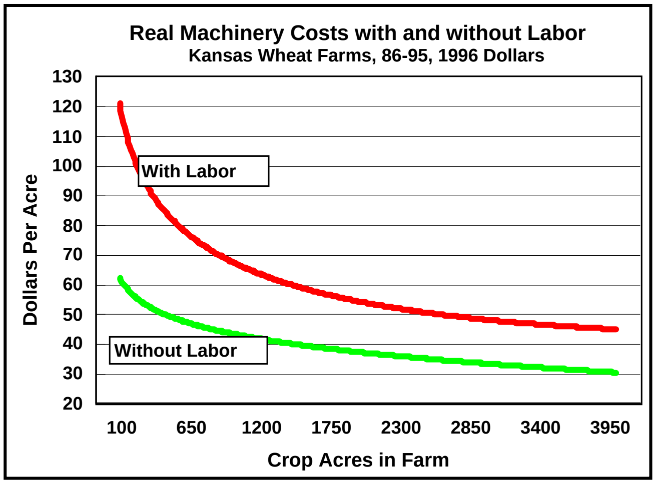

Figure 18

One especially important quantity discount has to do with borrowing money. Consider figure 19, which shows substantially lower costs associated with loans over $100,000 as compared with loans in the $10,000 to $100,000 range. This size benefit alone could easily amount to $1 to $2/acre annually.

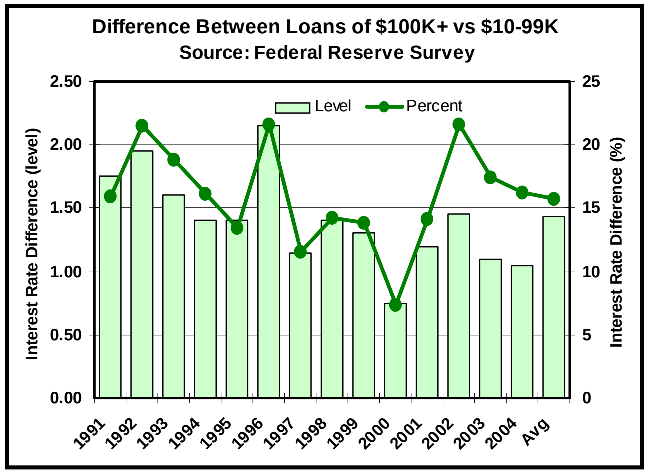

Figure 19

A third EOS benefit category might be that large crop sales often garner higher prices. A fourth important potential EOS benefit arises from the fact that, as farm level crop production decisions depend more and more on inferences arising from farm data, large farms will have an edge over smaller farms. In particular, a larger geographical spread means it takes less years of on farm research before reliable inferences for the future can be made. Closely related, the larger geographical spread often means reduced yield risk for larger farms compared to small farms, which provides yet another distinct advantage.

Besides each of the more direct EOS measures noted, one that is less direct is business image. Larger farms tend to be faster adopters of new technologies and heavier users of newer, more technologically advanced machinery. The image of success that these things exude is something revered by many landlords since they want their tenants to be successful. That, coupled with a typically larger geographical spread of their farms, means that larger farms often have more opportunity to become larger yet. Of course, some will argue the opposite – that some landlords prefer to help “smaller” farms by giving preference to them over larger farms in tenant relationships. While true, our experience suggests that such landlords are fewer in number and have smaller land holdings than landlords who have a preference for “larger” tenants. All in all, given that larger farms tend to be more profitable, it should not be surprising that landlords have a preference for tenants who operate large farms.

Regarding landlords’ apparent preference for larger farms it should be noted as a caveat that it may not explicitly be farm size that is targeted by landlords but rather other things that often are correlated with size. For example, landlords probably like to help out younger farmers, especially if they are part of a multi-generation setting that displays longevity, profitability, technological advancement, and community viability. But, such are precisely the traits of profitable commercial farms.

IMPLICATIONS

Large equity requirements

Farmers routinely echo the words “it takes so much to get started farming these days” (see again figure 4). Though trite, these words reflect the fact that the equity requirements for a successful farm are especially large and growing ever larger. In the data underlying figures 3-11 in this paper, at the end of 2004, the average Kansas farm enrolled in the Kansas Farm Management Association program had a net worth of $653,059, a debt-to-assets ratio of 0.35, and managed $1,729,888 worth of capital.

Now, consider a non-farming couple who wants to "save up to farm." Assume that the couple's annual wages are $60,000, and that the wages grow at 1.5% annually in real terms due to an increase in real productivity over time and 2.5% annually due to inflation (observed growth of around 4%). Assume further that the couple is able to set aside a rather large portion, say 30%, of its pre-income tax wages each year into a savings account that pays 4% annually (fairly high paying savings account given the assumption of 2.5% inflation), and that the couple pays a 20% combined state and federal income tax rate. With these assumptions, it would take the couple 20 years to save up the $653,059 equity required to enter farming with an average-sized farm.

Unfortunately, saving money for an average farm is not as easy as the example just described – because the "average" farm is a moving target. In the 1992-01 study discussed earlier in this paper we reported an average real growth (i.e., growth in main crop acres) of 1.3%, noting at the same time that this average growth itself has probably been increasing over time. To accommodate that, let us assume a 1.5% real growth coupled with the same 2.5% inflation rate assumed for the wage earning couple. Now, it will take our example couple 45 years to save enough to enter farming with an average farm. Even if the couple is astute enough and can take on the risk associated with investing directly in farm land as a landlord, earning say 9% (6% rent and 3% capital gains) rather than the 4% assumed for a savings account, it would still take the couple 26 years to save enough to enter farming with an average farm.

The foregoing is not to say that saving one's way into the farming business cannot be done. It can be. The point is just that it is not easy. Moreover, by the time 25 to 40 years of one's wage earning life is over, it is often difficult to muster the will to keep the farm expanding from that point further – as we know from earlier in this paper, it needs to do just that to ensure future success. The problem of saving one's way into farming is complicated further by the fact that the saving couple often believes there is substantial gain to "farming the land themselves" while still holding full time jobs during the equity growth stage. In fact, given the EOS already noted, that saving couple likely would be better off renting the land it buys along the way to someone else. But, that often negates a large part of what is desired from the process, namely the pleasure associated with farming. And, hence the dilemma.

Given the difficulty associated with saving one's way into farming, it is probably true that tomorrow's successful farms will be either those that started with a substantial inheritance (vertical accumulation of equity across time) and which leave a large inheritance, or those able to pull together equity from other people contemporaneously (horizontal accumulation). But, accumulating wealth across generations is difficult because heirs and forebears often have diverging goals. Further, as with many small businesses, minority shareholders in farming families often do not believe their rights and goals are adequately protected, which hinders horizontal equity accumulation. Also, that problem does not go away when dealing with non-family farming partners. Regardless, because of farming's increased demand on equity, the most successful farms of the future likely will be those that overcome the hurdles of equity accumulation, both vertical and horizontal. Thus, learning those skills should be a goal of future farm managers.

Large debt requirements

The previous section discussed large and growing equity requirements for future farms. To provide a more complete picture, the requirements are not specifically equity-related, but rather capital (money) related. For all businesses, capital is in the form of *either* equity or debt, or what is more typical, both. Large business firms routinely issue shares of stock to acquire investors' equity, while simultaneously issuing bonds or engaging in borrowing to secure the capital of creditors.

Assuming that a firm is profitable to begin with, debt has the effect of leveraging investment returns, that is, causing them to be higher than they would be without debt. As such, debt often is the least cost way of securing the capital required of a firm expansion, an expansion that typically is staged to capture expected EOS. For farms, debt is often an important source of the capital needed to ensure growth. More practically, given the traditional impediments to securing outside equity for farms, debt can be viewed as nearly essential. Put another way, given that a farm's equity source is usually internal (i.e., from a farm's re-investment of its profits) rather than from outside, those farms choosing not to use debt have been at a disadvantage to those willing to use debt. In short, farms that are willing to use debt are able to grow faster than those that do not, providing stiff economic competition in the pursuit of the gains arising from EOS.

Traditionally, farm management and farm financial consultants and educators have recommended that an important goal of the farming business should be to pay down debt. Even today, such recommendations abound. For example, in an article about "taking charge of your farm's financial future" in a recent issue of the <u>Kansas Farmer</u> (February 2003), a university extension educator recommended that "The goal is to achieve better equity position." (p.29) Likely, such recommendations are a vestige of traditional thinking where a farm was considered to have a life cycle that matched its owner's life cycle. That is, observing a high debt-to-assets ratio late in a farm owner's life meant that the farm was not successful. Implicit in such recommendations for financial success is the assumption of a farm with static farm size – an assumption that clearly should be questioned in today's world of large and growing-ever-larger farms.

Successful farms of the future will consider a goal associated with debt that largely departs from the traditional life-cycle one noted. For such farms, the focus will turn from "paying down debt" to selecting a debt-to-assets ratio that the farm can live with, one that helps the farm meet its intertwined goals relating to growth, profitability, and risk, that is, a debt philosophy similar to that of agri-businesses and other industries. In that framework, each dollar of additional equity (internal or outside) acquired over time can mean more debt. Then, the additional equity *and* debt together can be used to fuel the growth needed to ensure profitability. Of course, it goes without saying that generally unprofitable farms, where return on assets is lower than the interest rate on debt, will only accelerate their demise with debt. Clearly, such farms should focus first on improving their management, then on growth.

New labor requirements

Over the decades, many agricultural technologies have been labor reducing (e.g., larger tractors). That means one operator has been able to farm more and more acres over the years, taking advantage of any other, non-labor, economies of size without increasing labor. But, it also means that farmers have not generally gained experience in incorporating employees into their operations. Such discreet barriers (e.g., the reluctance to hire that first employee) lead to a vicious circle of giving preference to labor-saving technologies. Thus, for many farms, it is the labor-saving aspect of no-till farming that makes it appealing, rather than the higher yields or lower crop input costs. That is, farms move towards less tillage so that they can spread their “fixed” labor costs over more acres (by expanding their farms), thus reducing the labor cost per acre, and thereby allowing them to capture other non-labor economies along the way.

As noted earlier around figure 18, despite continued effort to adopt labor saving technologies, the EOS associated with labor probably plays out at a farm size substantially smaller than the size required of future successful farms. Additionally, some new potentially profitable technologies, for example many of those related to precision agriculture, are not labor reducing – at least early on. Taken together, this means that successful farm managers of the future will be those who learn new skills associated with labor, those who are not averse to labor management. Such skills will involve considering labor to be an investment in human capital rather than as a crop input investment akin to fertilizer or seed. Successful future farm managers will recognize that the farming business needs different people with different skills, and that inherent skills can be further developed with education. They will recognize that a future son, daughter, relative, or non-relative does not necessarily have to become the overall manager, but that he or she might fit the business in one of many possible capacities. After all, just because a family individual may not be “management material,” an astute manager should not overlook many of the other valuable traits routinely held by a family member, such as having a predictable personality, or having a firm commitment to the success of the family business. This will be a sharp departure from the traditional “grooming a son to take over the business,” or from the traditional “I’m going to rent my son some land so he can get started.” Nonetheless, we believe such a departure will be required of the successful farm manager of the future.

A small farm often struggles to keep the inherited family farm in the family – as it borrows against it to afford a living. The problem is made worse by virtue of the fact that the farm was inherited. Thus, a number of years probably pass before the manager realizes the farm is heading for financial difficulties, years that make retraining for a new career less likely, especially where off-farm job opportunities are limited. But, astute farm managers focused on growth will see in such situations an opportunity to both grow the farm and acquire the necessary labor simultaneously. For example, the small farmer can be employed by the growing farmer in exchange for renting his land to the growing farmer. Suddenly, becoming a landlord is a way for the struggling farmer to both “save face” in the community and save the family farm. Also, little new training is required and the small farmer probably does not even have to change the place of residence. The ensuing loss of independence for the small farmer is often viewed as a small price to pay for the gains acquired, especially since that farmer now has to make fewer of the heart-wrenching economic decisions it likely found unsavory anyway, and especially since that farmer probably gets to operate nicer machinery than before. Additionally, such landlord/employees can become important brand riders, ambassadors, and spokespersons for the hiring farm – features that the hiring farm considers most favorable. Importantly, it probably does not particularly matter whether the farmer-turned-to-landlord/employee actually remains an agricultural employee over time – he or she might find another career of interest. As long as fair treatment was the norm during employment, there is little reason to think that such career changers will become negative ambassadors for the former employer. The important thing is that the whole arrangement likely provided an important transitional step for all parties involved – the small farmer exiting farming and the large farmer honing future employment skills while growing the farm.

Can EOS be captured without growing the farm?

The forces associated with EOS have become increasingly prevalent in the last few years. Consequently, agricultural magazines routinely offer stories about farms that are "working together" in some capacity or other to capture the EOS associated with farming. For example, in 1998, Farm Industry News provided an entire special issue around the topic, entitled "The Power of Partnerships." More recently, Top Producer (February 2003), discussing a North Dakota partnership between four farms that brought the combined acreage to 10,000 acres, offered the following quote by one of the partners. "We managed to cut costs by 22% immediately with volume buying and other efficiencies reserved for 5000-acre and larger growers." So too, seed dealers today routinely are aiding farms that wish to purchase seed together to capture volume discounts.

Formal businesses, such as MachineryLink (a lessor of combines and other machinery), have emerged to help farmers capture EOS without large equity requirements. In particular, by renting a combine to different farms for different harvest periods during a year, MachineryLink hopes to let a farm capture the economic gains associated with modern intensively-used large equipment, without that farm having the large number of acres normally required to accomplish the same gains through farm ownership of the combine. Similarly, commercial custom harvesters are increasingly providing rental combines to individual farms for the same purpose. Such activities serve to make the increasingly more discreet and discontinuous decision of machine ownership (since individual machines have become ever larger) more continuous. Agricultural service providers are also attempting to meet the large demand of EOS activities by helping farmers overcome the labor "problem" noted earlier. For example, crop input providers such as co-ops are increasingly providing custom farming services associated with harvesting, planting, and chemical application. Additionally, the services of local custom farming businesses will probably increase over the coming years to accomplish similar EOS-capturing goals.

Despite the current increase in efforts to help farmers capture EOS without growing their farms, it is too early to judge success of such efforts. Frankly, the importance of timeliness in operation, coupled with large transaction costs associated with operating rental businesses, might mean that the nod will still go to "in house" operations. If that is true, then these activities merely will constitute a transitional blip on the way towards larger farms. Moreover, machinery rental firms and custom farming businesses probably still will give preferential rates to larger farms, meaning that there will still be benefits to growing the farm. But, that transitional blip might be an important one for farms that choose to formally work together. That is, independent farm managers probably have less trouble accepting a slow transition to becoming a "corporate employee" than by being thrust into such changes abruptly. Formal working together types of partnerships afford such transitions over time as one of the farms ultimately becomes dominant.

Regardless, even if farming activities are more economically accomplished "in house," it might still be that large farms use custom and rental services as transitional components during discreet changes on their own growing farms. For example, a rental combine might be appropriate for the second or third combine on a farm – at least until the farm gets large enough to sustain the ownership (and labor) associated with that second or third combine. The successful future farm manager will undoubtedly be an astute assessor of costs, especially those related to timeliness of operation and asset ownership, so that he or she can economically compare the many ways that farming inputs and activities can be acquired. That farm manager will also become an astute negotiator with input and service providers –

to capture as much of the EOS associated with the activity for the farm itself rather than for the provider.

CONCLUSION

By providing a mixture of objective and subjective assessment, this paper has sought to aid understanding of historical and expected trends in commercial agriculture as it relates to farm size and growth. Historical 1992-2001 data from Kansas farms have shown that average farms had grown about 1.3% annually in terms of the number of acres of traditional crops. Additionally, the dollars of capital the average farm manages had grown by 4.1% annually. But, farms in the top third of profitability (2.82% annual growth) and farms in the top third size-wise (2.75% annual growth) had each grown faster in terms of acreage than average farms. Moreover, there appears to be a strong statistical association between growth and profitability among Kansas farms. Other, more recent, studies reported in this paper confirm the importance of size and growth and that the disparity between large and small farms in numerous meaningful dimensions has been increasing over time.

Traditionally, as farms expand, they first take advantage of economies of size associated with labor (becoming more efficient labor-wise and more fully employed), followed next by economies of size associated with machine size (they operate ever larger machines), and next by volume discounts on input purchases and volume premiums on farm sales, and lastly by the benefits associated with an image of size, making it easier to grow in the future.

On average, tomorrow’s farms will have ever larger equity requirements, ever larger debt requirements, and ever larger labor requirements. This means that it will become ever more difficult to use off-farm wages to “save one’s way” to acquisition of a farming business. It means also that it will be ever more difficult to avoid becoming a manager of people or to avoid becoming a manager of other people’s money. It means that one-generation farms, where the business dies with the owner, will become more and more a thing of the past. In their place will be multi-generation farms, where those involved will embrace the idea that they are only employees of a business that started before them and will go on after them, farms that are not static but rather target growth, farms that do not confound personal goals such as being out of debt in old age with business goals such as growing debt while maintaining a suitable debt-to-assets ratio.

This is not to say that the traditional life-cycle farms (start small, build size during middle age, sell or rent land into retirement) will suddenly cease to exist. Afer all, it sometimes takes decades to consume one’s wealth, especially if an inherited wealth was large to begin with. But, it does say that targeting such a life-cycle approach to farm management will probably meet with less and less success over the years.

This paper is not to say that a farm cannot be both small and economically successful. There still is a substantial range in profitability associated with different farms in the same size class. But, it is to say that it will become ever more difficult to achieve profitability with insufficient farm size. Also, those who target a finite farm size will probably fail in the end – if not during the current operator/owner’s lifetime, then during the lifetime of the one or ones to follow. A far better goal for farms of the future is to embrace growth as a business precept. With that embrace, the pessimistic and often painful goal of survival will be replaced with the optimistic and pleasurable goal of profitability.

This paper is not about what should be so much as it is about what will be, given current and historical economic trends. In a democracy such as the U.S., "what should be" is determined at the ballot box. For example, the U.S. could choose to adopt a farm structure more like Japan's, where numerous small farms exist as virtually zoo-like reflections of a penchant for nostalgia. Or, it could become more like that of a number of European countries, where farms are more heavily subsidized and regulated than in the U.S., but less so than in Japan, where urban citizens have rights to certain recreational attributes of the farm land. But, it is important to remember that curtailing technology advancement in agriculture (and that is what it often comes down to) is most acceptable in countries where agriculture is a relatively small industry (e.g., Japan). In Japan, the higher food prices (either at the grocery store or through the necessary increased taxes) wrought by domestic agricultural policy is not particularly consequential given that most of the food comes from overseas anyway. On the other hand, the U.S. could go more in the direction of New Zealand, which has effectively abolished farm subsidies, opening the doors to a market economy free to capture any technology and economies of sizes gains that might be present. In short, due to the relative importance of the agricultural industry in the U.S., we do not think it appropriate to bet against a trend to ever larger farms discussed in this paper.

Dynamics of Change: Industry Structure and Markets

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Abstract
Farm managers are exposed to economically-driven trends or forces that impact their businesses. They routinely must assess the characteristics, persistence, and implications of those trends, to determine how their businesses should react to them. In their strategies, managers can choose to either ignore, resist, or participate in current business trends. In this paper we identify five such trends: 1) increasing consolidation, 2) rapid technological change, 3) greater connections to the non-agricultural world, 4) increased requirement of paperwork and computer work, and 5) more reliance on people with specialized skills. Understanding and embracing these trends should give farm managers an edge over those who choose to ignore or resist them. Key thoughts arising from this paper are as follows. The principal force underlying these trends is economies of size. Consolidation is here to stay, with fewer and larger farms and fewer and larger agribusinesses for those farms to deal with. Profitable farming always have been based on using the new technologies available, and using them sooner than others. Successful farm managers of the future would be wise to carefully weigh the benefits of value-added investment off-farm against the large and growing need for capital on their own farms. For growing farms, paperwork and computer only will increase as managers attempt to ferret out subtle opportunities for profit in large scale commercial production of agricultural products, in a world where government and private interactions become more complicated and offer more opportunities each year. More and more, farm managers will see a need for people with specialized skills, as farms look more like agribusinesses over time. If there is one theme that pervades this paper, it is the fact that farm managers will need to develop ever better people skills – because personal long-term relationships will become more valuable as the numbers of farms and agribusinesses decline.

BACKGROUND

As with managers in other industries, farm managers are exposed to economically-driven trends or forces that can profoundly impact their businesses. They routinely must assess the characteristics, persistence, and implications of those trends, as well as how their businesses should or will react to them. In their strategies, managers either can choose to ignore, resist, or participate in current business trends. Their choices tend to be based on a mixture of emotion, ideology, and objective assessment. Regardless, it probably is safe to say that the more persistent the trend, the more a manager should embrace it and learn how to profit from it. Certainly, assuming managers have more control over their businesses' actions than those of others, it should be easier to react to change than it is to garner the broad support needed to reverse it. More personally, it often comes down to attitude. Some view change as opportunity, a chance to increase profit and happiness, while others view change, even inevitable change, as something that must be resisted, or at best, endured to survive.

This paper discusses several underlying trends or issues believed to be greatly influencing production agriculture today. The focus is on economic forces that seem to be firmly in place, ones that probably will not disappear soon and hence must be reckoned with in the next decade or two. We identify five such trends: 1) increasing consolidation, 2) rapid technological change, 3) greater connections to the non-agricultural world, 4) increased requirement of paperwork and computer work, and 5) more reliance on people with specialized skills.

This paper builds upon a related paper by the same authors, entitled either Thinking About Farming in the Nearby Future, Especially Related to Size and Growth, or Dynamics of Change: Must I Grow My Farm? That paper, available on the www.agmanager.info website, discusses economies of size in commercial agriculture, which is an economic force that critically drives the various trends discussed in this paper. Hence, it would be beneficial to read that paper first.

1. Increasing Consolidation

Consolidation has been a long-term characteristic of production agriculture

Consolidation means that the same or an increasing amount of business is being conducted by fewer firms. Examples of consolidation abound, both historical and recent. Countless brands of automobiles existed in the 1940s, and far fewer by the 1970s. Many dry goods retailers and grocers existed even 10 years ago, but Walmart dominates today. Massive consolidation in tractor and combine manufacturing and sales has occurred over the last couple of decades, for example the Case-IH merger followed by the further merger with New Holland to become CNH Global. Adding CNH sales to those of John Deere would certainly capture the lion's share of U.S. tractor and combine sales. And the list goes on, with fewer meat packers, fewer cattle feeders, and fewer crop farmers. In fact, it is difficult to find examples of industries where consolidation has not been a strong trend over the last 10, 20, or even 100 years. At a more relevant level for farm managers, consolidation continues in machinery dealerships, grain elevators, crop and livestock input providers, just to name a few examples.

Consolidation among farms usually is noted graphically by showing average farm size and total number of farms over time, as in figure 1, corresponding to data from the U.S. Census of Agriculture for general farms in the U.S. Based on the Census data, the number of farms in the U.S. declined from 1920 through the 1990s where they stabilized and then increased slightly in 2002. This increasing number of farms in 2002 led to a lower average farm size, which marked the first time average farm size decreased from one census to another since the early 1900s. But, average farm size may not

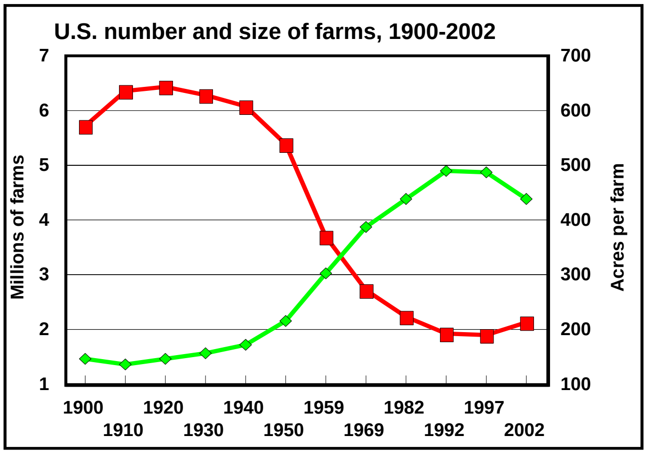


Figure 1

adequately convey the forces of consolidation, especially when the distribution of farm sizes is especially skewed. Such is the case in recent years when the definition of a farm (annual sales >$1,000) allows for an increasing number of small, lifestyle (hobby) farms. Hence, it may be better to ask the question, On what size farm does the typical acre in the U.S. fall? Put another way, If I selected a random acre, on what size farm would I expect it to fall? We might also be interested in dollars of sales, asking the question, On what size farm does the typical dollar of sales fall? Based on the authors' calculations, figure 2 shows these numbers since 1979. It is interesting to ponder the political power implied by the lines in the figure. Assuming farmers are active politically, the typical vote would come from roughly the same sized farm over the years. On the other hand, assuming political dollar-valued contributions are driven by farm sales, then the typical political contribution dollar would have been arising from much larger farms in recent years than even two decades ago.

For farms, consolidation has been an on-going process for many years, however, it has not necessarily happened at the same speed for all sectors. For example, consolidation in the broiler industry and cattle feeding industry has occurred more rapidly than the beef cow sector. As previously mentioned, consolidation among farms is demonstrated graphically by showing the number of farms and some measure of the average farm size over time. Figures 3 and 4 show this information for poultry (layers), swine, dairy, and beef cow operations for the years 1959, 1964, 1969, 1974, 1978, 1982, 1987, 1992, 1997, 2002 (U.S. Census of Ag).[1]

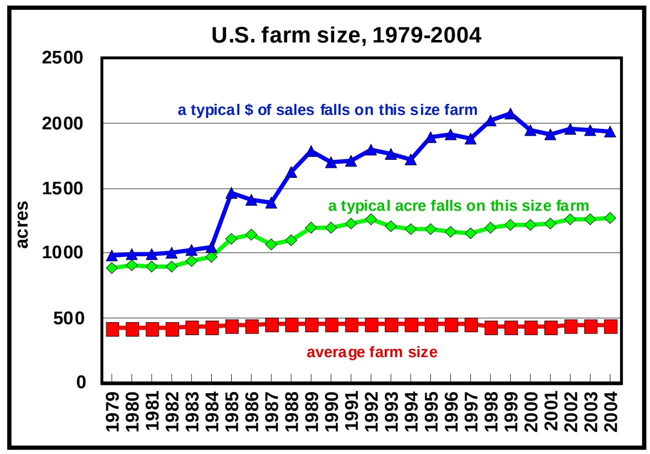


Figure 2

The annualized average growth rate for the number of poultry farms in the U.S. between 1959 and 1997 was a -8.9%. That is, the number of farms decreased an average of 8.9% per year over that 38-year time period. Consolidation also occurred quite rapidly in the swine and dairy industries, but at a slightly slower pace than the poultry industry. From 1959 to 2002, farm numbers decreased, on average, by 7.1% and 6.7% annually for the swine and dairy industries, respectively. The beef cow industry has seen considerably less consolidation, in terms of farm numbers, than the other livestock

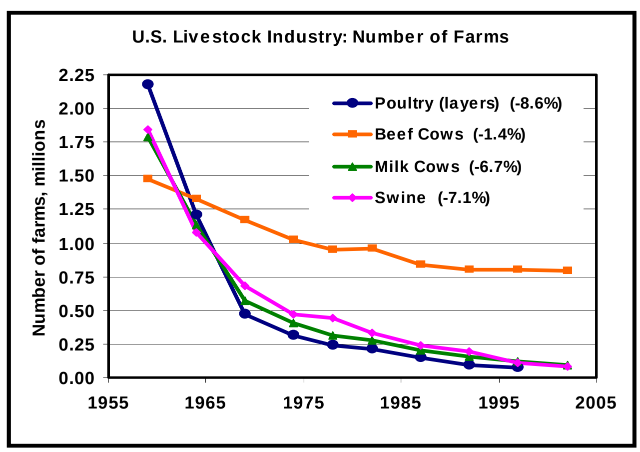


Figure 3

[1] 2002 data for poultry operations are not reported here. The authors believe that there was a change in how this information was reported in the Census and thus looking at trends with this time period makes little sense. If readers are interested in the information, they can contact the authors for the 2002 data.

industries – annual decrease in the number of farms of only 1.4% from 1959 to 2002 (the authors estimated the number of beef cow operations in 1959 as this value was not reported that year).

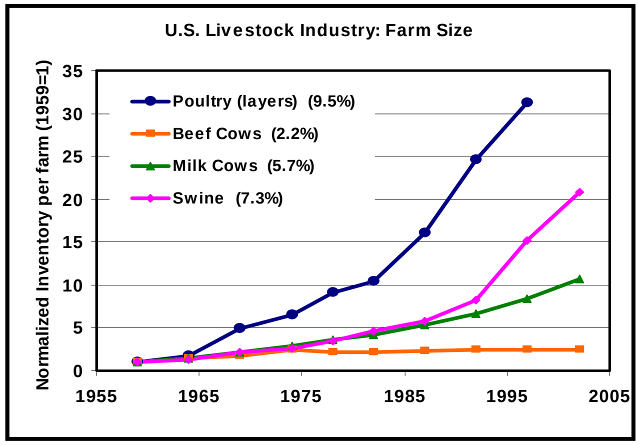


Figure 4

Figure 4 shows the average farm size for the four livestock industries displayed in figure 3. Average farm size is calculated as the total inventory in the U.S. divided by the number of farms. Because of the vastly different magnitudes of farm size, values reported in figure 4 are normalized to 1959 levels.[2] Thus, the average farm size for each industry equals 1.0 in 1959 and then each subsequent year is relative to that base year. The average farm size in the poultry industry increased the most rapidly, with an annual growth rate (from 1959 to 1997) in the inventory of layers per farm of 9.5%. This growth rate resulted in poultry farms in 1997 being over 30 times larger than they were in 1959. The average farm size in the swine and dairy industries also grew considerably, with annual growth rates of 7.3% and 5.7%, respectively. Average 2002 inventory levels of swine farms were almost 21 times what they were in 1959, whereas dairy saw an 11-fold increase in farm size over this same time. Much of the increase in the swine industry occurred from 1992 to 2002, i.e., average farm size went from 8 to 21 times the 1959 size in this 10-year time period. The annual growth rate in the size of beef cow farms was 2.2%. This growth rate resulted in the average beef cow farm being 2.5 times larger in 2002 than it was in 1959.

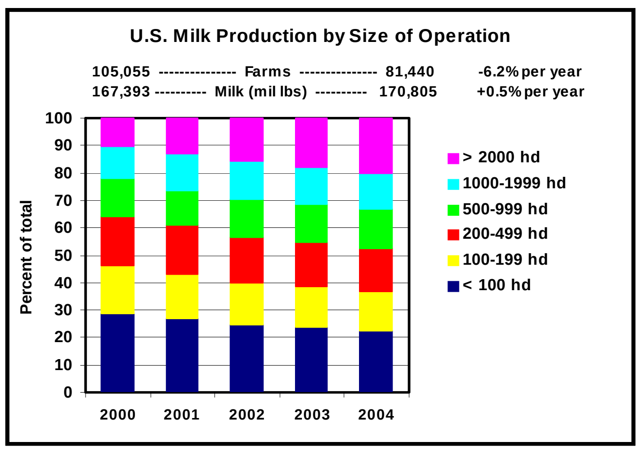


Figure 5

As previously noted, average farm size and farm numbers may not adequately convey the forces of consolidation, especially when the distribution of farm sizes is especially skewed. First, during consolidation, the number of larger farms usually expands while the number of small farms usually (but not always) contracts. The result is that the market share of production held by large farms is rising especially rapidly, which could have important implications for market and political power in agriculture. For example, figure 5 shows the percent of milk production in the U.S. by farm size from 2000 through 2004. Over this 5-year time period, the number of dairy farms decreased by 6.2% per year while milk production increased, on average, 0.5% per year. In 2000, dairies with less than 200 cows produced slightly less than half of the milk (46.1%) yet dairies of this size represented 92.4% of the total number of dairies. In 2004, dairies of this size

[2] The average farm sizes (head per farm) in 1959 were the following: Layers (162), Beef cows (17), Milk cows (9), and Swine (37).

produced only 36.6% of the total milk, but they still represented 90.6% of the total dairies in the U.S.[3] On the other hand, dairies with 1,000+ cows produced 22.1% of the milk while they represented only 0.9% of all dairies in 2000. By 2004, this size category accounted for 33.3% of the total milk production while only representing 1.6% of the total dairies. Thus, it is clear that while the trend shown in figure 4 pertaining to "average farm size" is clearly indicative of increasing concentration, it does not accurately depict the magnitude of concentration as it relates to production.

Figure 6 shows the U.S. hogs and pigs inventory by farm size for 1994, 1999, and 2004. The number of swine farms decreased by almost 10% annually from 1994 to 2004, but pork production actually increased almost 1.5% annually. In 1994, farms with less than 500 head represented 84.5% of swine operations and accounted for just under a fourth (24.5%) of the pigs. By 2004, 75.5% of the swine farms were still in this size category but they only had 5% of the total inventory. On the other hand, farms with over 5,000 head (less than 1% of all farms) accounted for just over a fifth (21%) of the total hogs in 1994, but over half (53%) of the hogs in 2004 with only 3.3% of all farms. As pointed out above for dairy farms, it is clear that data pertaining to "average farm size" do not accurately depict the skewness that exists with regard to the concentration of production.

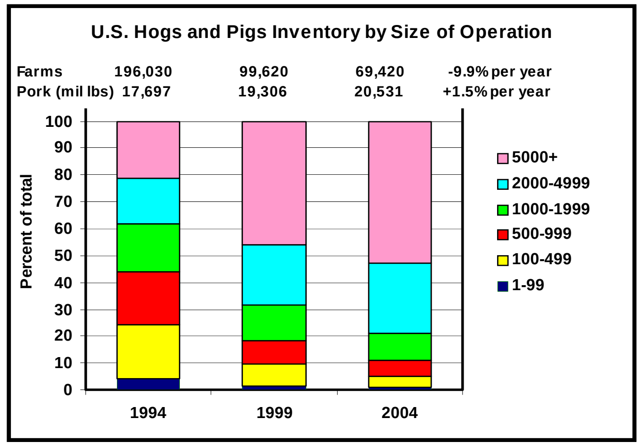
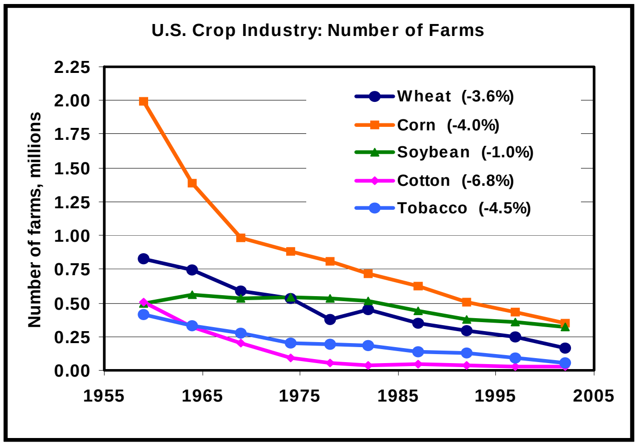


Figure 6

Figures 3 through 6 revealed the consolidation in the livestock industries. What about the crop industries? Are they going through the same consolidation patterns as the livestock industries? Figures 7 and 8 show information for wheat, corn, soybean, cotton, and tobacco farms similar to what was displayed for livestock farms in figures 3 and 4. The number of farms for all crop types reported here has been falling, with cotton and tobacco declining the fastest with annual rates of decline of 6.8% and 4.5%, respectively (figure 7). It should be noted that since the 2002 census, the number of tobacco farms has been declining quite significantly as government programs for tobacco currently (2005) are being phased out. The number of soybean farms has fallen the slowest, however, it is important to remember that there were not a lot of soybean farms in the 1950s as this was a relatively new crop. Figure 8 shows the normalized average farm size where 1959 is defined as 1.0.[4]

[3] In 1995, dairies with less than 200 cows represented over 95% of the total number of dairies and produced 60.3% of the milk. Data for dairies with 1,000 or more cows were not reported until 1998 (i.e., prior to then, such dairies simply would have been placed in the 200+ category).

[4] Average acres per farm in 1959 are 60.1 (wheat), 35.2 (corn), 44.2 (soybean), 28.9 (cotton), and 2.7 (tobacco). Average acres per farm in 2002 are equal to value in figure 8 in 2002 times these 1959 averages.



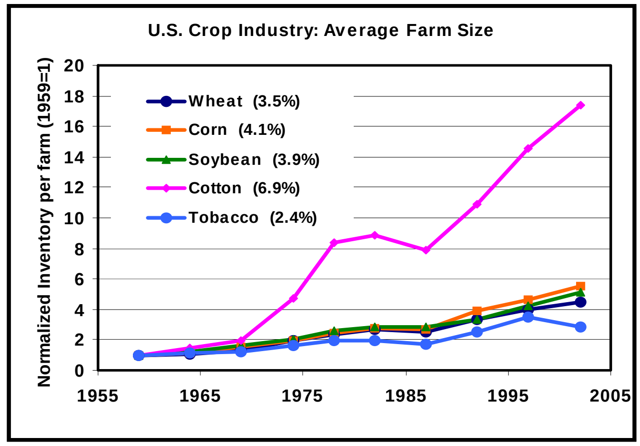
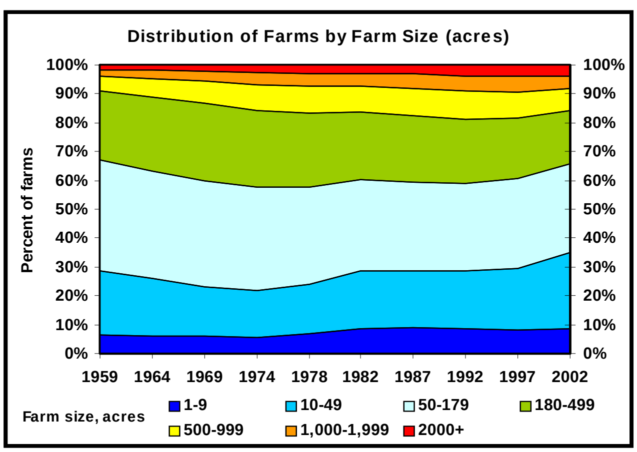


Figure 7 **Figure 8**

Figure 9 shows the distribution of farm numbers by farm size in acres for the different time periods. In 1959, approximately 30% of the farms had few than 50 acres and about 10% of the farms had 500 acres or more (remaining 60% had between 50 and 500 acres). In 2002, slightly over half (50.8%) of the farms were in these "small"(34.9%) and "large" (14.9%) categories. This provides some evidence that the middle-sized family farm is somewhat being squeezed out and replaced either by small or large operations. Figure 10 shows the distribution of acres by farm size. While those farms with less than 50 acres accounted for 34.9% of all farms in 2002, they farm less than 2% of the total acres in the U.S. On the other hand, farms with greater than 2,000 acres account for 47.3% of the total acres but yet they represent only 3.7% of all farms. These large farms represented 1.5% of the total farms in 1959 and 32.4% of the acres. The information in figures 7-10 makes it clear that consolidation is occurring in crop production similar to what is going on in the livestock industries.



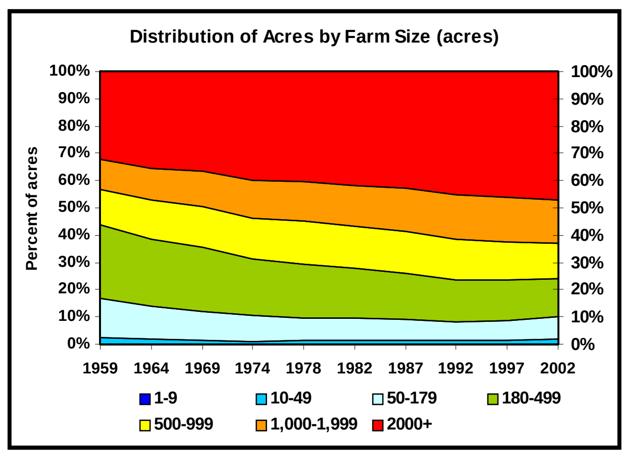


Figure 9 **Figure 10**

The driving force behind the consolidation trend principally is economies of scale, which is a phenomenon that occurs when per-unit costs are lower, or per-unit revenues are higher, for larger firms relative to smaller firms. For example, large factory farming techniques have lent themselves well to poultry and swine production. More recently, changes in feeding, milking, and housing dairy cows have been especially supportive of large factory farming dairy operations. Whether firms view the situation reactively (I have to get bigger to survive) or opportunistically (If I get bigger I can lower my cost or increase my revenue and make greater profits), the end result is the same – firms get larger and fewer over time.

As opposed to gradual ongoing consolidation, rapid consolidation typically comes about because of new technologies that are especially scale dependent. How those technologies are captured is somewhat different for producers of animal products than for crop producers, but the end result is similar – larger farms.

In animal production, to capture scale-dependent technologies, existing businesses engage in substantial expansions and new, large, business startups occur as well, which increases the average farm size. Constrained only by biological limitations such as gestation length and age to sexual maturity, these expansions rapidly increase the supply of output to the market, which results in lower market prices. With falling prices, high cost producers exit the industry, that is, those that are too small to take advantage of the technologies. This exit of smaller farms from the industry then exacerbates the transition to larger average farm size.

In crop production, because acres of available crop land in the U.S. are more-or-less fixed, scale-dependent technologies generally are captured by existing farms becoming larger, not by new business startups. This comes about through cash rents and land values that are bid up by those farms that have lowered their production costs by using the new technologies. The result is larger average farm size. If the scale-dependent technologies also increase yield per acre or allow for more intensive farming (more crops raised per land acre), then there will be a price-lowering supply effect similar to the animal situation. When this supply effect is coupled with higher cash rents and land values, those farms that are too small to take advantage of the technologies exit the industry, which again exacerbates the transition to larger average farm size.

Rapid consolidation often induces dramatic changes in regional production, especially in animal agriculture. For example, large-scale hog production has caused North Carolina to become an important contender with Iowa for swine production. Figure 11 shows the number of farrowings and farm numbers for swine operations in Iowa and North Carolina from 1984 to 2004 (in 5-year increments). As recently as 1994, Iowa had twice as many farrowings as North Carolina and more than four times as many operations. By 1999, North Carolina had more farrowings than Iowa, and by 2004 it had over 25% more farrowings than Iowa, making it the largest state in terms of the number of farrowings. Both states saw large decreases in the number of swine operations over this 20-year time period – annual decreases of 7.6% and 9.9% for Iowa and North Carolina, respectively.

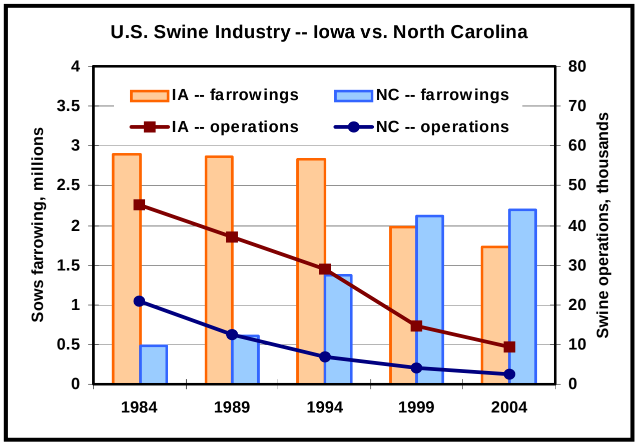


Figure 11

Figure 12 depicts a similar story for the dairy industry as was shown for the swine industry in figure 11. That is, as consolidation has occurred, there has been a change in production from the "typical" dairy state of Wisconsin to the more "large-scale" dairy state of California. In 1954, Wisconsin produced over 2.3 times as much milk as California, but by the early 1990s California surpassed Wisconsin and by 2004 Wisconsin produced only 60% as much milk as California. From 1974 until 2004, the average farm size – as measured by cows per farm – in Wisconsin increased from 32 to 74 cows (a factor of 2.3), whereas, average farm size in California increased 5.7 fold (from 124 head to 703 head).

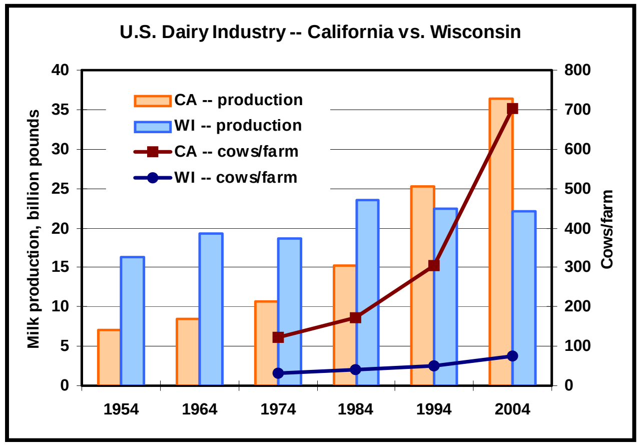


Figure 12

While figures 11 and 12 show dramatic regional shifts that have occurred across state lines, regional changes can, and do, occur at a more localized level. For example, the dairy industry in Kansas somewhat mirrors trends that are occurring nationally. The western third of the state historically produced less than 10% of the milk in the state. However, with the construction of several large dairies in western Kansas beginning in the mid 1990s, this region now produces approximately 67% of the milk in the state (figure 13).

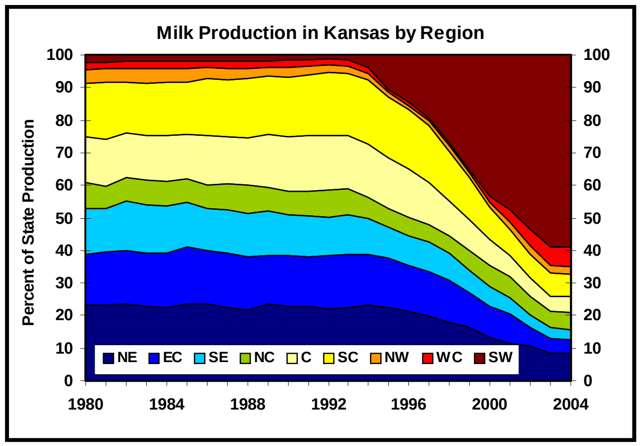


Figure 13

The previous figures clearly have indicated that there has been considerable consolidation in the livestock industry. First poultry and cattle feeding, then swine, and now dairies. A natural question is, Will the cow/calf sector follow suit? There are several reasons that suggest that the cow/calf industry will continue to be a little slower to consolidate than the other livestock sectors. First, cows depend heavily on native grass, a feed source that would be prohibitively expensive to harvest and dispense in a factory farming setting. Second, many small cow-calf operations are retained on principally crop farms as important symbiotic enterprises with crops – to use inexpensive off-season labor, for example, or inexpensive crop residue as a feedstuff. Such "small" operations would be stiff economic competitors of large sole-purpose cow/calf ranches designed around economies of size. Third, many people outside of agriculture prefer to own cows as a quasi hobby. Clearly, such hobby operations are hard to drive out with economic competition alone.

After pointing out potential advantages of smaller over larger cow/calf operations, it is important to note that there are economies of size associated with most aspects of cow/calf production. For example, an operator who gets out of bed at 3:00 am to check on first-calf heifers that may be calving might just as well be checking many heifers as checking only a few. Similarly, selling calves in larger lots consistently has been shown to increase selling price. Further, as technologies such as grid pricing and electronic animal identification work their way through the cattle industry, there ultimately might be large selling-price advantages to volume, which would induce faster and faster consolidation of this sector. Nonetheless, it is probably safe to say that the consolidation in the cow/calf sector likely will occur at a slower pace than with poultry, swine, and dairy.

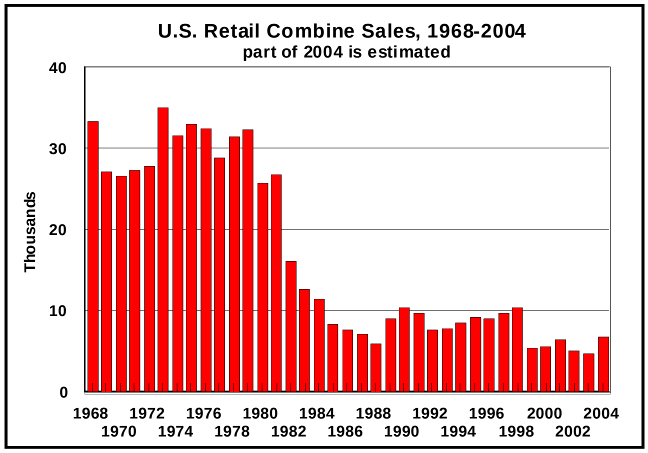


Figure 14

Perhaps even more interesting than the cow/calf consolidation question is the following. Will crop farming follow suit with the livestock sector, with a long term gradual consolidation (farms getting larger) followed by a rapid surge of consolidation? Certainly, a number of things point to at least an accelerated rate of consolidation for crop production. First of all, tractors, combines, and other machines are rapidly becoming especially complex in terms of new computer-based technologies. GPS-assisted steering (where the driver operates the steering wheel only on turnarounds) is one such example. Such technologies greatly add to the purchase price of these machines and hence the number of acres or hours required to justify their purchase. Certainly, fewer and fewer combines and tractors are needed to produce the same or more crops than in the past. This fact is demonstrated quite clearly in figure 14, which shows that annual new combine sales in the U.S. currently are only about 20% of what they were 25 years ago (data from the Association of Equipment Manufacturers).

But, what might cause a rapid change in the economies of size, and hence consolidation, associated with crop production? Frankly, we do not know! On the other hand, we did not know in the case of cattle feeding, poultry, swine, and dairy production either. That is, it would have been difficult in real time to say "*this* is the cause of the rapid consolidation." Rather, the consolidation in those sectors seemed to be based on a number of small technologies that appeared to combine to reach a threshold where the advantages to larger size became extremely obvious. Of course, the supply increase wrought by rapid expansions, as described earlier, surely helped with rapid consolidation in these areas. So far, we have not seen dramatic supply increasing technologies in crop production, which leads us to think that consolidation will simply continue, albeit at perhaps an increasing rate.

Implications of Consolidation

Consolidation means there will be less companies and less people for the farm manager to interact with. Traditionally, farmers could purchase inputs from many suppliers in their geographical areas and could sell their production to many buyers. Not "burning bridges" will become a more important maxim in years to come, meaning that farm managers will have to acquire ever better interpersonal skills. Fortunately, new information and transportation technologies have mitigated the problems associated with fewer buyers and sellers. Cell phones mean needless trips to distant machinery dealers can be avoided. The internet means that many inputs can be purchased from companies that are many miles away. UPS routinely makes delivery in only a day or two. Farmer-owned semi trucks mean bulk goods easily can be shipped larger distances.

But, doing business over greater geographical distances brings problems of its own. For example, it may be more difficult to assess the credit rating and integrity of a company that is several states away than one the farmer has been intimately familiar with for decades. Further, that credit rating or integrity might become more important to assess when it is for a company with which the farm is conducting a large portion of its total business. In short, doing business with a company that goes broke can be devastating.

Although consolidation means fewer sellers and buyers to deal with, it does not necessarily mean fewer choices, rather, product differentiation is a natural outcome of consolidation. For example, John Deere and CNH dominate the tractor and combine markets but the choice is not merely between Deere and CNH. The relevant choice is among the numerous classes and features of a machine – even if the brand choice already has been made. Today's tractor has many more features to pick from than an M Farmall of the early 1950s or a Deere 4020 of the 1960s. Each feature comes with a separate price and must be evaluated against that price.

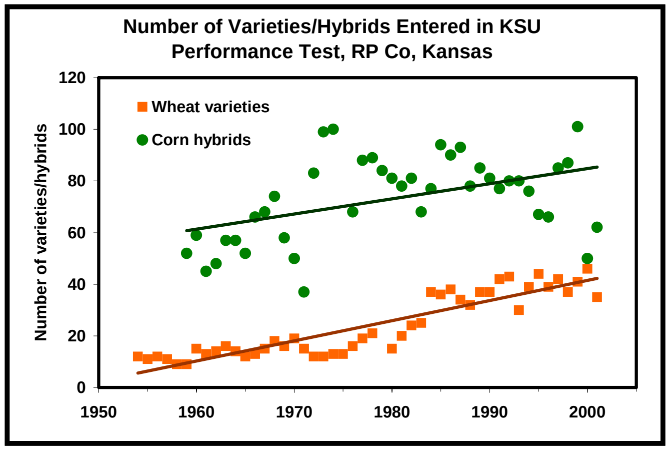


Figure 15

Similar to the increase in number of machine features, the number of feasible corn hybrids or wheat varieties has become large in recent years. Figure 15 shows the number of wheat varieties and corn hybrids that have been entered in the Kansas State University (KSU) Performance Test in Republic County for the last 40-50 years. While the number of companies may have decreased over this time period, the number of varieties and hybrids in the performance tests has been trending up.

Consolidation-induced product differentiation has appeared in other areas as well. For example, although there may be only a few grain buyers in an area, the number of grain marketing packages has grown immensely. Farmers routinely must choose among minimum price, hedged-to-arrive, flat price, and deferred price contracts, to name just a few, or any of the various cash-sales-combined-with-futures-and-options strategies. Likewise, there may be fewer bankers providing credit but there likely are more lending packages with interest rates and payments tailored to particular needs. The key point is that while the number of input providers (and output purchasers) may be decreasing, the choices they offer to producers are not necessarily decreasing.

Fewer buyers and sellers coupled with many choices means that transactional (market) prices will continue to become less transparent and less informative. A $75/cwt slaughter steer price reported in the local newspaper may not mean an individual farm's slaughter steers would have sold for that price on that day. It all depends on the characteristics of the cattle being considered. Knowing that a neighbor purchased a new tractor for $155,000 may not be particularly informative even if the brand and model are known. It all depends on the features included. Even a reported wheat price of $3.50/bu may not be particularly informative unless one knows, for example, the wheat class (white or red?), its protein content, and the grading specifications. Once again, acquiring informative transactional prices will depend heavily on acquiring improved people skills. Farm managers will need to establish interpersonal relationships with other farm managers, so that reliable information on product prices, features, and availability can be gained through communication and consensus.

With fewer firms to do business with, and the associated increase in product differentiation, comes the need to acquire a better understanding of the businesses that remain. Car buyers have long known this, and established websites that improve understanding of dealer costs associated with cars and their features. Such information has become valuable for those negotiating automobile purchases, helping them establish effective starting points for negotiations. But, such information likely will be inadequate in the future. For example, it will become important to recognize the difference in dealer cost associated with volume purchasing by the dealer from the manufacturer; such kickbacks, rebates, and discounts are not particularly transparent today. So too, with single farm machinery items routinely costing in the $100,000 to $250,000 range, it will become especially important to garner a better understanding of "how much room" a machinery dealer has to work with when negotiating on purchase prices.

As noted or alluded to several times, the most important implication of consolidation in production agriculture is fewer, hence more valuable and more in depth, business and interpersonal relationships. With fewer relationships to go around, it will become both necessary and profitable to invest more time and effort in the relationships that remain. That will be true for all parties involved. Machinery dealers, lenders, and crop and livestock input providers will spend more time courting the smaller number of farms that remain. So too, those farms will spend more time cultivating long term trustworthy relationships with such businesses. Once again, possessing good communication and people skills will be an important part of such relationships.

2. Rapid Technological Change

It has long been known that early adopters of new agricultural technologies are the ones who profit the most. That is, technology-based positive economic profits related to crop production quickly are bid into land values and rents. Higher rents mean higher costs, which mean that many farmers find themselves either out of business or that they have to adopt the new technologies just to break even. More succinctly, the non-adopting farmer finds that he is not "holding his own" economically, but rather that he is steadily going broke in the face of what he views as rents that are too high.

In the economic technology treadmill of modern agriculture over the last couple of centuries, why is it that some technologies are adopted more quickly than others? The answer lies in the fact that different technologies vary greatly in terms of a) the magnitude of expected profitability associated with them, b) the degree of confidence an adopter assigns to that magnitude of profitability, and c) the size of the required investment in dollars (farms are more willing to gamble small amounts of money).

Technologies with small expected gains, but where those gains are very clear and distinct, such as Roundup-Ready soybeans, are adopted rapidly. That is, Roundup-Ready soybeans easily could be assessed by comparing well-known higher seed costs against well-known herbicide cost reductions. Figure 16 shows adoption rates for herbicide-tolerant soybeans, cotton, and corn in the U.S. Interestingly, USDA's Economic Research Service (ERS) behind the herbicide-tolerant study found that adoption was heavily dependent on farm size, with small farms adopting at much lower rates (not shown). This finding shocked the ERS since the technology is embodied in the variable inputs (e.g., seed), which makes it completely divisible and not particularly scale dependent. But, what the ERS possibly ignored was the fact that "getting educated" about new technologies is not scale dependent. Educational and informational costs associated with new technologies are essentially lower for large farms since they can be spread over more acres.

More colloquially, technologies such as those behind figure 16 are belly-button or "duh" technologies as everyone can easily calculate their advantages. To some extent, lightbars (GPS guidance) comprise a belly-button technology. Their potential advantages in either cost or accuracy are easy to assess against their competition of foam or mechanical markers. Tractor cabs also were adopted quickly, not necessarily because the gains could be easily quantified, but they probably were easy to qualify. That is, the reduced stress of tractor operation wrought by cabs was viewed as sufficiently worthwhile to merit the investment. It is likely that GPS-guided assisted steering devices also will be adopted relatively rapidly, at least by larger farmers (since the investment is substantial). That is, who can argue with savings associated with reduced overlap or even with the unknown-in-magnitude-but-clearly-positive reduction in operator fatigue and improved equipment monitoring associated with assisted steering devices? Any real (easier to get rented land?) or perceived (personal satisfaction) gain from straight rows is an added benefit.

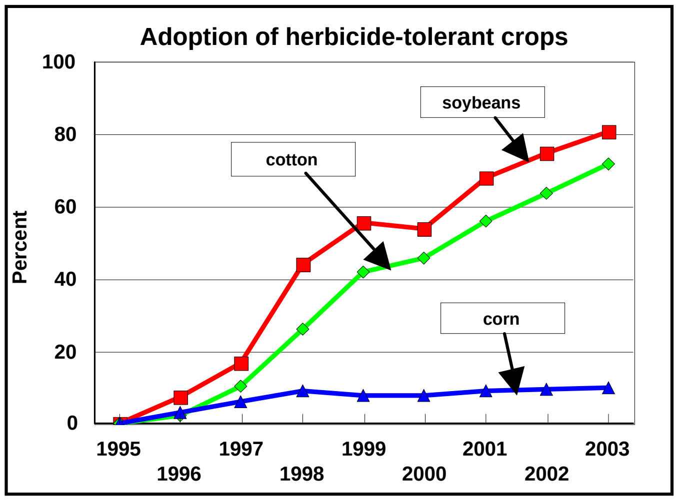


Figure 16

Just as the gains for some technologies are obvious, the gains associated with others are elusive. Though it might be hard to imagine from today's perspective, tractors and fertilizer are two such examples. Tractors had to evolve for many years before they were clearly superior to draft animals, causing tractor adoption to take nearly 40 years (see figure 17). It is interesting to note that in figure 17 there was clearly a trade-off between horses and tractors (and tractor size) from 1920 forward, however, the 2002 Ag Census showed an increase in both the number of horses and the number of tractors in

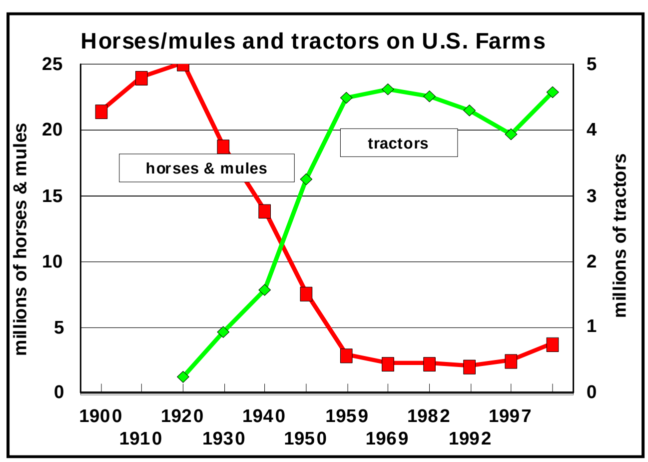


Figure 17

the U.S. This "change in trend" is consistent with the increased number of part-time and hobby farms.

In the early years of fertilizer, many fields still were adequately fertile for the existing crop potential at the time. That meant farmers would regularly debate for years about the gains to commercial fertilization. Because of low rainfall and relatively late breaking of the land out of native pasture, Colorado represents a good example. In figure 18, this "debating" phase can be seen to cover roughly the 1960s through the 1980s, with more rapid adoption following thereafter. A more recent example of such technologies is no-till farming. Many regions of the U.S. slowly have been migrating in the no-till direction for decades, as it becomes increasingly more obvious just where that technology might pay, and as herbicides and related machinery become ever better along the way.

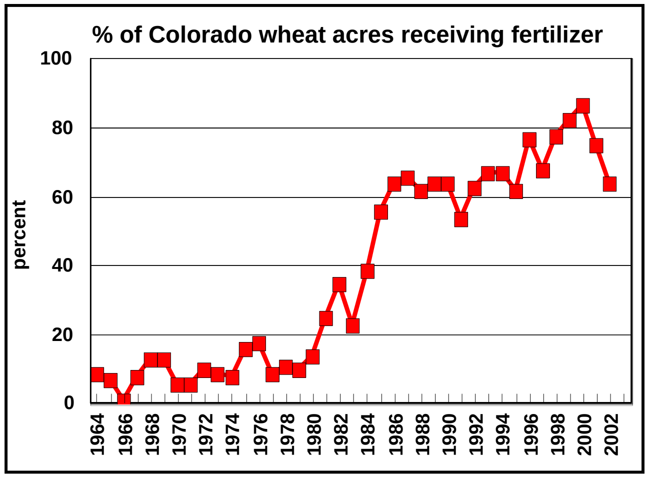


Figure 18

For many years production agriculture has been associated with substantial economies of size. That is, many of a farm's cost categories are associated with both fixed and variable costs. The per-unit (e.g., per acre or per bushel) cost of the fixed component always falls with increased farm size, providing an intrinsic economic advantage to larger farms over smaller farms. Over the decades, many agricultural technologies have been labor reducing (e.g., larger tractors). That means one operator has been able to farm more and more acres over the years, taking advantage of any other, non-labor, economies of size without increasing labor (e.g., volume discounts for input items). But, it also means that farmers generally have not gained experience in incorporating employees into their operations. Such discreet barriers (e.g., the reluctance to hire that first employee) lead to a vicious circle of giving preference to labor-saving technologies. Thus, for many farms, it is the labor-saving aspect of no-till farming that makes it appealing, rather than the higher yields or lower crop input costs. That is, farms move towards less tillage so that they can spread their "fixed" labor costs over more acres (by expanding their farms), thus reducing the labor cost per acre, and thereby allowing them to capture other non-labor economies along the way. Consequently, no-till adoption would be much slower yet were it not for the intrinsic labor savings. In short, technologies with associated labor savings tend to be preferred to those that might be labor increasing.

Two messages around technology adoption emerge for the successful farms of the future. First, rapidly moving technologies must be adopted very quickly – just to be able to survive and compete. Second, farms certainly should consider adopting slow-moving technologies – because they will result in a profitability edge that can go on for years. Thus, it especially should be valuable to consider labor-intensive technologies, precisely because so many farms seek to avoid them and the gains therefore should be long-lasting. An example of this is alfalfa production. While Kansas Farm Management Association enterprise data consistently show alfalfa to be one of the most profitable crops, many producers shy away from it likely because of the labor and management requirements. Taken together, these messages mean that the successful farm of the future must become an astute judge of technology trends.

Unfortunately, consolidation, economies of size, and product differentiation can make it more difficult to identify worthwhile slow-moving technology trends. For example, only a few farms in the state or region might own a new specialized machine designed to capture new technologies, say, a particular class of no-till drills. That means one cannot simply drive around the neighborhood to assess such things, but rather must consider informational activities that are more immune to geography, such as the internet. Furthermore, such slow-moving technologies can get quite farm-specific (consider the myriad of crop rotations that might be considered within a no-till setting), making it difficult to assess a technology's advantage simply by observing other farms or university research.

Some new agricultural technologies require a substantial investment in infrastructure, not just by the farm, but also by the agribusiness industry. A classic case is hard white wheat in Kansas as an alternative to hard red wheat. Many grain elevators lack the physical ability to simultaneously take in both white and red wheat at harvest. A similar situation occurs when a new crop is just beginning to become popular in an area, for example sunflowers. In such cases it may actually be economically advantageous for those grain elevators to "talk down" the potential benefits of the new crop – at least until such point when they are ready to make a changeover to the new crop. The information arising from those elevators during the talking down phase easily might be construed as an indication that the new technology is merely a fad, not something to be taken seriously. Yet, these same elevators will quickly reverse their story after making a commitment to the new technology. The result is a threshold effect that makes technology assessment more difficult for the farm manager. Threshold effects also are common among farmers themselves, as they adopt new technologies. Here, the classic case probably is no-till farming. There is an obvious benefit for a farm to have its techniques considered "proper" by other farms and especially by landlords. Thus, it should not be surprising to see a farm talk down no-till one year and reverse its stand the next year after making an investment commitment in the no-till direction. The main point is that the astute assessor and adopter of technology must acquire the skills necessary to see through such threshold effects – which can only be acquired through objective observations of a new technology's outcomes.

3. More Opportunities for Non-ag Involvement

As farms get larger over time and look more like other businesses, and as informational technologies like the internet bring people closer together, there undoubtedly will be more interconnections between production agriculture and the outside world. Among the trends considered in this paper, this one is the most broad, capturing the idea that there will be more opportunities for farmers to invest off-farm, for non-farmers to invest on the farm, and for farms to sell services to non-farmers.

One class of off-farm investment by farmers most certainly is that which is known as value-added investment, where value-added usually means further processing, wholesaling, or retailing beyond the farm gate. In recent years, the farm press has contained numerous stories concerning such value-added investment, with stories describing both business successes and business failures. The text of a recent article (Top Producer, Summer 2003, p.10) even suggests that there is a trend among larger farmers (i.e., those grossing over $500,000 annually) to invest more and more in off-farm investments such as value-added firms, implying that economies of size in production agriculture is waning. But, a closer look at that article might suggest otherwise. In particular, expected 5-year growth among corn and soybean farmers was 32%, which compares to answers of 25% in 1998 and 18% in 1993. In fairness, expected future growth in the livestock sector was down from prior surveys – which should not be too surprising given the wide-scale industrialization of especially the swine and dairy sector in recent years.

It is likely that value-added firms will continue to solicit investment funds from agricultural producers. Particularly popular investments of this nature today are ethanol and more recently biodiesel production plants. Certainly, there has been a large expansion in that area across the whole U.S., with new production records regularly being set. The Renewable Fuels Association reports that there currently are 87 U.S. ethanol plants, with a capacity of producing over 3.92 billion gallons annually (http://www.ethanolrfa.org/ – accessed August 3, 2005). Another 18 plants are under construction, which will increase production capacity almost another billion gallons. In the Great Plains, and Kansas in particular, another popular value-added investment is large commercial dairies, as alluded to earlier in this paper. Since both dairies and ethanol plants use feedstuffs grown by crop farmers, they are heralded as vehicles by which farmers can pick themselves up by their bootstraps.

In consideration of value-added investments, successful farms of the future will want to consider a number of issues. First of all, the question needs to be asked, Am I getting a higher commodity price with my involvement in a particular venture? More fundamental, Am I even passing my commodities to or through the firm? It should be remembered that today's value-added investments are a far cry from corn producers who decided in the past to add value by bringing a swine or beef finishing enterprise into their businesses. The more an off-farm investment is divorced from the actual farm itself the more important is the follow-up questions: Why would I trust a particular plant-promoting team with my investment money over a more professional investment team that likely would consider a broader set of investments? In particular, why should I invest in a commercial dairy or an ethanol plant when I could just as well invest in Microsoft or Walmart?

Likely, the most important question a producer considering off-farm investment should consider centers around whether the investment money would be better spent on the farm itself. Growing, successful farms often are in dire need of equity capital to fuel their quest to capture the economies of size intrinsic to production agriculture. Can such farms really spare equity capital to invest in a business that in all likelihood will return a lower rate of return than what can be achieved on the farm itself? Alternatively, should such farms convince their lenders to allow them to increase their debt so that they can invest off farm? These issues are discussed in Stock Market vs. Land vs. Farming Returns, a paper available on the www.agmanager.info website. That paper offers an extensive analysis of the impact of off-farm investment in ag-related stocks. Though not exactly the same as investing in a particular ethanol plant or a particular dairy, the conclusions are just as relevant. It is worth repeating one paragraph from that paper here:

> Should farm managers invest in the stock market? The answer is often no if it means taking on more debt to do so. Which farms are most likely to benefit from stock market investment? Those which are low- to mid-profit with no debt. That low-

profit no-debt farms would benefit is likely a statement that such farms are either hobby farms or that they will probably diminish anyway. Simply put, such farms would probably be better off (at least economically) if they had their capital invested elsewhere. Which farms are least likely to benefit from stock market investment? High-debt farms and high-profit farms. If the reason for stock market investing is principally risk reduction, it appears that paying down debt will accomplish the same task, while giving up only small amounts of profit. Especially high-profit farms, by definition, will not find stock market returns sufficiently attractive.

Interestingly, for tomorrow's successful farms it could very well be more important to solicit off-farm investment *in* their farms rather than to offer off-farm investment *from* their farms. That is, and repeating what has already been noted both here and in the related economies of size paper, growing farms often need equity capital beyond what their farms' profits will provide.

Historically, production agriculture has long been dependent on investment from those not directly involved in operating farms – in the form of landlord ownership of farm land that is operated (rented) by farmers (tenants). More recently, there seems to be a surge in investment from those further and further removed from agriculture, not just from those who once were farmers themselves or at least heirs of one-time farmers. In short, poor stock market and money market returns of recent years are causing investors to consider agricultural land in their investment portfolios. For those farmers willing to consider farming returns separately from land investment returns, this only can be construed as a positive. This is especially true given that farm land seems to be increasingly valued on the basis of its non-agricultural attributes, meaning that ownership of land could tie up substantial amounts of equity for growing farms – given that it may be valued at much higher prices than those supported by agricultural production alone. The key here is that a successful farm will not get hung up on the idea that it has to own land to be a successful farming operation.

To benefit from outside investment in farm land, successful farms must possess or obtain the skills to demonstrate to the investor expected returns from rental arrangements. Clearly, such investors will have different needs than traditional landlords who once farmed themselves. What is needed is a good understanding of farm land investment, and how it might compare to other investments considered by investors. To gain some insight into this area, readers can read the various land ownership and land rental papers available from the authors at the www.agmanager.info website.

As tomorrow's successful farms hone their skills on acquiring outside investment into the land they farm, for some, it will be a natural extension to consider outside investment into the farming business itself (the machinery and other non-land assets). Likely, this will not be easy given that outside investors may be minority shareholders in a closely held corporation or similar entity. Nonetheless, it would be wise to start thinking in this direction. One might start by considering only those outside investors who are extended family members, and then progress to others as success is demonstrated over time. Either way, those who become successful at acquiring outside equity likely will have an edge over other more traditional farmers, those whose quest for economies of size may be constrained by internal growth.

One class of opportunities involving the non-ag sector in one's farm has to do with capitalizing on the fact that non-farming persons value certain non-ag attributes of farm land. One such attribute is hunting habitat. Increasingly, urban people are willing to spend money to ensure successful hunting experiences. As that recreational activity matures, farmers are finding that they can be involved as little or as much as they would like. In Kansas, farmers who want minimum involvement can consider enrolling their farms in the state-run walk-in hunting program, which might garner $1 to $2/acre annually. Others might want to lease their land to sportsmen associations, or become involved with guiding hunts, outfitting, raising game birds, etc. Still others might wish to sell off their land that is the most suitable for hunting – to those willing to pay a premium. Regardless, successful farms of the future will need to be mindful of such non-ag recreational opportunities for their land. After all, those who choose to ignore these opportunities may end up no better off than those who choose to ignore distinctively agricultural technologies. That is, they will find themselves steadily going broke in the face of land values and rents they perceive as being "too high."

4. More Paperwork (Computer Work?)

As farms become larger and more like agribusinesses, the amount of paperwork, or more appropriately computer work, undoubtedly will increase. Farm managers who recognize the value of these activities will have a comparative advantage over others. We believe there are at least four major areas that will benefit from increased computer activity: 1) improved accrual accounting, 2) better capital asset management decisions, 3) better day-to-day decisions around complex problems, and 4) improved production data management and analysis.

One area of paperwork/computer work that can especially benefit farms of the future is increased accrual accounting, in terms of detail and in terms of frequency. Accrual accounting (which is a must) means that changes in inventory values, machinery values, and growing crop values are tracked to better reflect net worth, as are accrued assets and liabilities. Otherwise farm managers and lenders will focus on changes in cash position (i.e., changes in debt) as their indicators of profitability – which most certainly is a mistake, and especially for growing farms that routinely are purchasing production inputs for more acres than are currently being harvested.

Once a farm has committed to accrual accounting, the next step naturally should be more frequent accounting and reporting, preferably monthly, but at least quarterly. With frequent analysis of financial net worth comes a more accurate picture of how a year is progressing economically. In years when poor yielding crops are expected during the growing season, it should be informational to "write down" the crop values if needed, of course allowing for expected crop insurance indemnities at the same time. That way there are no surprises and the manager can react appropriately in real time. An additional benefit is that the lender will know the current status of its line of credit with the farm. Similarly, it should be beneficial to know how much government payments and disaster payments are expected to be, well in advance of receipt. Such information helps with cash flow planning. Additionally, frequent accrual accounting reports should help acquire preferential treatment with lenders, both in terms of interest rates and in terms of money needs. Finally, it is difficult to overstate the reduced mental stress that comes with frequent accrual accounting. And, reduced mental stress helps a farm manager cope with and eventually embrace the idea of substantial leverage. All in all, frequent accrual accounting probably is one of the best uses of increased expenditures in the clerical area.

A second area of increased computer work is the area of capital asset management. The impact of machinery purchase and trade decisions on a farm's profitability is becoming greater and greater as individual machines become larger, more technologically advanced, more specific to the task they are intended for, and more expensive to purchase. The added complexity of new machines, along with the fact that there are fewer and fewer owners of a particular machine with particular features, means that intuition and common sense will become less useful in assessing the economic differences among the machines being considered. So, too, will land purchase decisions become harder to assess as land will increasingly be valued on the basis of both ag and non-ag characteristics. In particular, subtle distinctions in capital asset investments can make a large difference in a farm's profitability. Consistent with the critical need for accrual accounting, successful producers of the future will recognize the difference between economic costs associated with capital assets versus cash flow requirements. That is, when they consider capital investments they will recognize the importance of considering concepts such as the time value of money and income tax implications and how they relate to the purchase decision.

Fortunately, there are calculators, often in the form of computer spreadsheets, to aid capital ownership decisions. Several of these are available on the www.agmanager.info website, and also on other websites from universities and private companies. However, these calculators still require substantial involvement on the part of the user. Consequently, farm managers who are willing to make investments in their own education or that of their employees will have an edge over those who merely purchase based on "gut feel" or based on neighbor recommendations. Once again, it is fortunate that today's information technology, especially the internet, can greatly aid the farm manager wishing to expand his/her education. Also, education is becoming more of a continuum, where managers are not forced to choose between the extremes of a short meeting/training session and a full blown college-credit program. The MAST program currently offered at K-State is one example of such in-between educational experiences, involving two days on campus, followed by several months of web-based home-study modules, followed again by two days on campus.

A third area of increased computer work is in the area of day-to-day decision making that is becoming increasingly complex. One example of increased complexity is the crop insurance purchase decision. Each year it seems as though there are more policies with more nuances being offered under the federally subsidized crop insurance program. Again, just asking neighbors what they are doing will be less than adequate for optimizing such decisions for one's own farm. Similarly, the land renting decision is becoming more complex as traditional share renting agreements become inappropriate for new tillage and crop rotation systems, and as combinations of cash and share renting agreements are being considered. Clearly, managers who will be able to objectively and numerically analyze these decisions will have an edge over those who cannot.

A fourth area of increased computer work is the area of production record keeping, which is along the lines of precision agriculture technology, but not limited to it. As production systems become ever more unique to one's environment and economic circumstances, it will become less and less appropriate to rely on traditional university-provided production guidelines. In short, a farm manager will become more reliant on information collected on his/her own farm. At some point, as a farm expands and as its data are collected at an ever finer scale, a computer becomes an absolute necessity for data collection and storage alone. Furthermore, analyzing those data will be nearly impossible without the aid of a computer. In addition to collecting, storing, and analyzing data for use in making operation-specific production decisions, computer records likely will become increasingly more important from a compliance issue (e.g., pesticide application, individual animal identification). Once again, farm managers who embrace and value the benefits of additional paper work and computer work surely will have an edge over those who do not.

5. More Reliance on People with Specialized Skills

As farms become larger, more like agribusinesses, and more complex, it is only natural that there will be more reliance on people with specialized skills. Financial management (agricultural economics and accounting), crop production (agronomy), and livestock production (animal science) skills will certainly be of key importance. But, specialized agricultural engineering skills also will be needed from time to time, as managers struggle to understand the workings of modern complex machines. Also, specialized computer skills may be needed to keep the necessary computers working productively. Lawyers to help with all of the legal issues involved with farming also will become increasingly more important.

The best way to make clear the need for people with specialized skills probably is with examples. Consider the decision to move from conventional tillage to no-till. The farm manager (or someone advising the manager) first must determine whether the change will be positive to profitability, which only can be assessed after obtaining reliable expected cost and crop yield information. If the goal is to be an early adopter, then one must be able to read and interpret research results around no-till farming. The farm press and conversations with neighbors will help, but probably will not be adequate for the early adopter, who must rely on his/her theoretical understanding of agronomic principles. Suppose the decision has been made to change to no-till. The natural question is, Do I hire my spraying or bring the activity in-house by purchasing a sprayer. Suppose the decision is to purchase a sprayer. The next decision is brand, model, new vs. used, etc. Market forces work to make many of the decisions nearly a wash. That is, if certain choices had obvious advantages over others they probably would have already occurred. In short, decisions like buy vs. custom hire or lease vs. purchase often are subtle, with intuition or gut feel being a poor aid to the process. Nonetheless, it is the farms that capitalize on subtle differences among management decisions that will have the greatest edge in coming years. Many small advantages, added together, and especially when associated with large farms, become substantial differences in profitability.

The first step to benefitting from specialized skills is to recognize their need. But, that recognition is not enough, as various questions immediately follow. Should I, or someone else in the business, get trained to make these more complicated decisions? If yes, should that come about by dedicating time to studying books or articles in print or from the web? Should it come about via a non-degree training program, or a formalized advanced degree? On the other hand, do specialized consultants exist who might cover the tasks for me? If so, are they worth their cost and who should I hire? At what point should I consider hiring persons with specialized education, for example, with an M.S. degree in agricultural economics? After all, it is our preference that we do not “send young adults back to the farm” without a masters degree – at least if they will be expected to make management decisions when they get there. With much less than a masters degree the educational edge over one's neighbors soon will dissipate.

We have no pat answers to the many questions asked in this section, only some conjectures. First, growing successful farms will be too large and complex for one person to solely make the related financial and production management decisions, even if the farm contains a bevy of laborers with no specialized skills. But, that probably could be done with a sole manager who depends on advice from various consultants. Second, because it is costly to hire and train new employees, one probably should consider developing the skill set of existing employees – by allowing and encouraging them to attend educational workshops, programs, etc. Third, and perhaps most important, successful managers will be those who learn to empower, encourage, expect, and reward employees to make business decisions. Micro-management most certainly will doom a farming business to stagnant size as the manager's time becomes swamped with small decisions.

Summary

This paper identified five trends believed to be important in production agriculture over the next decade or two. The trends are 1) increasing consolidation, 2) rapid technological change, 3) greater connections to the non-agricultural world, 4) increased requirement of paperwork and computer work, and 5) more reliance on people with specialized skills. Understanding and embracing these trends should give farm managers an edge over those who choose to ignore or resist them. The principal force underlying these trends is economies of size, and the topic of a sister publication by the same authors. Thus, it should be helpful to first read the economies of size paper noted at this paper's outset.

Key thoughts arising from this paper are as follows. Consolidation is here to stay, with fewer and larger farms and fewer and larger agribusinesses for those farms to deal with. Profitable farming always has been based on using the new technologies available, and using them sooner than others. Successful farm managers of the future would be wise to carefully weigh the benefits of value-added investment off-farm against the large and growing need for capital on their own farms. For growing farms, paperwork and computer only will increase as managers attempt to ferret out subtle opportunities for profit in large scale commercial production of agricultural products, in a world where government and private interactions become more complicated and offer more opportunities each year. More and more, farm managers will see a need for people with specialized skills, as farms look more like agribusinesses over time. The trick will be to figure out whether those skills should be hired out in the form of consultants, or developed in-house through educational training or new hires. If there is one theme that pervades this paper, it is the fact that farm managers will need to develop ever better people skills – because personal long-term relationships will become more valuable as the numbers of farms and agribusinesses decline.