

Farming in the Nearby Future: Must I Grow My Farm?

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Terry L. Kastens, Agricultural Economist
Kansas State University, Manhattan, KS 66506
(785)-532-5866 FAX (785)-532-6925
email: tkastens@ksu.edu
web: www.agmanager.info

and

Kevin C. Dhuyvetter, Agricultural Economist
Kansas State University, Manhattan, KS 66506
(785)-532-3527 FAX (785)-532-6925
email: kcd@ksu.edu
web: www.agmanager.info

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.

Thinking About Farming in the Nearby Future, Especially Relating to Size and Growth

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Terry L. Kastens, agricultural economist, Kansas State University

Kevin C. Dhuyvetter, agricultural economist, Kansas State University

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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. 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 1999 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.

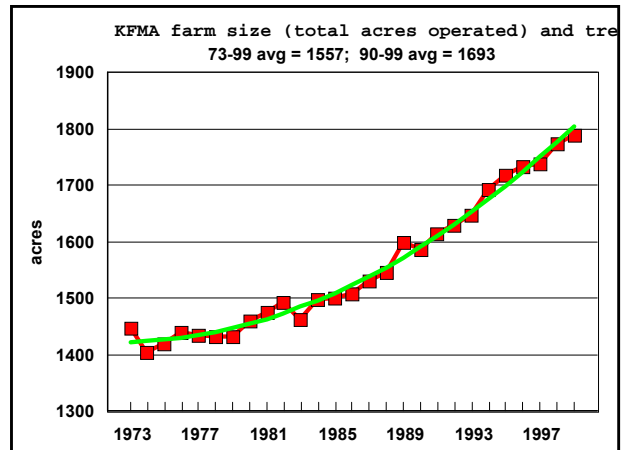


Figure 1

Figure 2, showing 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.

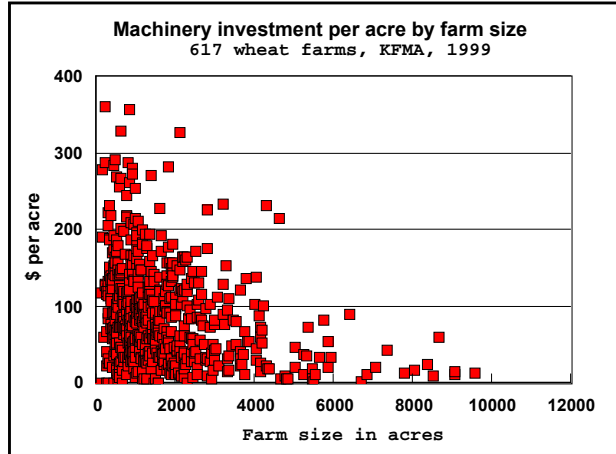


Figure 2

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 Really Matters*, examining around 1,000 Kansas farms from 1992 through 2001 (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 \$11.95/acre over the

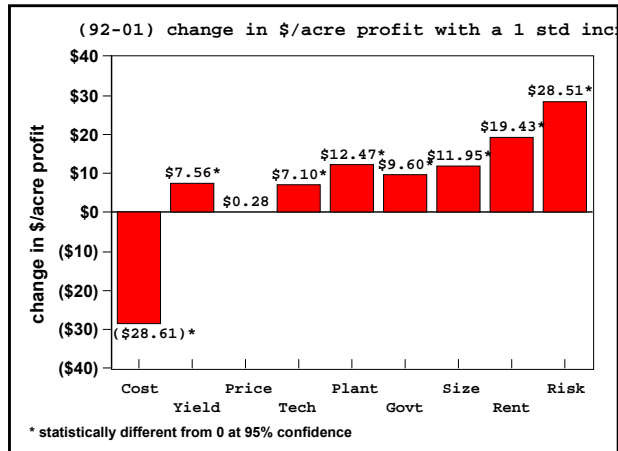


Figure 3

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 \$11.95/acre was *after* accounting for a number of traits (e.g., the ability to lower costs or the ability to get higher yields) that are more directly impacted by management. 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 1977-1999 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. 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 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.

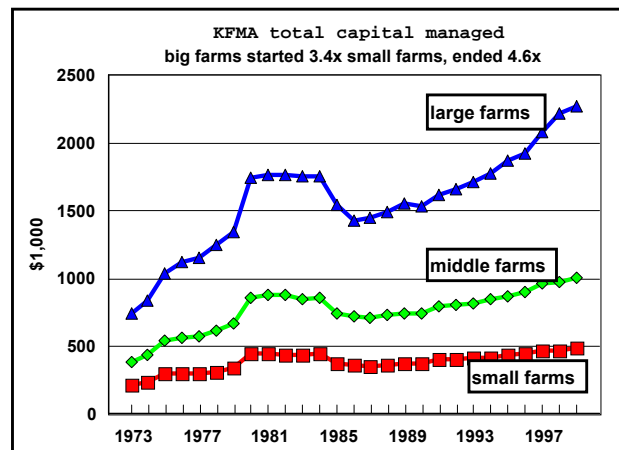


Figure 4

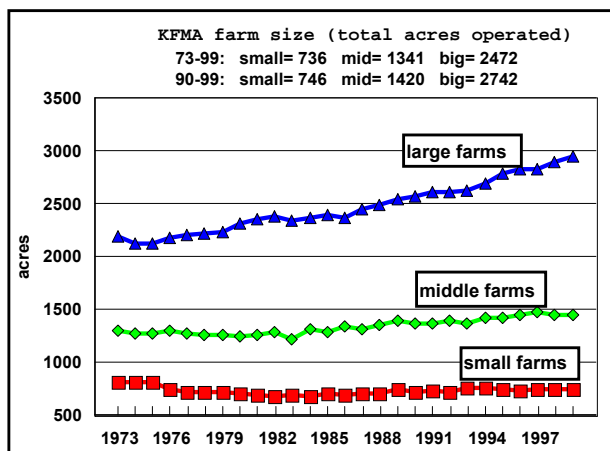


Figure 5

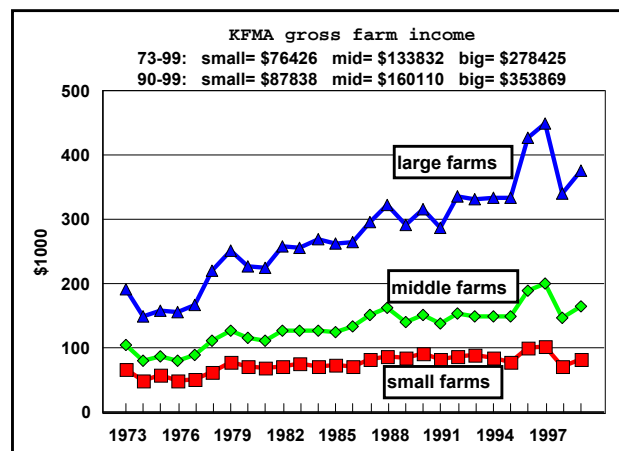


Figure 6

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.

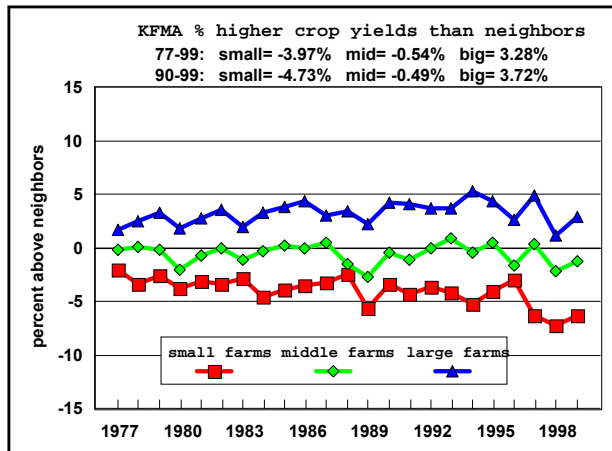


Figure 7

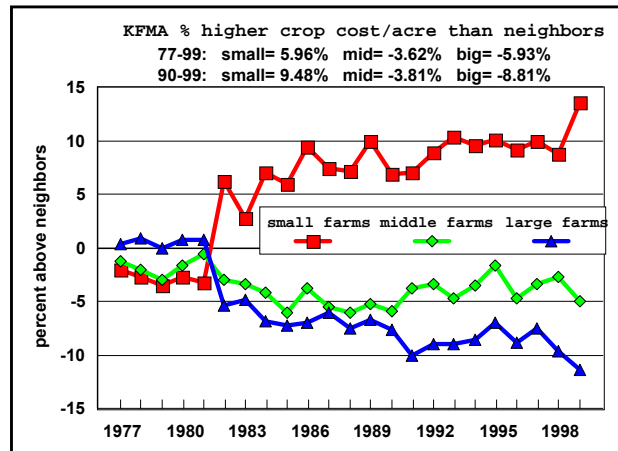


Figure 8

Figure 9 considers the management trait of technology adoption. In this case, the technology is “less tillage” and the measure is the number of years a farm is ahead or behind its neighbors (the regional average) in its degree of adoption. This figure is especially revealing in that it shows that larger farms are much faster adopters of less tillage than mid-sized farms which are much faster adopters than small farms. Likely, as other research has found, this is a general statement about other technologies as well. That is, 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.

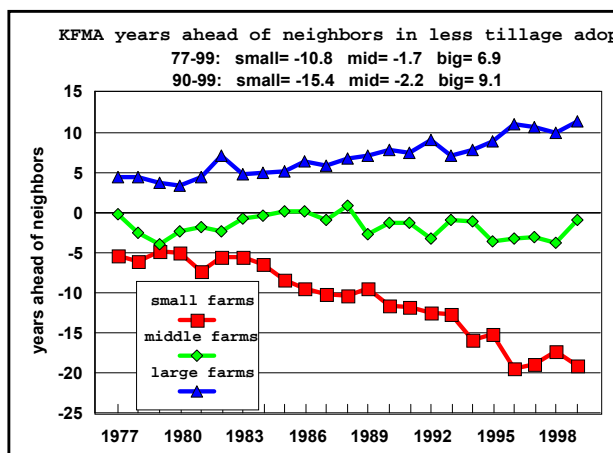


Figure 9

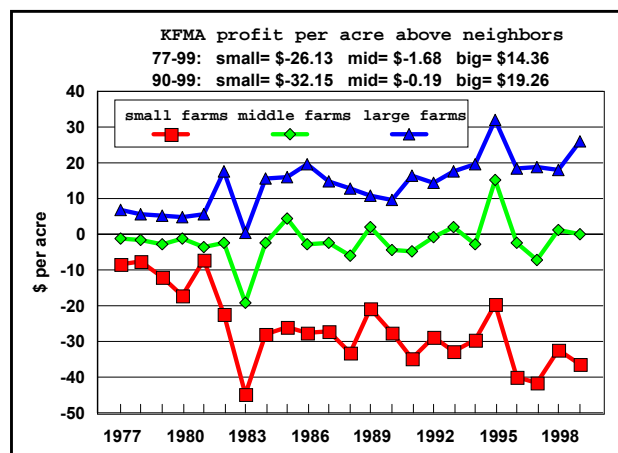


Figure 10

Finally, figure 10 shows the per acre 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 10 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 11 continues with the idea that “you do not have to be large to be profitable.” It shows the same three lines as figure 10, 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.

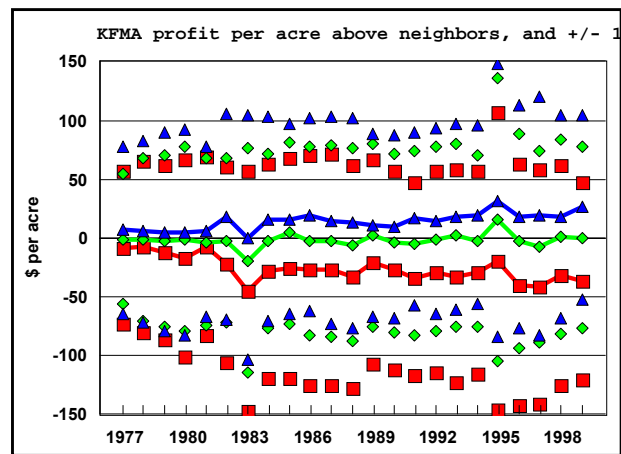


Figure 11

The disclaimer offered through figure 11 is to ensure that farms do not excuse their unprofitability by saying they are too small to be profitable. Likewise, figure 11 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.

What about growth?

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, we re-visited the Kansas management factors study underlying figure 3, adding 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 are 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 be missing some farms that have 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:

$$[\text{Eq. 1}] \quad \text{profit} = f(\text{cost, yield, price, government payments, risk}),$$

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):

$$\text{[Eq. 2]} \quad \text{cost} = f(\text{speed of less-tillage adoption, farm size, planting intensity, percent of acres rented, growth}),$$

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%. 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 smaller farms? The answer, not surprisingly, is that more profitable farms are growing faster. 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 12 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 12 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.

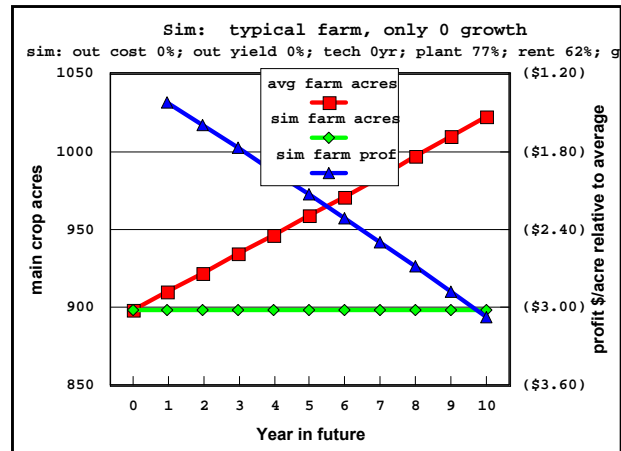


Figure 12

Figure 13 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 fit 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.

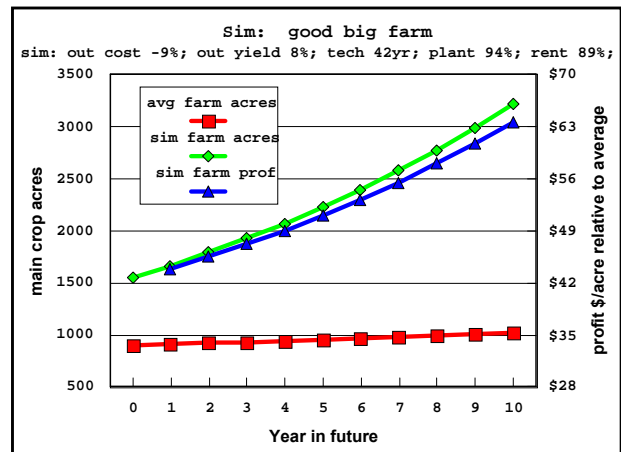


Figure 13

Figure 14 is identical to figure 13 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).

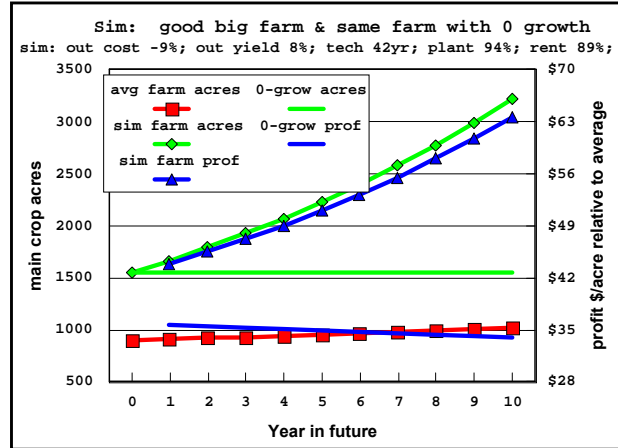


Figure 14

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 15 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.

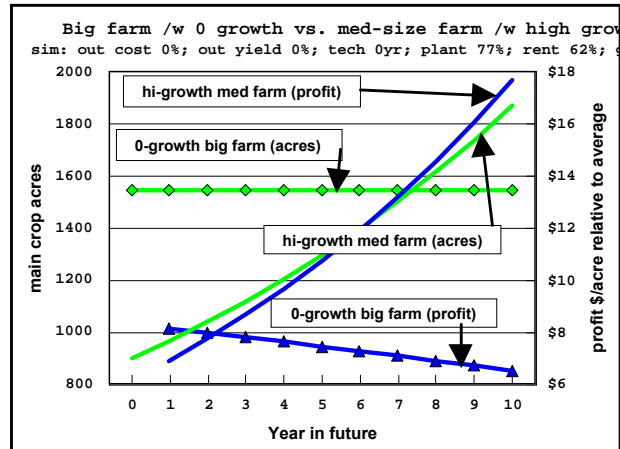


Figure 15

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

From previous research, figure 16 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.

Statistically, since we do not get to observe many very large farms, it is difficult to definitively answer the question set forth. There are simply 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.

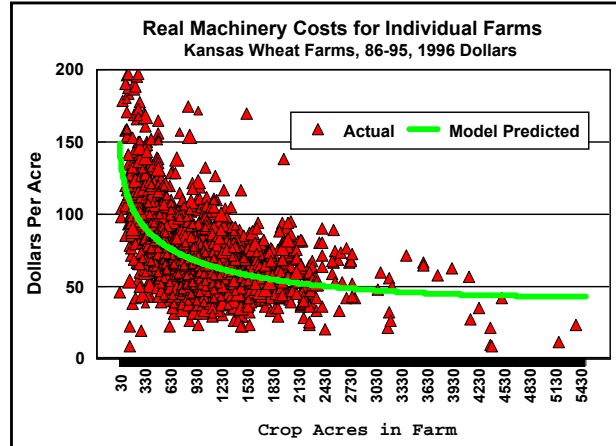


Figure 16

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.

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”), which involves “growing” health-related drugs by using high-tech genetic engineering of traditional crops such as corn. Lengthy communications 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. In this scenario, 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 irrigated corn 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 17 builds on the research behind figure 16 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 approximately 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 17 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 are not attempting 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. Third, large sales quantities likely garner higher prices. Fourth, larger loans often mean lower interest rates. Fifth, 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.

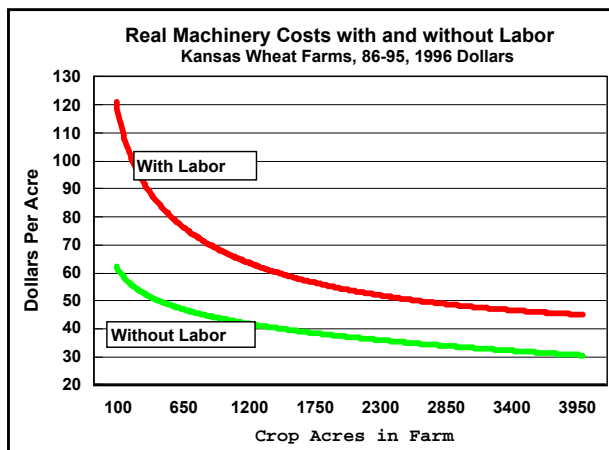


Figure 17

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.

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. At the end of 2001, the average Kansas farm enrolled in the Kansas Farm Management Association program had a net worth of \$485,569, a debt-to-assets ratio of 0.34, and managed \$1,411,357 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% annually due to inflation. 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% inflation), and that the couple pays a 20% combined state and federal income tax rate. With these assumptions, it would take the couple 17 years to save up the \$485,569 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 research 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% inflation rate assumed for the wage earning couple. Now, it will take our example couple 30 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 20 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 20 to 30 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 Kansas Farmer (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 17, 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 10000 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), 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 those 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 will merely constitute a transitional blip on the way towards larger farms. Moreover, machinery

rental firms and custom farming businesses will probably still 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 data from Kansas farms have shown that average farms have grown about 1.3% annually in terms of the number of acres of traditional crops. Additionally, the dollars of capital the average farm manages has 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) have 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.

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. After 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 is still 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 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.