A SIMULATION ANALYSIS OF COTTON GIN FINANCIAL VIABILITY UNDER RISK

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Abstract

Cotton ginning is a vital component of the cotton industry in Texas and the Texas High Plains Region (THP). The industry has experienced management and financial changes brought on by increased cotton production within the region coupled with a declining number of gins. Gins in the region are facing decisions regarding upgrading present facilities or constructing new ginning plants to handle the increased ginning volumes due to increased regional cotton production.

The general objective of the study was to analyze a cotton ginning firm's capacity decisions and financial viability given the variability and uncertainty of annual ginning volume. Simulation analysis was used to evaluate financial performance measures based on stochastic variables and projections. This study is the first of its kind that uses audited financial information from individual gins to evaluate financial performance under risk.

Representative gins were selected for four size classifications based upon their historical annual ginning volumes. The size classifications consisted of: (1) less than 30,000 bales, (2) 30,000 to 45,000 bales, (3) 45,000 to 60,000 bales, and (4) greater than 60,000 bales. Ten-year simulations were made for each representative gin for three different decision scenarios: (1) a status quo scenario incorporating forecasted production and inflationary/deflationary data; (2) a new equipment scenario incorporating the installation of new equipment that resulted in processing efficiency gains for the gin but requiring new debt service; and (3) a new plant scenario incorporating both higher processing efficiency gains and requiring higher acquired debt. The financial measures analyzed were net income per bale and ending equity.

The results indicated that the representative gin with less than 30,000 bales in annual volume has some risk of a negative average net income over the time under the status quo scenario; however, this gin has much greater risk under the two new investment scenarios. Only the gin with a volume greater than 60,000 bales annually appears to be able to invest in a new ginning plant without significant financial risk. As expected, the results indicate that as gin size increases, the risk associated with stochastic production and additional debt has less negative effect on long-run financial viability.

Introduction

The number of active gins in Texas and the Texas High Plains (THP) has been declining, while the average volume per gin has been increasing. Ginning firms have grown larger through internal growth, mergers and acquisitions. This consolidation has resulted in the need for capital investment, which requires large cash outlays. These large cash outlays often result in the creation of substantial financial obligations and changes in the firm's capital structure. Economic survival in this ever-changing environment requires that planning and control be fully implemented to stay competitive. A financially stable and viable ginning industry is necessary to maintain the long-run economic strength of the cotton industry in Texas and the THP.

National Cotton Council estimates indicate that in 2008 the U.S. cotton industry provided approximately $27.6 billion annually in products and services from gin to textile to consumer (National Cotton Council, 2009). The farm value of cotton was approximately $5.6 billion for the entire United States (National Cotton Council, 2009). Additionally, the National Cotton Council goes on to state, "annual business revenues stimulated by cotton in the U.S. economy exceeds $120 billion, making cotton America's number one value-added crop" (National Cotton Council, 2009).

The THP is often referred to as the "largest cotton patch in the world" (the THP is defined here as Texas crop reporting districts 1-N and 1-S). In 2007, the region produced 5.47 million bales of cotton from 3.2 million acres, representing 66.26% and 28.46% of Texas and U.S. cotton production, respectively. Cotton production in the THP over the 10-year period 1998 to 2007, as shown in Figure 1, averaged 3.596 million bales with a low of 2.23 million bales in 2003 and a high of 5.68 million bales in 2005 (TASS, 1998-2007). Figure 1 also illustrates the increase in regional cotton production starting in 2004. Average cotton production in the THP increased from 2.65 million bales for 1998 through 2003 to 5.00 million bales for 2004 through 2007. This increased production can primarily be attributed to the adoption of new cotton varieties with higher yield potential and genetic technologies for herbicide tolerance and insect resistance.

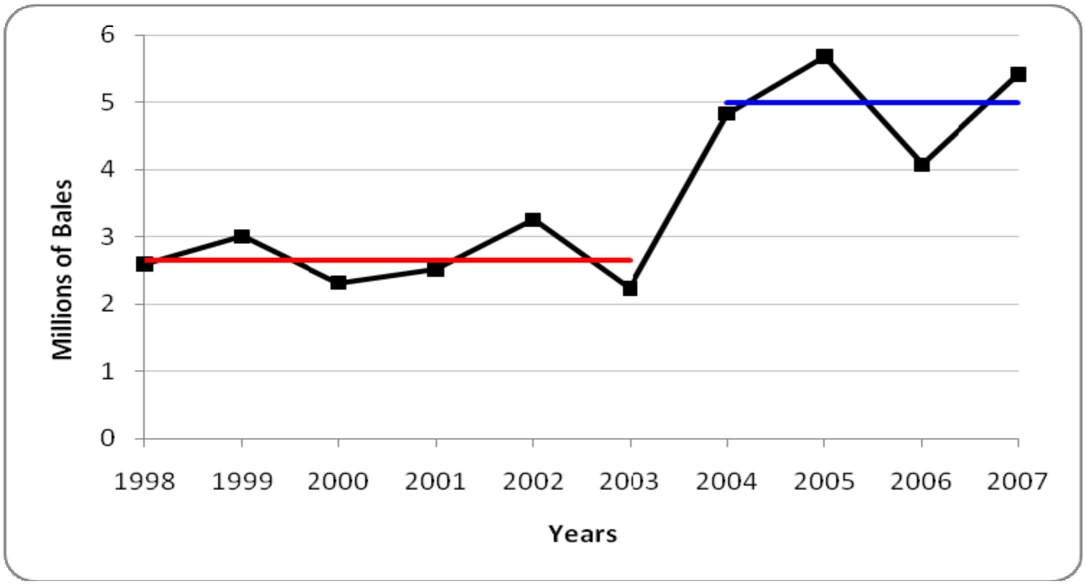

Figure 1. Historical cotton production in the Texas High Plains region.

Over the period 1998 to 2007, the number of active gins in Texas declined from 360 to 271. Over the same period, the number of active gins in the THP declined from 163 to 128, while the average per gin volume increased from 15,204 to 42,207 bales annually (USDA-NASS, 1998-2007). The increase in gin volume to over 40,000 bales was due to both the lower number of gins and the increased cotton production.

The Cotton Ginner's Handbook identifies that cost savings exist for larger ginning operations. In addition, it also indicates a gin should strive to obtain the volume needed to extend the time of its annual ginning season and result in greater ginning efficiencies. There is a need to determine what this volume is, along with the per hour volume needed to create the most efficient ginning plant (Anthony, 1994), but this determination can be difficult.

The general objective of this study was to analyze a cotton ginning firm's capacity decisions and financial viability given the variability and uncertainty of annual ginning volume and to use this to determine optimal production amounts.

Literature Review

There are published studies demonstrating that larger gin plant sizes are, in general, beneficial, but the best size gin plant is one where the maximum capacity of the gin plant is only slightly over what is produced and delivered to the gin each year. No study has yet to determine what an optimal capacity would be nor do they agree on the exact methods or parameters that would determine such.

McPeek (1997) evaluated the optimum organization of the cotton ginning industry of the Texas Southern High Plains. His study was based upon a survey conducted of gin managers in the area. The findings indicated that there was excess capacity in the ginning industry in the study area. The amount of excess capacity was determined to be below that which can be deemed acceptable due to the large number of gins that were operating far below capacity. The study determined that while the majority of the gins in the area operated below capacity, the larger gins operated farther below capacity than the smaller sized gins. The study also concluded that the larger gins in the area observed greater economies of size than the small gins, but that an optimal industry structure would contain both a mix of large and small gins. The work did not examine where the optimal structure lay, only that consolidation within the industry was needed.

Boyd and Hudson (1999) conducted a similar study of the ginning industry in Mississippi. Their study operated on similar assumptions, a survey, and the same linear programming model as McPeek. The survey results were divided into four separate groups based upon the average bales per hour processing capacity. This study concluded that the ginning industry in Mississippi would also benefit by a decreased total number of gins, but that those gins should be larger in size capacity.

A compilation of financial data from various gins in the west Texas area by COBANK (1994) divided gins into five different capacity groupings. The groupings were categorized by the annual bales ginned and not by the bale per hour capacity. While this study did not attempt to evaluate the findings in relation to a recommendation, the observation that larger producing plants were in a better financial position than smaller ginning plants was found to be true.

Fuller, et al. (1996) studied the economic implications of required debt investment in air pollution control systems that were needed to comply with the Clean Air Act. This study categorized gins by their bales per hour capacity and divided them between those with long-term debt and those without long-term debt. The results predicted that smaller size gins would be unsuccessful in the long run, regardless of whether they held long-term debt. Furthermore, the study verified that as gin capacity increased, the gin was more likely to remain financially successful.

Analytical Framework

A clear understanding of the principles of both business and financial risk is essential in understanding the risk that the ginning industry faces. The effect that the production variability of cotton has on the overall financial structure of the ginning firm must be thoroughly explored and these ideas used to formulate a procedure to establish the optimal size of a ginning plant.

The adoption of new technology often requires debt financing, which leads to higher interest costs and lower cash reserves due to principal payments. For a gin with already troubled finances, added debt might be more of a financial burden than the company can handle. Additionally, the avoidance of the adoption of new technology and needed maintenance and upgrades, while lowering debt levels, can be a factor that will be detrimental to the ginning firm. Increased down time and higher repair costs can place significant strain on the financial status of the gin. It is generally thought that the greater the input of raw cotton/output of cotton lint, the better; however, this may not be the case. This will depend upon how the gin was sized at inception.

Gabriel and Baker (1980) defined business risk as "the risk inherent in the firm, independent of the way it is financed." The concept of business risk is exhibited by the fluctuation of net operating income or net cash flows. They further stated that business risk comes from two major sources: (1) price variability of both inputs and outputs and uncertain availability of inputs; and (2) the biophysical environment, which produces yield and production variation (Gabriel and Baker, 1980). For a gin, this means that the variability of yields in their trade territory make up an abundance of their business risk. Additionally, there is very little that can be done to ease this type of risk.

Gabriel and Baker (1980) defined financial risk as "the added variability of the net cash flows of the owners of equity that result from the fixed financial obligation associated with debt financing and cash leasing." This applies to the ginning firm because a gin plant is expensive to build and requires constant maintenance, repair, and upgrading. These costs, while critical, must be managed effectively.

This concept is further discussed by Gabriela and Baker (1980) as risk balancing. Risk balancing is the idea that exogenous shocks to the existing risk balance can lead to necessary adjustments in the components of total risk (Gabriel and Baker, 1980). In other words, if a shock to business risk changed the level of the total risk such that it exceeded the existing risk constraint for the firm, financial risk might need to be adjusted to a level that would bring total risk back into balance. Unfortunately, it is often difficult to make changes to existing debt obligations in the short run and thus adjust financial risk.

Methods And Procedures

The study was based on historical data from the ten-year production period of 1998 through 2007 for 28 gins in the THP. The financial data for the individual gins was obtained from the accounting firm of D. Williams and Company. All data was provided on an anonymous basis with only a gin number as an identifier, thus maintaining the strictest confidence with regard to the identity of the gins.

The data for the 28 individual gins was stratified into different size classifications based on annual ginning volume. As is generally accepted, companies of different sizes are not viewed as comparable to their counterparts in the industry when those companies reside in different financial and plant size classifications. For this reason four different gin size classifications were identified based upon five-year average ginning volumes for crop years 2003 (FYE 2004) through 2007 (FYE 2008). The four categories were defined as: (1) gins averaging less than 30,000 bales annually – classified as Gin A; (2) gins averaging between 30,000 and 45,000 bales annually – classified as Gin B; (3) gins averaging between 45,000 and 60,000 bales annually – classified as Gin C; and (4) gins averaging more than 60,000 bales annually – classified as Gin D.

Three strategic decision scenarios were evaluated for each gin with regard to expansion of the gin plant. The first scenario assumed no gin plant expansion (the status quo scenario) with regard to ginning plant size; the second scenario (the new equipment scenario) assumed that the gin would make some expansion with upgrades to the present ginning plant; and the third scenario (the new plant scenario) assumed that a new ginning plant would be constructed. The status quo scenario assumes normal maintenance as needed for the existing gin plant as well as annual forecasted changes in labor and energy. The new equipment and new plant scenarios assume increasing efficiencies along with increasing debt levels.

The key outcome measures evaluated were projected net income and ending equity of the representative gins. A comparison was made of each representative gin for the three decision scenarios using the 10-year average net incomes for all scenarios. A comparison was made of the ending equity of each gin for each of the scenarios. This was important to determine the effect of net incomes or net losses upon the ending equity. This gave an indication of which scenarios were feasible for the gin's long-term financial viability.

Results

Gin A - Net Income

Under the status quo scenario the simulation results indicate that Gin A has only a 4% chance of having a loss (net income below $0) for the 10-year average time horizon. Conversely, there is a 52% chance that Gin A will have an average net income above $15 per bale and a 44% chance that net income will be between $0 and $15 per bale.

Under the decision scenarios for new equipment and new ginning plant, Gin A would have a much higher chance of a loss. In the new equipment scenario, Gin A has a 33% chance of an average net loss with only a 15% probability of net income greater that $15 per bale. The probability of average net income between $0 and $15 per bale is indicated to be 52%. The results for Gin A under the new plant scenario indicate that the gin would sustain an average net loss 99% of the time.

The results indicate that Gin A can anticipate a net income in two out of three years if they invest in new equipment to upgrade the gin and increase efficiencies. While these probabilities are not as good as under the status quo scenario, there may be considerations such as completing the ginning season earlier and/or increasing annual volume over time, which would allow this gin to take the greater risk.

Under the scenario in which Gin A incurs debt to build a new gin plant, the probability that the gin would experience substantial financial stress and possibly failure are very high. Due to the relatively small volume processed by Gin A, it is unable to sustain the debt service required for a new ginning plant, even with increased efficiencies associated with a new plant.

Gin A – Ending Equity Position

Historical figures for Gin A show that it entered the study period with an equity near $1.0 million. Gin A in the status quo scenario had a 96% probability of a positive net income over the study period; therefore, it is not surprising that Gin A would maintain a positive equity under this assumption.

The probabilities associated with ending equity under the new equipment scenario indicate that there is more pressure on equity to support the lowered net income and probabilities of loss associated with the new equipment debt. This correlates with the higher probability of the gin experiencing a negative equity over the study period. In year 2, Gin A had a 58% chance of ending the year with an equity amount between $0 and $1.0 million and a 42% chance of being above $1.0 million. However, in the later years the pressure on the existing equity mounts as the probabilities that the gin will experience a net loss with the increased debt levels put an accumulating strain on equity. In years 5 and 8, the probability of having a negative equity is 8% and 10%, respectively. The probability of increasing equity above $1.0 million declines to 65% in year 8 compared to 95% under the status quo scenario.

As expected, the new plant scenario for Gin A shows significant stress on the gin's equity position. The high probabilities of a net loss in income under the new plant scenario put a significant strain on equity position such that in year 8 the probability of a negative equity is 95%.

Gin B - Net Income

The simulation results indicate that Gin B has a 100% probability of having average net income over the 10-year time horizon of greater that $15 per bale under the status quo scenario.

In the new equipment scenario, Gin B still does not have any probability of experiencing a loss; however, the added debt burden that accompanies the newly purchased equipment is not totally offset by increased efficiency. The gin exhibits a 28% chance of attaining average net incomes per bale above $15, but the increased debt has caused a 72% chance that the gin will experience net income between $0 and $15 per bale. Under the new plant scenario, Gin B's probability of success is much lower. There is a 97% chance of experiencing an average net loss over the 10-year time horizon. This result indicates that the added debt of a new plant cannot be offset through increased efficiency.

The results indicate that Gin B can maintain positive net incomes with an investment in new equipment to upgrade the gin and increase efficiencies. While these probabilities are not as good as under the status quo scenario, there may be considerations that would allow this gin to take the greater risk. Under the scenario in which Gin B incurs debt to build a new gin plant, the probability that the gin would experience substantial financial stress and possibly failure are high.

Gin B – Ending Equity Position

Historical figures for Gin B show that its equity has ranged between $1.5 million and $2 million; therefore, a $1.75 million figure was used for evaluation. Since the status quo and new equipment scenarios showed high probabilities that this gin would experience a positive net income over the study period, the probability of ending equity being greater than $1.75 million was 100% for both scenarios.

However, under the new plant scenario there is a probability that ending equity could be negative for Gin B given the substantial additional debt load. The gin did not have enough production volume to offset these debt payments through increased efficiency. Therefore, by year 8 there is a 69% probability that equity would be negative which makes it doubtful that this gin would survive under the new plant scenario.

Gin C – Net Income

The results indicate that Gin C has a 100% probability of having a positive average net income over the 10-year time horizon under the status quo scenario; however, only a 5% chance of net income greater that $15 per bale.

In the new equipment scenario, the probabilities for net income are similar to the status quo; however, the added debt burden that accompanies the newly purchased equipment is not totally offset by increased efficiency. The gin exhibits a 100% chance of attaining average net incomes per bale between $0 and $15 per bale.

Under the new plant scenario, Gin C's probability of success is much lower. There is a 95% chance of experiencing an average net loss over the 10-year time horizon. This result indicates that the added debt of an entirely new plant cannot be offset through the increased efficiency for this gin.

It should be noted that the financial performance for Gin C with regard to net income is lower than Gin B. In general, it would be expected that the larger gin would perform better. However, in the case of this particular representative gin for the 45,000 to 60,000 bale category, debt and total liabilities had increased significantly during the 5-year period 2003 - 2007, which may indicate that the gin had been making new investments in upgrades to their ginning plant during this time period. Therefore, the level of debt already acquired may have had an effect on the profitability indicated in the study period.

Gin C – Ending Equity Position

This representative gin began the study period in a strong equity position, with $3.3 million in equity. Under the status quo scenario, the probabilities are that the gin will maintain or increase equity over the study period, with a100% chance of equity greater than $3.0 million for all years shown.

Evaluation of the ending equity projections for the new equipment scenario shows somewhat similar results, with a 95% chance that in year 2, the gin will still retain ending equity above $3.0 million. This trend continues throughout the study period, with a 100% probability of equity greater than $3.0 million in year 8. The new plant scenario presents a much different picture. The significant debt associated with this scenario increases the likelihood of a decline in equity and an increase in financial stress. By year 8 of the time horizon there is a 33% chance of a negative equity.

Gin D – Net Income

Gin D represents gins in the category with average bales greater than 60,000 annually. The projected net income results indicate that Gin D has a 100% probability of having an average net income greater than $15 per bale over the 10-year time horizon under the status quo scenario. These results are consistent with results over the five-year period of historical data, where Gin D sustained a positive net income each year with the minimum per bale net income of just over $19 per bale. The results for the new equipment scenario are very similar to the status quo, suggesting that the efficiency gains offset the cost associated with the debt from the new investment. However, under the new plant scenario the probability of net income greater than $15 per bale declines to 22% and a probability of net income between $0 and $15 per bale is 78%.

Gin D – Ending Equity Position

The gin began the study period with $3.8 million in equity. Under the status quo and new equipment scenarios, the gin exhibits a 100% chance of ending equity being greater than $4 million in all of the years shown. Under the new plant scenario there is a 15% and 4% chance of a ending equity between $0 and $4 million for years 2 and 5; however, by year 8 the probability of ending equity greater than $4 million is 100%. Therefore, it appears that Gin D has a high probability of maintaining and growing equity over time.

Conclusion

Generally, higher volume gin plants tend to do better financially than lower volume gin plants. There appears to be a significant break in terms of profitability between the lowest volume gin and the highest volume gin. To survive in the long-term, gins will need to become right-sized for their territorial volume or else continue to consolidate and grow where feasible.

The results indicate that smaller gin plants are in a much more vulnerable position financially than larger size gins. The larger size gins have significant equity and production, in general, to survive long-term and to also incorporate new technologies that will lead to better and more comfortable ginning arrangements for the employees with quicker ginning times to satisfy customers.

There is pressure for gins to increase capacity to better serve their current customers in providing timely ginning and to have a manageable ginning season. The larger gins appear to be able to expand through upgrading equipment and still manage risk. The lower volume gins may not be able to expand unless there is an expectation that ginning volumes will increase at a rate greater than that incorporated into the analysis. These gins may be candidates for mergers or consolidation to reach a volume to justify new investment.

All of the representative gins have a better per bale net income in the status quo scenario. This might lead to the conclusion that the gins are presently at their optimal size for their ginning volume.

On the other hand, it is apparent from an individual consideration of Gin C's historical information, specifically related to a drastic increase in liabilities and interest expense without accompanying increases in capital, that this gin has already made the decision that additional capital outlays are important.

Without detailed gin specific information, it is difficult to determine the actual reason for this increase if the gin was already at its optimal size, but it can be concluded that there was some pressure on this gin to both increase capacity and shorten the ginning season. It might also be concluded that this pressure might have originated from the need to shorten the ginning season due to pressure from customers to have their cotton ginned in a timelier manner or it may have related to the lack of available skilled ginning labor available. Either way, it is apparent that this gin made the decision to increase capacity even at the expense of both per bale net income and ending equity.

This leads to a conclusion that while the representative gins appear to be at their optimal size when the status quo is considered, other pressures unrelated to financial considerations have placed pressure on gins to increase capacity and shorten their ginning cycle.

Limitations

The gins in this study are all anonymous meaning the researcher was unable to discuss the individual situation with the ginning firm's management. The specific level of efficiency that a gin can achieve from adding new equipment or building a new plant can only be determined by discussion with management. Thus, the efficiency gains assumed of 5% for the new equipment scenario and 15% for the new plant scenario were arrived at through discussions with numerous knowledgeable people in the industry.

Custom ginning income and expense are seen occasionally in the historical data of some gins. In discussions with gin managers and experts, it has been determined that these amounts cannot be modeled. The reason for this is that the decision of whether or not to gin cotton for another gin or the decision to send cotton out for ginning are the decisions of individual gin managers. Some gin managers will never do so due to bad prior experience, while other gin managers do this frequently. Additionally, bale per hour requirements obtained from D Williams and Co., show that the gins in the study do not typically receive enough cotton to exceed either their efficient or maximum bale per hour and days per season capacity, but at least one of these gins has used custom ginning in the past. The need for custom ginning occurs from rare instances of huge crops in a certain territory or catastrophic breakdown of machinery that cannot be timely repaired. In addition, in disastrous crop years gins may consolidate and run only one plant where volume is too small to justify operating all the competing plants.

Selection bias is also a limitation of this study because four individual gins were chosen as representative gins. These gins were chosen based upon how well their average ginning volume resembled the average ginning volume of the gins within that size category. This may lead to conclusions that would be different had a different gin been chosen. On the other hand, while this is a limitation of the study, there is also a benefit of choosing just one individual anonymous gin to study in each size classification.

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