Basis trends in North Carolina and their effect on corn prices

By

DANA MARSHALL

B.S., Iowa State University, 2006

A THESIS

Submitted in partial fulfillment of the requirements

for the degree

MASTER OF AGRIBUSINESS

Department of Agricultural Economics

College of Agriculture

KANSAS STATE UNIVERSITY

Manhattan, Kansas

2017

Approved by:

Major Professor
Dr. Vincent Amanor-Boadu

ABSTRACT

Livestock production is a crucial industry in North Carolina. Broilers, turkeys, and hogs all have tremendous amounts of production numbers that are steadily growing particularly on the broiler side. This thesis seeks to explore the trends in three basis indicators and explore their effects on corn prices in North Carolina. Given the significant role corn plays in livestock production in the state and the deficit situation it finds itself in with respect to corn, these analyses may illuminate some challenges that may adversely affect the long term competitiveness of the poultry industry in the state. Already, hog and turkey production seems to be migrating out of the state possibly due to feed costs. The importance of this study is to help identify innovative solutions to arrest the increasing adverse effects of feed costs on North Carolina's livestock industry.

Using statistical analyses and data on corn prices and three basis indicators, CSX-90, Norfolk-Southern 75, and Truck Only, we show that while corn prices, on average, have declined slightly over the past several years, the transportation costs associated with moving corn into North Carolina have increased for all three options evaluated. The average growth rate in CSX 90 was approximately 7.4% per annum compared to 7.7% for NS-75 and 12.4% for truck only. Thus, while average annual trucking costs were lower than the rail transportation by between 82% and 92%, it was growing at more than 50% the growth rate in rail prices. Interestingly, we observe that the difference between the paired basis were all statistically significant at the 1% level. For this example the difference between the monthly average CSX 90 and trucking only was about $0.29, with a t-statistic

of 17.34 and a p-value of 0.00. Similarly, the difference between the monthly average CSX-90 and NS-75 was $-.04, with a t-statistic of 3.35 and a p-value of 0.00.

The foregoing reveal the advantage of sourcing corn via trucking given its lower basis. However, the higher variability in trucking compared to rail and the rapid growth rate in trucking suggests that an innovative strategic approach be adopted to overcome its potential long-term effect on corn prices. We show that a careful assessment of what the livestock industry in North Carolina is currently doing and what it needs to do could shed light on how to deal with this situation. Fixed assets like feed mills, production facilities, and slaughter facilities determine the type of access to outside rail or access to local markets. These assets are unlikely to change and therefore it is important to build an efficient supply chain to decrease marginal costs.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ACKNOWLEDGMENTS

The MAB program at Kansas State University has been a wonderful addition to my growth as a professional. I can't begin to explain how much it has helped to shape my framework for a higher level of thinking, beyond the local level. In my eyes, the highest value gained from this program in addition to the area of study really had a lot to do with my wonderful classmates. THE MAB Class of 2017 is a group of fantastic individuals that I can guarantee will be a part of my life for many years to come as colleagues and as personal friends. I know that I can call on any of you for help or for an opinion and you'll be ready and willing to serve or provide guidance.

I would also like to thank Dr. Vincent Amanor-Boadu for stepping in and helping me when I was a little lost on where to go, his emphasis on the ERIC model of Blue Ocean Strategy will definitely be a long term addition to my strategic thinking process. I would also like to thank the wonderful staff of the MAB program for all your assistance along the way as well as my other committee members Dan O'Brien, Arlo Biere, and Christine Wilson. Thanks for understanding the unique personalities of our tightknit class. I would also like to thank my boss Stephen Fletcher III for his support and encouragement throughout this program. I can't tell you how much I appreciated everything you have done for me. I would also like to thank Mr. Tim Frump, for providing counseling on topics when I was stuck and needed help. It really means allot when your employer is an advocate for education. In closing, thanks to my family and friends for understanding the time and commitment it took to get through this program.

CHAPTER I: INTRODUCTION

1.1 Background

North Carolina is one of the most agriculturally diverse states in the nation. Soil types ranging from sandy to the mineral rich soil, known as the Blacklands located along the coast, allow North Carolina to grow a wide range of crops. It is estimated that more than 8.2 million acres controlled by 48,000 farms are in production within the state (USDA-NASS 2016). The state produces tobacco, sweet potatoes, corn, soybeans, cotton, tree fruits, and wheat among others. It's top livestock products are broilers, turkeys, layers, hogs, and pullets for laying flock replacements. Table 1.1 summarizes the top crops and livestock industry by acres and total number of head. The table shows that while the top livestock industries in North Carolina are all within the top ten producing states in the United States, none of its top crops are in the top 10 with the exception of winter wheat for grain.

As a whole, poultry production in North Carolina is the state's largest industry and also the largest in the nation, and makes up more than 40 percent of North Carolina's farm income. Some of the largest poultry integrators in United States have birds in North Carolina (Farm Flavor 2017). The livestock industry within this state requires a tremendous amount of feed grains to support that production. Corn, soybeans, and wheat are top feed grains for the livestock industry of North Carolina. Their production is supported by grains grown within the state and surrounding regions as well as grains imported into the region both domestically and from abroad.

Table 1.1 Top Crops and Livestock in North Carolina by Acres and Numbers and Rankings in the US (2012 Census)

TOP CROPS	Acres	U.S. Rank
Soybeans for beans	1,564,806	15
Corn for grain	803,020	18
Wheat for grain, all	753,713	13
Winter wheat for grain	753,489	10
Forage-land used for all hay and haylage, grass silage, and greenchop	643,186	28
TOP LIVESTOCK INVENTORY	Number	U.S. Rank
Broilers and other meat-type chickens	148,251,469	4
Turkeys	17,191,277	2
Layers	13,091,384	8
Hogs and pigs	8,901,434	2
Pullets for laying flock replacement	6,239,251	8

Source: (USDA-NASS 2016)

However, as Table 1.2 shows, the only livestock industry increasing in numbers is broilers. Indeed, while broilers have increased by 5.3% between 2007 and 2015, turkeys and hogs both declined by 17.5% and 9.1% respectively. The principal reason for these declines may be the increasing cost of feed, especially corn, which forms the majority of livestock feed in the state. It is envisioned that the increasing cost of corn is more a result of transportation costs associated with moving it into the state and not necessarily increases in aggreiate average U.S. corn prices. This is evidenced by the migration of turkeys and hogs to the Midwest where corn basis is lower compared to North Carolina.

Table 1.2 Number of Broilers, Turkey, and Hogs in North Carolina (2007-2015)

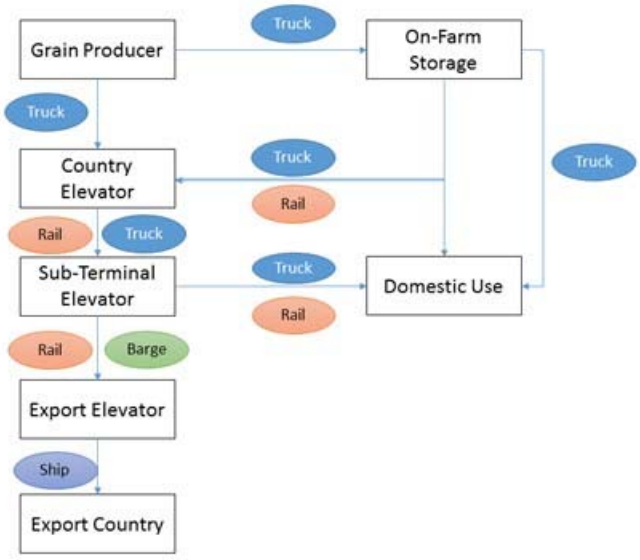
Year	Broilers	Turkeys	Hogs
2007	781,200	40,000	17,976
2008	796,100	35,500	19,529
2009	759,600	30,000	18,839
2010	766,500	32,000	17,676
2011	786,900	36,000	16,111
2012	799,600	33,500	16,636
2013	786,600	28,500	17,081
2014	795,200	31,000	15,243
2015	822,700	33,000	16,346

Source: (USDA/NASS Quick Overview 2015)

The effective movements of these feed grains is critical to the sustained competitiveness of North Carolina in its position as a major livestock producer in the U.S. The U.S. is the leading feed wheat, corn, and soybean producer in the world. It is obvious from Table 1.1 that feed grain production and livestock production do not necessarily occur in the same location. In these feed deficit locations, feed has to be moved from places of production to where livestock production is occurring. The process of moving grain from producers to end users is illustrated in Figure 1.1, an adaptation of the Transportation Research Board of National Academies (2011), (Transportation Research Board of the National Academies 2011). While the figure illustrates an example of grain moving for export, it also shows the steps of movement. The same process is followed when grain is moved outbound to an end

user for domestic use such as to the heavy broiler and pork sectors of North Carolina. The movement of these grains is mostly controlled by the class I railroads. The class I railroads of the United States are as follows: Burlington Northern Santa Fe, Canadian Pacific, Union Pacific, Norfolk-Southern, and the CSX. In addition to class I railroads, there is a large amount of grain that is moved via the US waterways systems with the use of barges to export facilities near the coasts. Shuttle trains have become a gold standard in regards to grain movement. Within the state of North Carolina, two class I railroads predominate the movement of grain within the state. These two class I railroads are the CSX and the Norfolk-Southern. Grain is moved from the Midwest to North Carolina on these Class I railroads with the use of hopper cars. The hopper cars are either owned by the livestock company purchasing the grain, leased privately to the livestock company, or leased on a trip by trip basis from the railroad. The hopper cars are moved into North Carolina in several fashions. Unit trains or groups of hoppers are moved into the state via the class I railroads. On the Norfolk-Southern, shuttle trains are moved into the state in mostly increments of hoppers ranging from 75-85 cars and also single car movements are available. The CSX offers shippers the option of 90 car blocks or 65 car blocks as well as single car movements (CSX 2016). According to CSX, "Unit Trains are a safe, efficient way to ship grain (CSX 2016)."

Figure 1.2 Alternative Paths for Grain Movements in the U.S.



Source: Adapted from the Transportation Research Board of the National Academies (2011.)

1.2 Problem Statement

North Carolina is a leading producers of poultry and hogs in the United States. Yet, it is not a major feed grain producer. This means there has been a need to move significant volumes of corn and soybeans into the state from other parts of the country and the world. There are two major means of moving feed into North Carolina: rail and roads. The different modes of transportation engender different basis for imported feed. What have been the trends in the basis for both rail and road transport for corn in North Carolina? What can the livestock industry do to minimize the effect of any adverse trends in corn basis on their competitiveness? These are motivating questions for this research. It is envisioned that addressing them would illuminate some viable pathways for the livestock industry in the future.

1.3 Objectives

The overall objective of this research is to identify the forces driving up corn cost in North Carolina and explore innovative ideas on how these costs may be controlled to enhance the economic viability of the state's poultry and pork industries. The specific objectives are as follows:

1. Conduct a trend analysis of corn prices and alternative rail and trucking basis in North Carolina with the view of ascertaining their growth rates over the past decade.
2. Estimate the difference between the different basis types and assess their implications for feed grain movement into North Carolina.
3. Conduct a strategic analysis of alternative approaches to mitigating the challenges posed by basis trends with the view of enhancing the competitiveness of poultry and hog industries in North Carolina.

1.4 Outline of the Thesis

The foregoing chapter provided an overview of the research problem and the objectives. A review of the literature is presented in Chapter 2. Chapter 3 presents the theoretical foundations of the research, the data and the analytical methods used in the analyses. Chapter 4 covers the results and discussion of their implications for the North Carolina livestock industry. Chapter 5 provides a strategic analysis of the industry and potential approaches to mitigating the challenges posed by basis trends. A summary and conclusion as well as suggestions for further studies are presented in the final chapter.

CHAPTER 2: LITERATURE REVIEW

Higher corn costs have become a problem over the last decade for a variety of reasons. These include rail performance, rate changes, and competition from coal hauling. Additionally, competing uses for corn, e.g. for ethanol, has put some pressure on prices.

In this chapter, we present a review of the forces underscoring the observed trends in corn basis in North Carolina. We look at rail performance and rate changes and then discuss the issue of captive shippers and the effect of that on transportation pricing. We also provide an overview of the ERIC model, which is used as a framework for assessing the strategic actions that the industry may take to address the adverse effect of the trends in transportation costs on its competitiveness.

2.1 Rail Performance

First and foremost we considered rail performance which is a crucial factor to the success of the grain and livestock industries of North Carolina. Over the past five years, the grain industry has faced some challenging times as a direct result of poor rail performance (Sterk 2014). The poor performance has affected cash grain basis level, profit margins, and unfortunately in some areas of the country the ability to harvest crops. The poultry and pork industries of North Carolina are mostly dependent on this resource to meet their corn needs for a large part of the crop year. In the production of livestock, one of the highest expenses is feed costs. As stated by Roy Roberson, "Feed makes up 70 percent of the cost of feeding livestock and historically the bulk of this feed has been corn, most of it sent to North Carolina by rail from the Midwest (Roberson 2013, 1)." Like other costs transportation costs are continuing to go up and reach record levels (Roberson 2013). Roberson also states that, "Large Livestock integrators are left to ponder the reality of continuing in the

livestock business in the region (Roberson 2013, 1)." The economic viability of the livestock industry of North Carolina depends on timely service of grain shuttles. Periodically the supply chain experiences capacity limits which can cause unpredictability, which adds to the total cost of transportation (Gallagher 2005).

2.2 Rail Transport Rate Changes

Rail rates in the Southeast have increased because of rail performance, as discussed above, as a result of volume of coal transport and other others. The fixed costs of railroads tend to be very high. There are investments in rail hardware, locomotives, and rail cars. Their fixed costs account for a higher portion of their total costs than in most other industries (Pittman 2016). Norfolk Southern Railroad moved about 788,690 cars loads of coal in 2016 which is a decrease of nearly 190,000 carloads of coal from its coal carloads of 2015 (Norfolk Southern 2016). That level of coal is more than the total grain car loads hauled in 2015 (Norfolk Southern 2016). With these reductions in carloads, the rail companies attempt to manage their costs by furloughing their crews. These furloughs have the potential to disrupt services, which can slow down grain movements from production areas to demand areas.

Pittman (2016) notes that; "Coal remains the single most important commodity for US railroads, but the volume carried has been declining since 2008 (Pittman, Changes in the Role of US Railroads as Haulers of Coal and Crude: Causes and Consequences 2016, 2)." Fortunately for the railroads, the decline in coal has been abated somewhat with an increase in oil, and other fossil fuel products since 2010 (Pittman 2016). The volatility in the volumes of these fossil fuel products, particularly shale extracted from the Balkans of the Dakotas and the rapid increase of hauling these products have led to disastrous accidents.

As a result, new regulations have been imposed on the railroads in attempt to reduce some of these accidents (Pittman 2016).

As indicated earlier, coal shipments have declined. A primary reason for this is that, electricity generation, a previously important use of coal, has been replaced by new energy inputs, especially natural gas which is transported via pipelines to the processing plants (Pittman 2016). Another reason for the slowdown of coal shipments is the increase of environmental regulations. The following series of legislation have had a dramatic impact on the coal industry: Cross State Air Pollution Rule of 2015, the Mercury and Air Toxics Program of 2011, New Source Performance Standards of 2013, and finally the Clean Power Plan proposed by the Environmental Protection Agency 2014 (Pittman 2016). In addition to the legislation listed above, electricity usage in the United States has been stagnant since 2007 (Pittman 2016). The recession and in turn the decline of the manufacturing industry has taken a significant impact on the total electricity usage in the United States. As the recession has ended, electricity usage has begun to increase and the total usage has continued to rise since 2011 (US Energy Information Administration 2015).

As the tonnage of coal continues to drop and an increase of crude oil continues to rise, grain shippers are continuing to feel the impacts on the rail lines particularly at harvest where the need to use the lines heavily increases (Pittman 2016). The struggle to balance the shipment of feed grains continues throughout the year due to crew furloughs around the grain belt. Crew furloughs have become a common place to make up for lost revenues and control variable costs along the transportation chain. Service interruptions directly impact shippers economically in the loss of potential revenue. Some examples include containers not making it to port to load onto vessels, shutting down an elevator due to no capacity to

unload inbound trucks, and not making timely shipments to end users which can result in higher replacement costs. Poor transit times, inconsistent delivery, quality of customers service, lack of competitive rates, and communication are all problems shippers report annually (Johnson 2000). Concerns from shippers often result in changes in transportation modes or rail lines until issues are resolved and the shipper regains confidence in the railroad (Johnson 2000).

2.3 Economics of Captive Railroad Shippers

The Staggers Act of 1980 was created in response to a struggling rail industry of the 1970s where railroads were on the brink of bankruptcy. The Act allows railroads to price routes according to market demand and operate more efficiently (Association of American Railroads 2016). In addition, the Staggers Act allowed shippers to enter into confidential contracts, streamlined procedures, and in general gave railroads more market power (Association of American Railroads 2016). In turn, the Staggers Act created a captive audience of shippers and receivers who are dependent on the railroads for service. A captive shipper is a term used to describe a shipper/receiver who lacks alternative means to transportation other than the single railroad system (Pittman, The Economics of Railroad Captive Shipper Legislation 2010). North Carolina is no exception to the captive shipper situation. Livestock producers within the state are captive shippers and receivers of corn. Pittman states that, "Some Shippers have complained that a lack of competition among railroads adversely affects their shipping options and makes them "captive" to high rates charged by the railroad companies serving them (Pittman, The Economics of Railroad Captive Shipper Legislation 2010, 3)." These complaints have occurred for many years but now carry more weight due to the high profits experienced by railroads in react years on top of dramatically increased rates (Pittman, The Economics of Railroad Captive Shipper

Legislation 2010). The majority of the large livestock integrators of North Carolina have a large leased and/or owned network of hopper cars that service their needs. Many of these integrators pay all of the freight to their final destination and therefore they are captive receivers of grain. The assets are established and many have few alternatives to rail. Captive shippers do have some regulatory protection, but more protection may become necessary in the years to come (Pittman, The Economics of Railroad Captive Shipper Legislation 2010). The 2000's have brought some of the highest increases in rail rates for grains which has left the captive integrators of North Carolina looking for others options to lessen the burdens of these higher rail costs (Pittman, The Economics of Railroad Captive Shipper Legislation 2010).

2.4 Ethanol Production and Higher Corn Prices

Another possible source of higher corn transportation costs may be a relationship between increased ethanol production and higher corn prices. Ethanol production experienced a sharp rise in the United States in 2002, when production was increased due to tax benefits and direct subsidies (Cunningham 2009). Table 2.4 shows that ethanol production has been increasing steadily since 2002 and continues to be a strong source of support for corn prices in the United States. Ethanol as well as an increased demand for world grains have been contributing factors to the increased costs of feed grains as associated with livestock production (Cunningham 2009). The demand for feed grains is likely to increase in the years to come as ethanol production continues to rise. As the demand for ethanol has continued to rise, so has the price of corn (Cunningham 2009). Farmers have responded to the increased need for ethanol by planting more corn acres.

Donohue and Cunningham (2009) outlined the effect of grain and oilseed prices on the costs of US poultry production. Their study sought to look at factors impacting rising feed

ingredient prices impacting the industry since 2006 (Cunningham 2009). Although nearly a decade old, their study provides interesting insights into how corn shipping costs could affect feed costs in North Carolina. Using Agristats data, Donahue and Cunningham (2009) show that feed ingredient costs can have significant adverse effect on poultry industry profitability. For example, because corn and soybeans together account for about 95% of poultry diet, and corn alone accounts for about 60%, any significant changes in their prices can have significant effect on profitability. A major component of these products landed at the facility is transportation costs. Thus, as transportation costs increase even when the ingredient cost itself is declining, it can lead to an adverse effect on industry profitability.

Volatility in the grain markets introduced another source of concern for poultry producers. Increased demand in commodities have affected prices in the industry. The writers of this article contribute the rise of ethanol as a factor contributing to the increase demand for corn as highlighted in Table 2.4 which show the total ethanol production numbers from 2002 through 2016. The primary input in ethanol produced in the United States comes from the use of corn (Cunningham 2009). At the height of the demand for ethanol and also due to speculative trading on fears of a short crop in May of 2009, corn prices soared to more than $8.00 per bushel (Cunningham 2009).

The findings by Donahue and Cunningham (2009) indicate that for every $.10 per bushel increase in corn it adds $0.01 per pound to feed ingredient expenses per pound of live weight produced (Cunningham 2009). In addition to the actual cost of corn other factors influence these ingredient costs and are as follows: distance of feed mill to core grain producing locations, number of rail cars able to receive, and futures position of the company (Cunningham 2009).

Table 2.4 Ethanol Production Percentage of Total US Corn Supply

Year	Total Bushels of Corn Produced(in Billions)	Ethanol Bushels of Use (in Billions)	Percent of Usage
2002/2003	9,507	996	10.48%
2003/2004	10,089	1,168	11.58%
2004/2005	11,807	1,323	11.21%
2005/2006	11,112	1,603	14.43%
2006/2007	10,535	2,119	20.11%
2007/2008	13,038	3,049	23.39%
2008/2009	12,092	3,709	30.67%
2009/2010	13,092	4,591	35.07%
2010/2011	12,447	5,019	40.32%
2011/2012	12,360	5,000	40.45%
2012/2013	10,755	4,641	43.15%
2013/2014	13,829	5,124	37.05%
2014/2015	14,216	5,200	36.58%
2015/2016	13,602	5,206	38.27%
2016/2017	15,148	5,350	35.32%
2017/2018	14,076	5,325	37.83%

Source: USDA S&D Data, NASS 2002 thru 2017

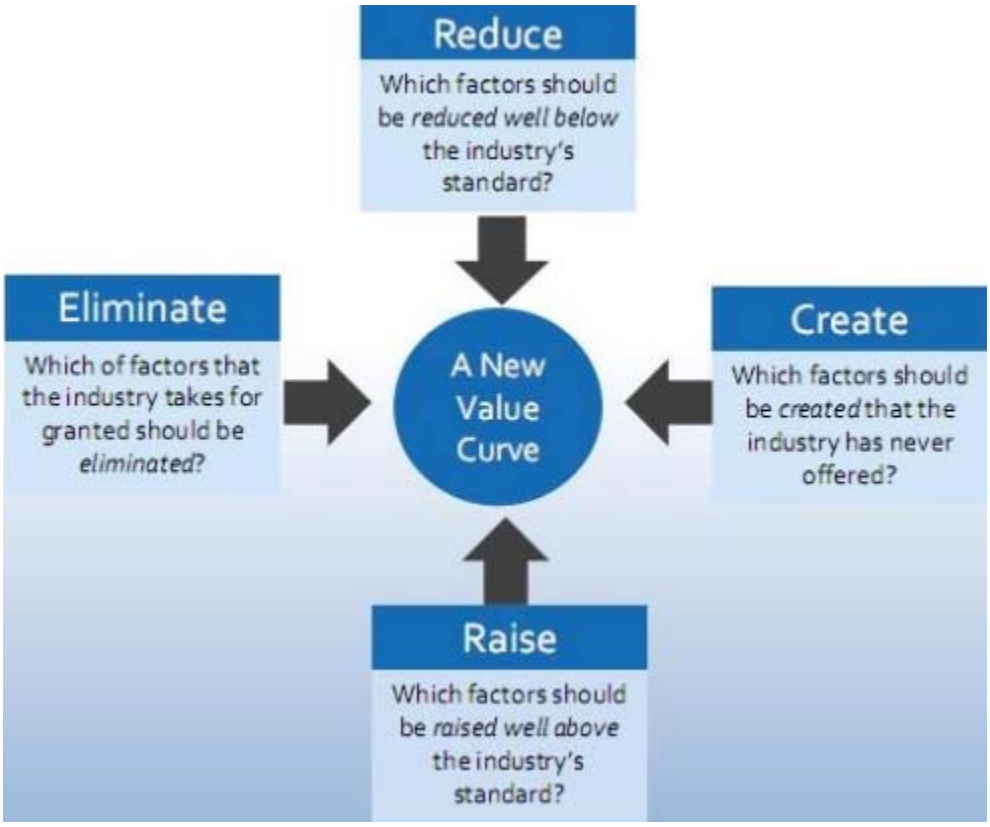
2.5 *Blue Ocean Strategy,* The Four Actions Framework

So far the discussion of framework for this paper has detailed several possible causes to higher corn costs in North Carolina. Some of these are increased ethanol production, higher rail rates, railroad performance issues, and increased livestock numbers in North Carolina. While these causes provide a framework for understanding the problem, they do not provide a picture of how changes can be made to decrease the impact of these factors. Blue Ocean Strategy provided a groundwork for achieving a new value curve as well as a model for strategic analysis (Kim 2015).

As shown in Figure 2.5, Blue Ocean Strategy allows the factors impacting higher corn costs in North Carolina to be analyzed by addressing four important questions which in turn creates a strategic logic and business model. As outlined by Kim and Mauborgne, the four factors of consideration are reduce, eliminate, create, raise (Kim 2015, 31-37). The

factor of elimination seeks to extract factors that are taken for granted (Kim 2015). These are factors such as competition, what a buyer values, and factors that detract from the value (Kim 2015). The second factor reduce encourages a deep look into the factors that are produced well below the industry standard (Kim 2015). This factor encourages a deep dive into assets or products that may have been overdesigned in response to a direct race with the competition (Kim 2015). The third factor in hand is raise and this factor seeks to encourage a look at products, services, or assets that may need to raise beyond the standards of the industry (Kim 2015). The fourth and final factor in the blue ocean strategy framework is create. Create encourages growth of new products of services which will in turn create new demand and shift the strategic pricing of the industry (Kim 2015).

Figure 2.1 The Four Actions Framework



Source: (Kim and Mauborgne, 2015, 31)

CHAPTER III: THEORETICAL CONCEPTS, AND CONCEPTUAL MODEL AND DATA USED

3.1 Theoretical Concepts

As discussed in previous chapters there are several factors influencing corn costs in North Carolina. There are several economic principles that were applied to help generate ideas which can serve as basis to help improve efficiency as well as economic sustainability of the livestock industries of North Carolina. The basis of theory includes a trend analysis of corn basis levels in North Carolina on a monthly basis versus the monthly corn close for the respective month of evaluation. Managerial economics lends a theory that trend analysis can be used to project future performance. This is based on the premise that an established pattern can be used to predict future basis activity (Managerial Economics 2017).

Cash corn for the premise of this project is the close of the Chicago Mercantile Exchange corn contract on the 15th of each plus or minus a premium or basis difference delivered to three different feed mills in North Carolina that have different types of access to grain. For example if an elevator is paying +90 CZ17 and the December corn board closed at 3.98 the cash price at the feed mill would in turn be 4.88 delivered to the elevator. See section 3.3 for detailed information about the basis factors evaluated in this study. This economic technique provides an assumption that data such as corn basis and corn price can be predicted based on the relationships between the factors in the past (Managerial Economics 2017). Time series forecasting is an excellent tool for use in forecasting for businesses as trends often develop and show long term increases or decreases over time.

Using the Blue Ocean Strategy Framework, a strategic analysis was conducted to look for performance based initiatives that could be implemented with the poultry and swine

production industries of North Carolina to aide in the mitigation of higher corn costs. Given what we have learned and is outlined in the data section of this thesis on the price relationships, this will help achieve the goal of filling in gaps that could provide possible monetary relief. The four action framework of reduce, eliminate, raise and create applied to the strategic canvas of the poultry and swine industries of North Carolina provides a plan for current logic by looking at alternatives as well as customer relationships (Kim 2015). The application of this strategy is meant to serve as a platform to enhance competiveness of poultry and hog industries in North Carolina.

3.2 Methods of Research

This chapter will present the methods used in this research. This study was conducted using a four step approach. The first method of study conducted was a trend analysis of monthly corn prices and basis in North Carolina and a growth rate was created. Next, a look into trends for alternative transportation systems in North Carolina was addressed. In addition to the two methods listed above implications of these basis trends in North Carolina were addressed. Finally, the methods of study was completed with a strategic analysis of the industry with performance-based initiative suggestions. The information needed to estimate included corn basis information for three locations in North Carolina and monthly corn close prices.

3.3 Variables Evaluated

Three sources of data were evaluated in this method of study and the source of the information comes from monthly basis levels for the following scenarios of livestock production in North Carolina. One CSX-90 car feed mill, one NS-75 car facility, and one truck only option. All data used in this study were collected by compiling relevant

information from the North Carolina Ag-USDA Market News from January 2006 through December 2016 (Beasley). A more through discussion of these factors is listed below:

3.3.1 CSX-90 Car Feed mill

Data is this set is basis information tributary to a CSX-90 car feed mill. The basis is cost delivered to the feed mill and reflects the higher costs associated with moving the corn into North Carolina from the Corn Belt. This basis reflects Midwest basis plus an additional transportation cost delivered to the facility. A CSX-90 car feed mill is a facility that is equipped to handle 90 car blocks of hopper cars at one time. Shuttles are a more efficient use of railroad equipment so lower rates are offered to entice participation from shippers and receivers. These cars must be unloaded in a 24 hour period and released from the facility. Failure to unload in a pre-determined time will result in a pre-negotiated penalty in the form of additional costs to the facility. In addition to CSX-90, additional corn receivers in North Carolina have facilities that can only handle CSX-65. At present there are shuttle rates available for both options, but the CSX would like to phase out this option in the future, which would force facilities to upgrade at a higher cost or be subject to single car rates.

3.3.2 NS-75 Car Feed mill

Data is this set is basis information tributary to NS-75 car facility. Similarly to the CSX-90 car facility this basis information reflects the local Corn Belt basis and an additional transportation cost delivered to North Carolina. A NS-75 or Norfolk-Southern 75 car feed mill is a facility that can handle blocks of at least 75 cars at one time. These shuttles must be unloaded in a pre-negotiated amount of time or facilities will face demurrage costs. Demurrage is a cost associated with a delay of load or unload of a hopper car which would result in higher costs to the facility. NS like CSX is suggesting that facilities upgrade to a

capacity of 85 as the 75 car rate will eventually be phased out over time which would result in higher transportation costs to the facility.

3.3.3 Truck Only feed mill

The third basis factor discussed in this study is a truck only option delivered to a feed mill in North Carolina. The basis associated with this data point is the total truck cost of delivered to the feed mill. CME cash corn plus or minus a local basis. This feed mill has the ability to buy local corn from farmers and dealers to supply their needs throughout the crop year. The basis changes in this scenario change based on local market availability, competition from other end users, and timing of the crop.

CHAPTER IV: RESULTS AND DISCUSSION

The results from the foregoing analyses are presented in this chapter. The chapter is organized as follows. We begin with the presentation of the summary statistics for principal data used for the study. We then look at the trends in corn price in North Carolina. We follow this with the results and discussion of the trends in the basis for corn for three different transportation options available to the industry. The final section of the chapter addresses the implications of the trends for the industry, setting up the stage for strategic considerations.

4.1 Summary Statistics North Carolina Basis Trends

Table 4.1 shows the summary of the data provided in the model and was evaluated for the average basis, the standard deviation, the minimum, and maximum basis levels. The average corn price between January 2007 and December 2016 was $4.82 per bushel, with a minimum of $3.24 occurring in August 2007, and a maximum of $8.14 occurring in July 2012. The standard deviation for corn prices over the period was $1.40. The maximum was an abnormality because of significant shortages in feed and an unusual spike in prices.

The CSX-90 portion of the table is the basis level delivered to the feed mill and reflects an average basis of $0.64 a standard deviation of $0.19, a minimum of $0.20 and a maximum of $1.65. The maximum occurred in July 2013 while the minimium occurred in September 2008. The NS-75 presented an average of $0.68 per bushel, with a standard deviation of $0.23, a minimum of $0.20, and a maximum of $2.00. The maximum for NS-75 occurred in August 2013 while the minimum was observed in September 2008. Thus, both NS-75 and CSX-90 presented their lowest basis between 2007 and 2016 in the same month and their highest basis were a month apart. Truck Only presented an average basis

of $0.35, with a standard deviation of $0.22. The minimum for Truck Only over the past decade was -$.15 while its maximum of $1.33. They occurred in October 2007 and July 2013 respectively.

Table 4.1 Summary Statistics North Carolina Basis Trends in $/bushel (January 2007-December 2016)

Variables	Average	Std. Deviation	Minimum	Maximum
Corn Price	4.82	1.40	3.24	8.14
CSX-90	0.64	0.19	0.20	1.65
NS-75	0.68	0.23	0.2	2.00
Truck Only	0.35	0.22	-0.15	1.33
CSX-90 Cash	5.49	1.47	3.76	9.04
NS-75 Cash	5.50	1.47	3.76	9.04
Truck Only Cash	5.17	1.43	3.3	8.49

The cash situation for the the three transportation modes averaged $5.49. $5.50 and $5.17 for CSX-90, NS-75 and Truck Only respectively. The standard deviations and minimums and maximums for both rail options were identical but Truck Only Cash posted lower variability and boundaries. The reason for the observed summary statistics may be because of the relative proximity of grain hauled by truck compared to rail.

While the foregoing averages are different, how statistically different are they? This is important because it helps in decision making about sourcing when basis is a factor in the decision. If the differences among the transportation modes are not statistically different, then they become irrelevant in the sourcing decision, We look for other factors to make decisions by. To do this, we test three hypotheses:

$$H_0^a : \mu_C = \mu_N; \quad H_1^a : \mu_C \neq \mu_N$$
$$H_0^b : \mu_C = \mu_T; \quad H_1^b : \mu_C \neq \mu_T$$
$$H_0^c : \mu_T = \mu_N; \quad H_1^c : \mu_T \neq \mu_N$$

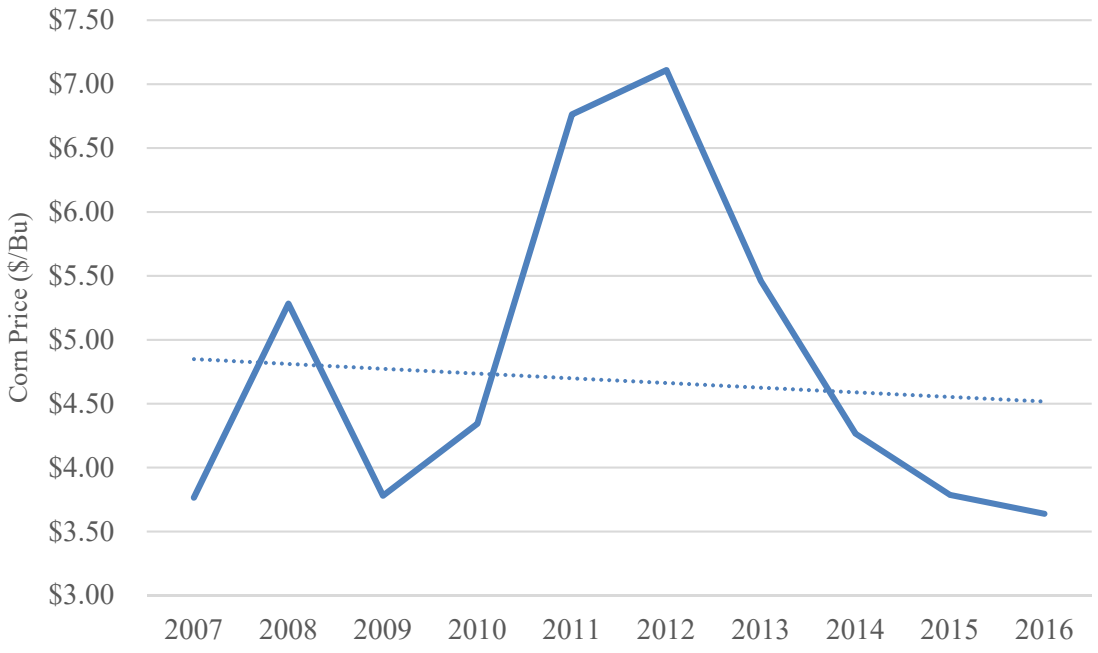
Where μ_i is the mean and C, N and T represent CSX-90, NS-75 and Truck Only respectively. The results show that the difference between the average CSX-90 and NS-75 basis of |$0.04| was statistically significant at the 1% level [(t = |3.353| and Pr(|T| > |t|) = 0.001]. That means we reject the hypothesis , H_0^a , stating that the mean basis for CSX-90 and NS-75 are equal. The results also show that the difference between the average CSX-90 and Truck Only basis of |$0.29| was statistically significant at the 1% level [(t = |17.336| and Pr(|T| > |t|) = 0.000]. This suggests that we reject the hypothesis , H_0^b , stating that the mean basis for CSX-90 and Truck Only are equal. Finally, the difference between the average Truck Only and NS-75 basis of |$0.33| was statistically significant at the 1% level [(t = |16.665| and Pr(|T| > |t|) = 0.000]. It suggests that we reject the hypothesis , H_0^c , stating that the mean basis for Truck Only and NS-75 are equal. The foregoing would suggest that it is important to take basis of the transportation mode into consideration when making procurement decisions, especially if we believe that the future trends are going to be similar to what has been observed in the past decade. The difference between the mean CSX-90 cash and NS-75 cash was only statistically significant at the 10% level. However, the differences between rail and trucking cash were statistically significant at the 1% level, just like basis. Thus, corn price was not able to overcome the real difference between the transportation modes.

4.2 Trend in Corn Prices in North Carolina

We know North Carolina is a corn deficit state. Therefore, it will not have local or regional trucking available as a sole option to livestock producers throughout the year in some locations. That constraint is reflected in looking at the overall trend in corn prices over the years and within the years. Figure 4.1 shows that over the past decade, corn prices

in North Carolina have, on average, been declining at an average rate of about 0.8% per annum. When the decade is broken into two and analyzed from 2007 to 2012 and from 2012 to 2016, we see two trends in counter motion. The average growth rate for the former was about 11.6% per annum, with an R-square of approximately 59.3%. The average growth rate for the latter one was -17.1%, with an R-sqaure of 92.2%. For livestock producers, the declining prices observed in the past few years has been a blessing in an increasingly competitive market. The question that we will explore is whether basis drives this advantage as price declines out.

Figure 4.1: Annual Trend in Corn Price in North Carolina (2007-2016)

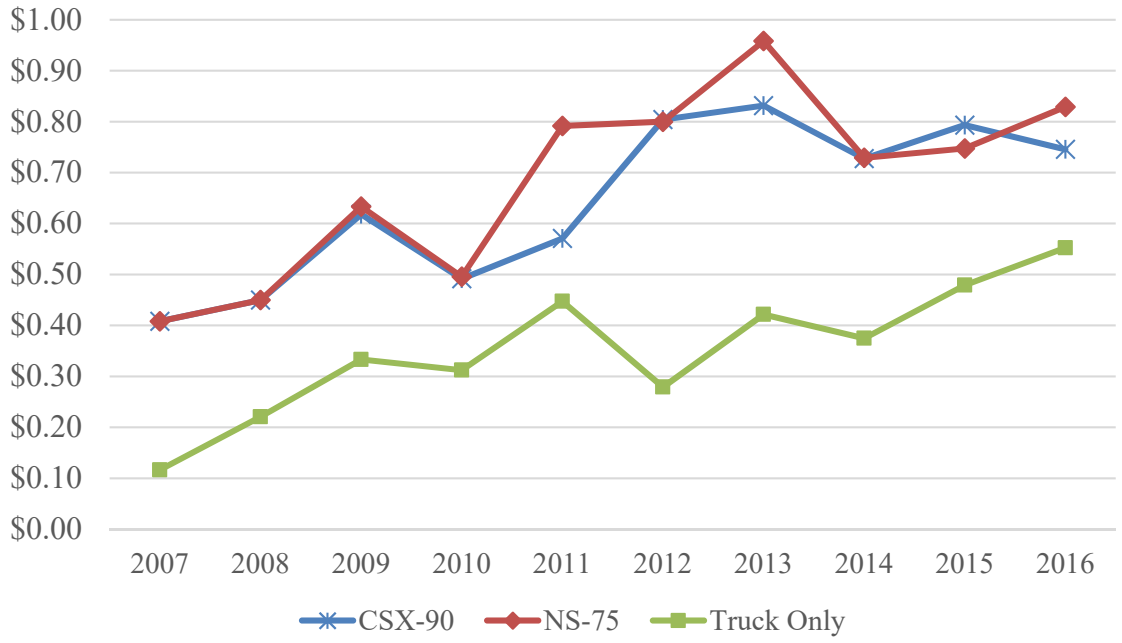


4.3 Trends in Corn Basis in North Carolina

Figure 4.2 shows the trends in the three corn basis levels considered in this study: CSX-90, NS-75, and Truck Only. The figure shows that on an annual average baisis, NS-75 has trended a little higher than CSX-90. However, Truck Only has been significantly lower than the rail options. The average annual growth rate for CSX-90 and NS-75 were

estimated respectively as 7.35% and 7.65% with R-square values of 72.9% and 64.6% respectively. Truck Only basis is shown to fall below the rail options, yet its growth rate was at 12.38% over the past decade. The fact that the rail basis levels are higher than truck only appears to be a direct reflection of the additional costs of transportation from the Corn Belt into North Carolina. The rapid growth rate in Truck Only suggests that the market will bid up trucking prices until it equalizes with the alternatives. This presents some interesting opportunities for livestock producers using corn in North Carolina to develop some strategic options to neutralize the market trends revealed in the foregoing analyses.

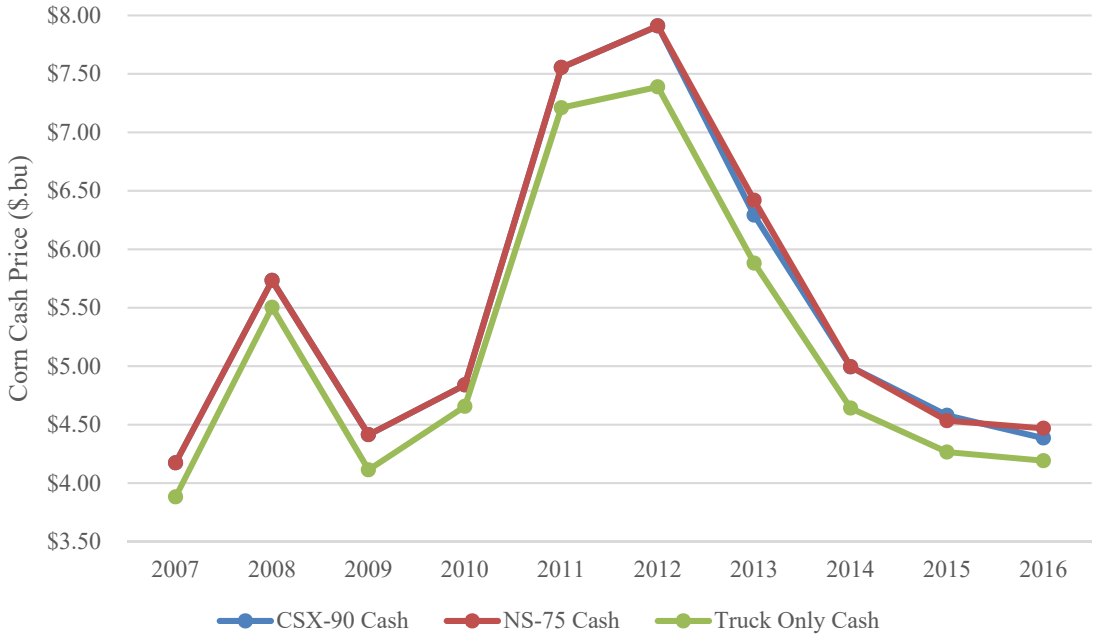
Figure 4.2: Average Corn Basis Trends for Alternative Transportation Systems in North Carolina (2007 – 2016)



What do the cash trends look like? Do they alter the foregoing trends in the basis? This is the question we turn our attention to next. Figure 4.2 shows that the level and trend for cash price for rail was nearly identical in the period after 2012. On the other hand, while the trend in trucking followed a similar pattern as that for rail, it remained lower than rail's

cash price in North Carolina on an average annual basis. The figure, however, shows that truck only cash is declining at a slightly slower rate of 14.5% per annum between 2012 and 2016 compared with almost 15.0% decline for rail cash options. This is in line with the prior observations of the market responding to the existing prices. Indeed, rail may be seen in regards to setting truck basis as the ceiling to which they move their cash price as well as their basis may move to. This is not independent, of course, of the corn supply and demand situation in North Carolina.

Figure 4.3: Corn Cash Trends for Alternative Transportation Systems in North Carolina (2007 – 2016)



A pairwise correlation analysis shows that the correlation coefficient between corn prices and NS-75 basis is the only correlation coefficient that is statistically significant at the 5% level. This would seem to suggest that the prevailing corn price in North Carolina may enter into the basis situation for NS-75 but not in the other cases. Indeed, the correlation coefficient between corn price and NS-75 was estimated at 0.23, which was

nearly 87% higher than the correlation coefficient between corn price and Truck Only basis, which was not statistically significant. The results of the pairwise correlation are presented in Table 4.2.

Table 4.2: Pairwise Correlation Coefficients Between Corn Price and Basis in North Carolina Basis (January 2007-December 2016)

	Corn Price	CSX90	NS75	Truck Only
Corn Price	1			
CSX-90	0.1389	1		
NS-75	0.2272**	0.818	1	
Truck Only	0.0346	0.6116	0.5309	1

** = Statistically significant at the 5% level

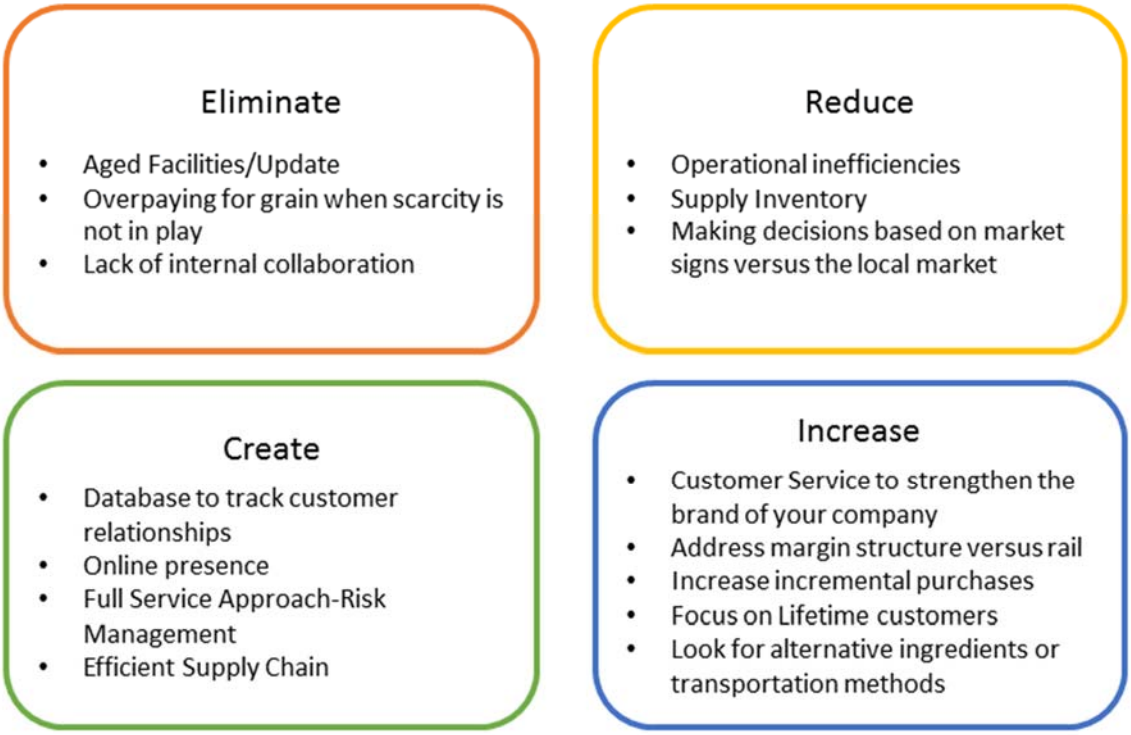
V: STRATEGIC ANALYSIS THROUGH BLUE OCEAN STRATEGY

In the foregoing sections of the thesis, we have shown that there is indeed a statistical difference between trucking and rail basis, which goes on to influence the eventual cash price experienced by livestock producers in North Carolina. These differences present some options for producers and to this we turn our attention in this chapter. The chapter is divided into two main parts: Applying the ERIC Model to the livestock industry in North Carolina; and illustrating how the industry can apply these findings to the situation confronting it with respect to corn prices.

5.1 ERIC Model Application to Livestock Industry of NC

There are choices every year that are made in business in regards to strategic planning. From what we learned in this study in regards to trends in North Carolina corn basis, building an efficient supply chain is crucial to the long term success of the livestock industries of North Carolina. Many companies spend a great deal of time searching for new ideas, services, or projects to be implemented in the near term or long term. Many of these ideas are never implemented or are simply thought of to fill a space on a document. The application of the ERIC model as outlined in *Blue Ocean Strategy* will provide a different approach to strategy. ERIC focuses on four key components to create a new value chain within your organization which are as follows: eliminate, reduce, raise, and create (Kim 2015). In Figure 5.1 listed below an ERIC model was created to conduct a strategic analysis of alternative approaches to mitigating higher feeding costs.

Figure 5.1 ERIC Model of North Carolina Livestock Industry's Corn Procurement



5.1.1 Eliminate

Eliminate as outlined previously will allow a firm to look at what factors may be dropped from an organization (Kim 2015). In the case of this model the following three factors are addressed: aged facilities, overpaying for grain when scarcity isn't in play, and lack of internal collaboration. The age of a facility and the ability to serve customers effectively is always a primary concern to merchandisers and operations management especially during crucial times at harvest. Organizations should recognize the impact these facilities have on the bottom line and keep a conscious watch of factors that can be implemented to either improve a facility or make the decision to start over. When considering these factors profit scenarios such as the receiving and storage costs of a facility should be examined as well as possible scenarios that can be implemented to improve the viability of a facility. For example if your elevators have receiving costs that

vary widely such as $.10 at one facility and $.36 at another, what factors can be eliminated to level the playing field. Another key factor considered in this model is the overpayment of grain during a non-scarcity scenario. In the recent years, the procurement of grain has been more challenging in many parts of the United States. As the percentage of on-farm storage has increased, once this grain hits the tanks at harvest it has become increasingly more difficult to move it out after harvest. This scenario often creates a bidding war for the players at hand when a demand is created for this grain during different parts of the calendar year. When this scenario isn't in play, it is important to try and avoid overpaying for grain. A few cents in this climate over a large amount of bushels can be the difference between making money and losing money within an organization. The importance of maintaining margin even if it means purchasing from multiple customers versus one large operator who seeks to command a premium may create a viable payback for an organization. Finally this model discusses the important of internal collaboration and elimination of factors that do not encourage this tool. As margins in the agricultural world continue to tighten any factors that can be encouraged to increase productivity should be addressed. Some examples of internal collaboration are arbitrage, cross training, or sharing of assets. These are just a few examples of opportunities to create this culture within your organization.

5.2.2 Create

Create as previously discussed focuses on factors within an organization that are currently not widely available within an industry and how to apply those factors to your organization (Kim 2015). The three points to consider are creation of a database to track customer relationships, creation of an online presence, and a full service risk management approach to the farmers served within your industry. First and foremost a database to track

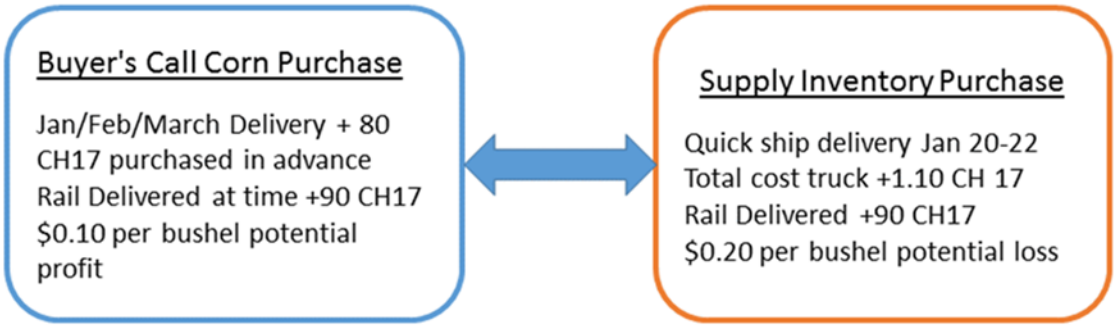
customer relationships could be created to track the communication between customers and members of merchandising staff. Hedging mistakes while enevetable in this business, a system of organization may provide the framework for stopping some of these errors. The database would serve as a place to record phone calls, store pertinent information about an account such as on-farm storage, and recent basis quotes or completed transactions. Another factor to consider is an increased online presence as the older farming generation continues to retire and a more technologically advanced generation starts to move into place, access to technology for these individuals will become increasingly important. An online presence provides your organization with a platform for online transactions such as offers for grain as well as presenting marketing programs and other crucial pieces of information. Many customers would also like access to grain settlements, grain tickets, and other pieces of account information electronically. Finally under the creation section, a full service approach to farmer marketing is currently a large part of the business model of cooperatives and private grain organizations in the Midwest, but is not readily available in North Carolina. The industry is headed in that direction as livestock companies seek to gain a competitive advantage on their competition. The full service approach would lend itself to helping the customer in the following ways: risk management of commodity marketing, agronomic services such as seed and fertilizer, and in some areas insurance services. This approach gives the organization many opportunities to reach out to the customer and gain value in the relationship. Another point to consider is a total focus on creating an efficient supply chain. Logistics and the movement of grain from the farm to the feed mill and all points along the chain should be evaluated on a regular basis to look for modifications that could be made to increase efficiencies.

5.2.3 Reduce

Reduce as outlined previously in the text refers to factors that should be reduced below the industry standards (Kim 2015). This factor seeks to discover if an organization has over designed in relation to the competition and therefore reducing your margin. The factors considered in this section were a reduction in operational inefficiencies, an attempt to control supply inventory, and reduction in making decision based on market signs versus the local market. Operational inefficiencies are inevitably a problem within any organization, but working to correct those problems is a step in the right direction. Some examples of operational inefficiencies includes moving grain without a plan in place, lack of communication of problems or scenarios that may arise such as dryer problems or storage issues, and facilities that need to be updated. As a livestock production continues to increase in North Carolina, an ability to unload and capture harvest margins and volume will continue to be critical to the success of maintaining profitability. Supply inventory, or just in time inventory in the livestock industry often arises due to failures within the supply chain. In North Carolina, this scenario has the potential to occur frequently especially at facilities that are dependent on rail for the majority of the crop year to meet their production needs. While it is virtually impossible to plan for the unknown, if you have had a problem consistently in the past especially in winter months it may be beneficial to consider having an emergency supply already in place. This supply would available as a buyer's call option where grain will be held until a problem arises. Supply inventory has the potential to cause drastic swings in margins as outlined in Figure 5.2 but while costly is far cheaper than an unacceptable situation of running a facility out of feed. The animals must be fed on time every time and users will pay what it takes to keep their animals healthy. The final point to consider in regards to reduce is making decisions based on

market signs versus the local market. What this point means is if the industry is pointing towards an increase in building storage is this scenario right for your organization just because others are doing it. An example of properly thinking out this scenario is your organization probably does not need to build storage if you do not fill your space at harvest and do not have trouble maintaining the flow of grain. However, if you have trouble maintaining the flow of grain and often fill and have to turn customers away you might want to consider building storage or adding another alternative such as temporary storage whether that be by bagging grain, building a covered pile, or leasing additional space. The main point at hand is to always consider your local market before making decisions based on the industry. What works in your area may not work for others.

Figure 5.2 Example of Emergency Supply Inventory and Buyer's Call Purchase



5.2.4 Increase

The final portion of this model is raise which allows an organization to increase certain factors well above the industry standard (Kim 2015). The examples provided in this factor are increase customer service to strengthen the brand, addressing of company margin structure, and increase incremental purchases. The first factor in this section is arguably the most important factor in the model and provides the most opportunities for future growth. Customer service is a crucial factor that sets an organization apart from the competition.

The brand that you portray to your customer provides the most opportunities for long term retention of customers. The value of creating a lifetime loyal customer is especially valuable in a corn deficit state where farmers have the ability to diversify their operations. Precise record keeping, continuity of service, and trust are crucial factors to uphold in portraying good customer service. Retention of customers as well as the creation of new customers should be an important part of a long term plan for your organization. Another factor to consider is the addressing of a solid margin structure. As mentioned earlier, as we continue to go through a down cycle in agriculture, margins will continue to be tighter than in previous years and attention to maintaining the value in your company margin will continue to be crucial. Another option to consider is presenting your customers with an option to sell in incremental amounts or buying a certain amounts per month up front with the premise of increasing market share within this customer base. The value of a lifetime customer is another point to consider. Retention of customers and creating a lasting relationship with those individuals creates true long term value to the company.

Finally, as the costs of transporting corn continues to rise in North Carolina a look into alternative ingredients to supply a portion of your corn needs may serve as a long term benefit. Corn and soybean meal will continue to be the primary diet for poultry and hogs in the future, but there are often times when a percentage of these rations can be substituted with alternate ingredients. In North Carolina, wheat as well as milo are popular alternative ingredients to corn during certain times of the growing season. Milo and wheat can be substituted into hog rations at very high levels, but within the poultry world the usage is much smaller (Mitchell 2017). A typical broiler ration in North Carolina may only contain up to 25% ground wheat or milo and up to 10% unground of the same product (Mitchell

2017). In addition to these ingredients, distiller's grains and soluables, (DDGs a bi-product of ethanol manufacturing) are often substituted into the diets of poultry and hogs when product is available for least cost formulation. Least cost formulation is a system used to create diets for both hogs and poultry where feed ingredients are evaluated to select the most profitable choice. Over the past few years the domestic supply of corn available has continued to grow within the United States. The carry out or total number of bushels of grain carried from one crop year to the next continues to grow. However the imports of corn and others grains along the coastal regions of North Carolina have also continued to grow. In 2002, Smithfield Grain production formerly known as Murphy Brown purchased a facility at the port of Wilmington, N.C to serve as a facility to import corn and other grains into the region (Newman and Bunge 2016). The grain import facility was added for a number of reasons including lower ocean freight, substantially higher rail rates, and favorable currency valuations (Newman and Bunge 2016). According to reports from grain traders at the companies Nash-Johnson, Prestige Farms, and Smithfield Foods, "lower ocean freight coupled with high cross-country rail rates for grain have allowed imports to become attractive (Newman and Bunge 2016, 1)." In April of 2016, the average cost including the cost to lease equipment resulted in a total rail freight bill of $.80 to $1.50 per bushel while ocean freights delivered to Wilmington were $.35 to $.50 per bushel (Newman and Bunge 2016). Even after adding in the additional trucking costs plus elevation at the port of Wilmington, these costs can often still be well below rail (Newman and Bunge 2016). As integrators in North Carolina continue to look for ways to lower corn procurement costs within the state, imported grains will continue to be an option in the

future. In addition to corn, Smithfield has imported French Wheat into the port of Wilmington as an additional feed grain to alleviate some of the higher feeding costs.

CHAPTER VI: CONCLUSION

As the livestock industry of North Carolina continues to grow, the protection of margins will continue to be crucial to its success. The foregoing results provided evidence that while corn prices increased between 2007 and 2012, they have been on the decline since. However, the basis for both rail and truck transportation of corn into North Carolina have been increasing. Indeed, they have been rising faster than inflation.

First and foremost the growth model created from monthly data over the past ten years show great volatility in the corn pricing of one CSX-90 car feed mill, one CSX-75 car facility, and one truck only. The range of basis level alone supported evidence of record strong basis levels. The high for the CSX-90 car facility was $1.65 and the low was $0.20 where the average basis was $0.65. In regards to the NS-75 car facility the average high basis was $2.00 and the low basis was $0.20 with an average basis of $0.68. The truck only facility which has the option of shipping corn from one of the largest corn producing areas of the state has seen a low of -$0.15 and a high of $1.33 with an average basis of $0.35. The main point to realize from this data is the high volatility in these basis levels, and that supply inventory prices are even higher and common when the inevitable train delay occurs. If anything these results show how crucial it is to know and understand your local markets and support the feed mills around the state when rail corn needs to be supplemented. Another factor to address is that for the cash corn price (similarly to the basis levels within the state) volatility is high, with a high corn price of $8.14 and an low price of $3.24 with the average price of $4.82 during the sampling of data collected in the this study. Growth rates over the period of this study for CSX-90 ended up at 7.4%. Growth rates for NS-75 and the truck only facility were 7.7% and 12.4%, over the same time period reflecting the higher relative increase in rail prices. These results provide

evidence of an alarming trend if cash corn prices start to climb again. In the future, simply put combined with higher rail rates and reduced carry out corn basis levels have shown tremendous volatility within the state. If a production problem were to occur in the eastern Corn Belt as well as the state of North Carolina, it could create a tremendous opportunity for basis fluctuations. The spread between truck and rail is narrowing at a rapid pace and has the potential to climb or grow larger in the future.

Livestock production in the areas of broilers, turkeys, and hogs within the state also placed strain on local basis levels. Broiler production is rapidly rising and will continue to place a floor under local basis levels within the state. Record production due to higher consumption patterns within the United States has increased the demand for poultry and integrators within the state have responded by increasing production. Heavy vertical integration within the industry and large presence of many livestock companies within the state provides the potential for future growth in the future which will continue to keep a firm handle on demand for corn in North Carolina. Even with alternative crops, local production of corn is projected to continue to be supported by strong local basis values.

The ERIC model provided a detailed analysis of alternative approaches to enhance the competitiveness of the industry. As outlined in this paper the demand for corn within the state is strong and shows no alleviation in the future due to the strong presence of production within the state. To increase economic sustainability in the future it is important to constantly evaluate your local business model in regards to grain procurement. The ERIC model outlined in the paper has provided a framework for discussion. Some of the major conclusions of this study are a tremendous focus on customer service and building your brand image. In an area with strong competition, the ability to serve your

customers effectively is often the difference between keeping and losing business. The four frameworks of strategy eliminate, reduce, increase, and create all focus in some way to increase customer service. Every implication in this model can be attributed back to providing value to both external and internal customers and in the long run can help mitigate higher feeding costs.

As the livestock industry of North Carolina continues to grow in years to come the availability of reliable transportation services and corn production from within the state or imported into the region will continue to be a point of discussion. Ways to lower corn costs to the livestock industry of North Carolina will continue to be crucial to its long term success. New ways to improve these factors will continue to be evaluated from both internal and the industry level of support. It is crucial to look at ways to build an efficient supply chain and minimize the risks of higher basis levels and in turn higher corn prices when possible. The ability to minimize risks and decrease marginal costs in the future will have a lasting impact on the longevity of the industry.

WORKS CITED

Agri Stats Inc. 2017. *Agristats.* Accessed March 12, 2017. www.agristats.com/partnership.

Association of American Railroads. 2016. *America's Freight Railroads Under Balanced Regulation.* Apri;. Accessed March 4, 2017. https://www.aar.org/BackgroundPapers/Impact%20of%20the%20Staggers%20Act.pdf.

Beasley, Stephen. 2007-2016. *Market Reporter.* North Carolina of Ag-USDA Market News, Raleigh, N.C.: USDA AMS, NC Market News. Available at http://www.ncagr.com/market/mktnews/.

CSX. 2016. *Agricultural Products.* Accessed March 3, 2017. https://www.csx.com/index.cfm/customers/commodities/agricultural-products/.

Cunningham, M. Donohue and D.L. 2009. "Effects of grain and oilseed prices on the costs of US poultry production." *The Journal of Applied Poultry Research* 325-337.

Farm Flavor. 2017. *Farm Flavor North Carolina Agriculture.* Accessed February 26, 2017. http://www.farmflavor.com/north-carolina-agriculture/.

Gallagher, John. 2005. "Grain Blasts Rails." *Traffic World* 2.

Johnson, Philip T. Evers and Carol J. 2000. "Performance Perceptions, Satisfaction, and Intention: The Intermodal Shipper's Perspective." *Penn State University Press* 27-39.

Kim, Chan W and Manborgne, Renee. 2015. *Blue Ocean Strategy.* Boston: Harvard Business Review Press.

Managerial Economics. 2017. *Wisdom Job.* Accessed March 12, 2017. https://www.wisdomjobs.com/e-university/managerial-economics-tutorial-307/trend-analysis-and-projection-10091.html.

Mitchell, Dr. Randy, interview by Dana Marshall. 2017. *Nutritionist* (March 12).

NCDA&CS Agricultural Statistics Division. 2016. *North Carolina Agriculture Overview.* July 11. Accessed February 26, 2017. www.ncagr.gov/stats/general/overview.htm.

Newman, Jesse, and Jacob Bunge. 2016. "Corn Imports Surge in the U.S., despite Record Harvest at Home." *Wall Street Journal* 3.

Norfolk Southern. 2016. *Coal.* December 15.

Pittman, Russell. 2016. "Changes in the Role of US Railroads as Haulers of Coal and Crude: Causes and Consequences." *Sustainable Renewable Energy Reports* 5-9.

Pittman, Russell. 2010. "The Economics of Railroad Captive Shipper Legislation." *Administrative Law Review* 919-934.

Roberson, Roy. 2013. "North Carolina Grain Grains Helping Feed Local Livestock." *Southeast Farm Press* 4.

Sterk, Ron. 2014. *Baking Business.* June 4. Accessed March 4, 2017. http://www.bakingbusiness.com/articles/news_home/Financial-Performance/2014/05/Rail_performance_improves_but.aspx?ID=%7B2DABDF21-DCE0-4B3C-A4DD-A38D6C36891F%7D.

Transportation Research Board of the National Academies. 2011. *Envision Freight.* Accessed February 26, 2017. http://www.envisionfreight.com/value/pdf/Grain.pdf.

US Energy Information Administration. 2015. *Eletricity.* February 19. Accessed March 29, 2017. https://www.eia.gov/electricity/data.cfm#sales.

USDA/NASS Quick Overview. 2015. *NASS.* Accessed February 26, 2017. www.nass.usda.gov/quick_stats.

USDA-NASS. 2016. *2016 State Agriculture Overview:North Carolina.* Accessed March 28, 2017. https://www.nass.usda.gov/Quick_Stats/Ag_Overview/stateOverview.php?state=NORTH%20CAROLINA.