EVALUATING RISKS AND RETURNS ASSOCIATED WITH ALTERNATIVE MARKETING STRATEGIES FOR PROCESSED CITRUS

By

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Abstract of Thesis Presented to the Graduate School
of the University of Florida in Partial Fulfillment of the
Requirements for the Degree of Master of Science

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The citrus industry is the largest agricultural sub-sector in Florida with 719,000 acres in use. Over 90 percent of the oranges produced in Florida are Valencia and early, midseason oranges grown primarily for processing. Volatility in the citrus industry caused by weather, disease, and other factors is a concern for citrus growers. Alternative marketing strategies are available to growers to manage this risk. This study provides an examination of alternative marketing strategies and forecasts potential outcomes. The results provide citrus growers with knowledge about these strategies and their forecasted returns and risks.

This study examines the risks and returns associated with 4 scenarios for each of the two major types of citrus used in processing: 1) the pooling method, in which growers pool their crops and receive payment based on the average price received for the entire pooled crop; 2) the 1-week cash market, which assumes the producer sells his/her entire crop into the cash market in one week; 3) the 3-week cash market, which assumes the grower sells his/her entire crop into the cash market over the course of three weeks; and 4) hedging, which assumes that the producer hedges his/her crop utilizing the FCOJ contract in the futures market when the previous seasons crop is ending.

Forecasted spot market and pooling prices are obtained using the forecasted all-orange prices from a recent study. Simetar© (Simulation for Excel to Analyze Risk), an Excel add-in that was developed explicitly for stochastic simulation modeling was used to create stochastic forecasts utilizing a pseudo-random number generator and observed probabilities. Using the stochastic forecasted prices along with stochastic forecasted yields in conjunction with a pro-forma financial statement model, the net present value (NPV) of discounted revenues through the year 2020 is determined.

Pooling provided the highest standard deviation as well as the highest NPV for Valencia. The one-week cash market scenario yielded the second highest NPV. The hedging scenario provided the lowest NPV along with the lowest standard deviation. For early, midseason, the pooling baseline provided the highest NPV combined with the highest standard deviation, that is, the highest return with the highest risk.

CHAPTER 1
PROBLEM STATEMENT AND OBJECTIVE

Problem Statement

The citrus industry is the largest agricultural sub-sector in the state of Florida, with more land being used to grow citrus than any other state in the country. With 719,000 acres used, citrus accounts for over 40 percent of all land used to farm crops in the state (NASS). In 2005, Florida accounted for 67 percent of the total U.S. production for oranges at roughly $843 million (Florida Agriculture). Out of that, over 95 percent of all oranges grown in Florida are processed.

The three major types of oranges grown in Florida include the early-mids, Valencias, and naval oranges. As implied by the name, the early-mids are harvested earlier in the crop season. The Valencia orange, also known as Murcia orange, is a late season fruit. Valencia oranges have zero to six seeds per fruit, however the excellent taste and internal color make it desirable for the fresh market as well as for processing juice. Naval oranges, also known as the Washington, Riverside, or Bahie naval, develop a second orange at the base of the original fruit, opposite the stem. Because these are seedless oranges, the only means available to cultivate more is to graft cuttings onto other varieties of citrus trees.

Of the 140 million boxes of citrus that were utilized through processing in the 2005-2006 season, early-mids and Valencias accounted for over 95 percent. While over 93 percent of all early-mids, and over 96 percent of all Valencias were processed, less than one-third of all naval oranges were processed. Early-mids and Valencias accounted for over 97 percent of all citrus grown in the state (NASS).

With ever increasing volatility in the citrus industry, citrus growers are faced with crucial decisions regarding the marketing strategies they use for their products. Supply is constantly affected by threats of weather such as hurricanes and freezes, diseases such as canker, greening, and tristeza, and even urban development (Brown).While the southern movement of the citrus industry in Florida has helped decrease the exposure to freeze damage, the threat of hurricanes comes every year. Because of these supply shocks, volatility is likely to remain high.

The futures market at the ICE (Intercontinental Commodity Exchange, formerly known as the New York Board of Trade) in New York City provides a common method of pricing frozen concentrated orange juice (FCOJ). While the market presents processors and growers with a place to buy and sell FCOJ, only a small amount of actual FCOJ is sold in these markets. The markets much more common purpose is to be used as a hedging and price discovery tool for both processors and growers while speculators provide the necessary liquidity while hoping to capitalize on price changes. With the FCOJ futures market, citrus growers can lock in a floor price for selling their product. This enables them to protect themselves against an adverse price change. While this elimination of risk with respect to adverse price movements can be helpful, the ability to take advantage of favorable price movements is greatly diminished in hedging programs (less so with the use of options as opposed to direct futures positions).

There is considerable price risk in FCOJ as evidenced in the futures markets. The seasonal coefficient of variation of the average weekly closes for the past 5 seasons (2002-2007) averaged over 12 percent. Also, volatility can be higher in the FCOJ market because the market for the FCOJ contract is not as liquid as others such as corn. A large number of FCOJ contracts traded at any time can cause a movement in price.

There are many other factors that can cause high volatility within the FCOJ futures markets. Hurricane season serves as a great example of this. Because of the uncertainty caused by hurricane seasons, volatility within the FCOJ can increase before a hurricane affects it. As the hurricane season begins, the price in the market will generally increase, as more and more speculators take long positions to prepare to capitalize on any formed storms that can damage the orange crop. As storms develop and trend toward or away from the state of Florida, prices fluctuate dramatically as information on the storms evolve. This is a great example of a situation in which the market price reflects potential for occurrences rather than current supply and demand.

Diseases pose an especially large risk to citrus growers because they can impact the production of a grown crop for several seasons. There are certain production practices that are used by growers to reduce the risk or uncertainty of these diseases. Tristeza, also known as CTV (citrus tristeza virus), is a viral species that causes the most economically damaging disease to oranges. It has accounted for the death of millions of citrus trees, and was coined the term “tristeza” from farmers in Brazil and South America, as it is Spanish and Portuguese for sadness. Citrus canker is an infection that causes lesions on the leaves, stems, and fruit of the trees. This causes leaves and fruit to drop prematurely. While these fruit are still eatable, they are generally blemished and harder to sell to consumers. The other main disease is greening, which is distinguished by the common symptoms of yellowing of the veins and adjacent tissues, followed by yellowing or mottling of the entire leaf and premature defoliation. The trees will have stunted growth, bear multiple off-season flowers, and produce small, irregularly-shaped fruit and the disease may often lead to the death and replacement of trees.

Perhaps the most common, easy to use, and easy to understand strategy of marketing is the use of pools. Pooling is simply a process where the proceeds from many sales of a particular commodity are averaged and growers all receive the average price after costs have been deducted. Pooling still has some volatility as well, though not as much. With early-mids, over the past 15 seasons the mean return for pooling was $1.01 with a standard deviation of 26 cents, while the mean return for Valencias was $1.157 with a standard deviation of over 22 cents. Both pooling and hedging in the futures market are risk management strategies, as opposed to growers selling straight in the cash market at the current price at the time of harvest.

The option of selling directly into the cash market is generally perceived to hold the largest risk for growers, and the most volatility. Selling directly into the cash market means that you accept the current price at the time of harvest, which can differ significantly from the price at the beginning of the production season. This makes budgeting more difficult, but does allow the farmer to capitalize on the market when the price rises during the production season. In situations where disease or weather hurts the crop, farmers who still hold their product are in great shape to capitalize on the favorable increased price that results from the decreased supply. Many farmers take out crop insurance to protect themselves from production risk that can result in a damaged crop.

One final method of price risk management is the use of forward contracts. A forward contract is an agreement between two parties to buy or sell an asset (in this case citrus) at a pre-agreed future point in time. The trade date and delivery date are therefore separated. Most forward contracts don't have standards and aren't traded on exchanges. A farmer would use a forward contract to "lock-in" a price for his oranges for the upcoming harvest.

Objective

The general objective of this study is to enhance the citrus growers' knowledge of marketing strategies available, and help to provide information regarding the differences in risks and returns associated with the alternative strategies. The specific goal of this study is to create a model which will demonstrate the forecasted situations, allowing a prediction of the best marketing strategy available, under a given set of assumptions.

It is the goal of this study to become a tool for citrus growers as well as pool operators to generate new ideas for alternative marketing strategies. It should be of interest to all growers to be informed of, and understand the options available to them regarding their marketing strategies, and be aware of the risks associated with them.

Organization of Study

The following chapter will give a background on the citrus industry and FCOJ, the futures and options market, risk management, and basic hedging strategies. Chapter 3 reviews literature related to the citrus industry and hedging. Chapter 4 presents the methodology, including data collection, the model used, and analysis. A discussion of the results is presented in Chapter 5, before summarizing and drawing conclusions in the final chapter.

CHAPTER 2
BACKGROUND AND PROBLEM SETTING

Citrus Industry

History

The oldest reference to citrus comes from Sanskrit literature. Jambhila is the name applied to citron and lemon in the White Yahir-veda, specifically in the Vajasaneyi Samhita, part of the Brahmin sacred book which dates prior to 800 B.C. The Citron was sanctified in India, and consecrated to Ganesh, the God of wisdom and knowledge (Scora). In non-rabbinic Jewish Tradition, a citron in the house keeps the Karines (bad spirits) away, while the Romans used citrus as a basic body oil. Citron was the first of all citrus to reach the west and also the first citrus fruit to grab European attention. This was all mostly due to its relative imperishability combined with pleasant odor and appearance that made it suitable for long travel. In Medieval times, visiting dignitaries would be entitled to a certain amount of sweet orange slices that were detailed in cookbooks. As an expensive item, citrus became a fashion of the rich merchants (Scora).

Citrus Industry in Florida

Citrus has been produced commercially in Florida since the mid-1800's. The environment of Florida provides a comparative advantage for citrus production due to natural resources such as the subtropical climate (Hodges). Also, the abundance of rainfall and water causes the soil to be light and infertile, so frequent and heavy fertilization is necessary. This helps the quality of oranges to be very good (Crist). Several freezes in north central Florida in the 1980's caused crop loss, permanent tree damage, and large price fluctuations (Ranney). The industry responded by moving into the southern region of the state (Andre). Florida citrus production followed an upward trend from 1990 to 2000, increasing 46 percent; oranges and grapefruit being the top commodities (Hodges). The Florida citrus industry contains much more processed oranges than California, the second largest citrus producing state, mostly due to the better taste of the Florida oranges, while the better look and texture of California's oranges cause them to be used as fresh fruit (Andre). In fact, 94 percent of Florida's round-oranges are processed (NASS).

FCOJ Industry

Research that led to the development of Frozen Concentrated Orange Juice (FCOJ) in 1947 allowed Florida to expand orange production. Florida produced 57.5 million boxes of oranges in 1947 with as much as 76 percent of the round-orange crop in the state processed. In 1948, there were only three processors, but by 1952 there were eighteen. The FCOJ contract was created in 1966, trading under the newly formed Citrus Associates of the New York Cotton Exchange. By 1980, the states record crop of over 206 million boxes of round oranges was produced, and over 83 percent of that crop was processed into FCOJ (NASS).

FCOJ stocks vary seasonally, with inventories approaching their maximum levels in the latter months of the harvest season. "Freeze bias" refers to the bidding up of futures relative to spot prices prior to the end of a freeze / hurricane risk period due to the potential for speculative windfall gains that could be realized if a freeze causes considerable fruit loss. Large swings in FCOJ prices caused by freeze and hurricane damage to trees are unique among commodities traded in the futures markets (Malick).

Futures Markets

Futures markets are organized exchanges of derivative markets where many buyers and sellers meet to trade futures contracts on an ever-expanding list of commodities (Salnars). Futures markets can be traced back as early as the Middle Ages, when markets were developed to meet the needs of farmers and merchants. The first futures-type contract was known as a *to-arrive contract*. The Chicago Board of Trade (CBOT) was established in 1848 to bring farmers and merchants together, and in 1874, the Chicago Produce Exchange was established, beginning with markets for butter, eggs, poultry and other perishable agricultural products (Hull).

The futures contract helped provide a way for both the producing farmer and the purchasing company to eliminate the risk it faces due to uncertainty of future prices. The main task in originally developing the markets was standardizing the qualities and quantities of the grains being traded (Hull). The futures market can be used by citrus growers to manage price risk while making sure they have somebody to purchase their product, while the processors can use it to manage price risk and make sure they have the ability to get the product. Speculators use various strategies in the markets in an attempt to make profit off of price movements. Speculative traders provide the necessary level of trading activity or “liquidity” in the market to prevent the occurrence of added risk from failure to establish or terminate a contract (Ward, 1974). The final function of the futures markets is price discovery. Futures prices change as buyers and sellers judgments about a commodities worth at a particular point changes. These judgments are subject to supply and demand developments, and the availability of current information. This continuous process is known as price discovery (Salnars).

Traditional futures contracts have been traded by what is known as the open-outcry system, in which the traders physically meet on the floor and indicate the trades they would like to carry out using a complicated set of hand signals and open outcry. This is still used during regular trading hours, however in recent years, electronic trading has grown largely as an alternative (Hull). There are certain terminologies that go along with the “futures language”. To go *long* on a futures contract is to buy the contract that would allow taking delivery of the specified commodity; to go *short* on a futures contract is to sell the side of the contract that would allow making delivery of the specified commodity. In its simplest terms, to go long is to be the buyer of a commodity and to go short is to be the seller of the commodity.

Options

In addition to futures contracts, option contracts are offered for many commodities, giving the holder (buyer) the right, but not the obligation to take a position with a futures contract. There are two types of options, the call option and the put option. A call option gives the holder the right to buy a futures contract by a certain date for a certain price, while a put option gives the holder the right to sell a futures contract by a certain date for a certain price. This certain price is referred to as the 'strike price'. The buyer of an option (frequently referred to as the holder) is long on that option, while the seller (frequently referred to as the writer) is short the option. An American option can be exercised at any point during its life, while a European option can only be exercised on its maturity date (Hull).

The first trading in puts and calls began in Europe and the United States as early as the eighteenth century; however corrupt practices gave the market a bad name in its early years. The Put and Call Brokers and Dealers Association was set up by a group of firms in the early 1900s, and in April of 1973, the Chicago Board of Trade set up the Chicago Board of Options Exchange (CBOE) which is the largest exchange in the world for trading stock options (Hull). Options first appeared in America in the early 19th century, and were known as "privileges". In 1934, the Investment Act legitimized options, and put it under the eye of the recently formed Securities and Exchange Commission. On April 26, 1973, the Chicago Board of Options Exchange began trading listed call options. By the end of 1974, average daily volume exceeded 200,000. The FCOJ options became available in the New York Board of Trade (now the ICE) in 1985.

Risk Management

There are various ways of managing risk for the citrus grower. Pooling, perhaps the most common, involves gathering the citrus from several growers and paying the growers the average sale price for the product in the specific pool. There are also forward contracts, which are similar to a futures contract in that it is an agreement to buy or sell product at a certain time in the future for a certain price. However, while futures contracts are traded on exchanges, forward contracts trade over-the-counter (Hull). This means that forward contracts are created by two parties who agree on a delivery date. These are not set quantity and quality amounts traded like they are on the futures exchange.

Hedging is a risk management tool that generally uses the futures and options markets. When a citrus grower takes a short position in the futures market equivalent to the quantity of citrus they are producing, they are lessening their price risk. With a short position in the futures market, the grower is putting themselves in a position to offset losses in their sale value of citrus if the price drops with a positive gain in the futures market. If the price of citrus rises, the loss in the futures market is offset by the higher price for which they can sell their citrus. The transaction costs become the only truly lost value, which is generally small relative to the price risk associated with the commodity.

There are multiple transfers of risk taking place in this type of risk management. The transfer from price risk to basis risk for a hedger, and the acceptance of price risk by speculators provides the necessary liquidity for the market to work. Using this method of risk management, the basis risk becomes the main point of interest for hedging. Understanding basis and being able to forecast it is the key issue in hedging (Salnars).

Basis

Basis refers to the difference between the price of a given commodity in the nearby futures contract and the price that same commodity could be bought or sold for in the spot market (also known as cash market). The equation used is: basis equals cash price minus futures price.

$$B = CP - FP \tag{2-1}$$

Where B represents basis, FP represents futures price, and CP represents cash price

In reality, basis is the connecting link between the present and future (Malick). Cash and futures prices generally move together and react to continuous changes in supply and demand factors (Salnars). Basis residuals are a calculated deviation from the average basis (Malick), and can be represented as

$$BR = BM - ABS \tag{2-2}$$

Where BR represents the basis residual, BM represents the basis for a specific month, and ABS represents the average basis for a season. Basis residuals refer to the difference between expected basis and actual basis.

Basis can change based on many factors. An increase in basis is referred to as a strengthening basis, when the spot price increases by more than the futures price. In a normal market where the futures price is higher than the relative cash price due to carrying costs (such as time, place, and quality) a strengthening basis is a narrowing basis. A weakening basis is just the opposite, in which the futures and cash prices diverge in a normal market (Hull). The hedging term used for someone that is planning on selling goods is a short hedge, because their initial position taken in the futures market is a short position. A long hedge is used for managing the risk when purchasing a commodity, and is accomplished by first taking a long position in the futures market.

Basis in the Citrus Industry

Basis levels in general can be affected by product quality, transportation, location, insurance, time, storage, delivery method, or any combination thereof (Salnars). Basis risk in FCOJ is hypothesized to be affected by six major variables: a measure of risk premium, convenience yield, market liquidity, freeze / hurricane bias, bias adjustments, and an actual freeze / hurricane event (Ward, 1977). Basis risk decreases as the time to the hedge expiration (delivery month) decreases. If the asset to be hedged and the asset underlying the futures contract are the same, the basis should be zero at the expiration of the futures contract (Hull).

If nearby prices (the price of the nearest futures contract traded on the exchange at any given time) reflect a current shortage in cash product, some convenience yield exists for having at least a minimal stock held for future consumption. This yield offsets at least part of the carrying cost of holding the stocks in inventory (Ward, 1977). Lower stocks help push cash prices up relative to futures encouraging stock holders to draw down existing inventories (Malick).

Hedging Examples

The benefit of implementing a short hedge for a producer can be demonstrated as shown in figure 2-2. The basis in figure 2-2 remains constant over the period of holding the hedge to show the general objectives of hedging with futures.

The current (June) spot market price, per pound solid FCOJ is $2.05 in figure 2-2. The current futures price is $2.25. The basis therefore is -0.20. A grower who plans to sell 75,000 pounds worth of FCOJ in September, would need to take a short position with 5 contracts (each contract contains 15,000 pounds) to offset any losses in the spot market between the time the hedge is implemented and the time the FCOJ is sold in the cash market (which should be about the same time as the contract maturity date).

In Figure 2-2, the prices in the spot and futures markets rise to $2.30 and $2.50, respectfully, by September. While there has been a 25 cents increase in the spot price, this gain is offset by a loss of 25 cents in the futures position held by the hedger after liquidation. Therefore the realized price that the grower receives for his crop remains the original $2.05 due to a lack of change in the basis ($2.30 for the cash market combined with a 25 cents loss in the futures contract). At 75,000 pounds of goods, the total sale value is $153,750 (note: this simple scenario neglects transaction costs).

In a second scenario (shown in Figure 2-3), the prices in the spot and futures markets fall to $1.65 and $1.85, respectfully, by September. In this situation, the 40 cents per pound solid lost in the spot market is offset by an equal gain in the short futures position after liquidation. Again, the realized price for the grower would remain equal to the original spot price of $2.05, due to no change in the basis (ignoring transaction costs).

The above examples hold basis constant and disregard transaction costs, neither of which generally occurs in the market. Figure 2-4 demonstrates the outcome of a hedging transaction when basis strengthens. Again, the current spot market price is assumed to be $2.05 per pound solid when the hedge is implemented, and the futures price is assumed to be $2.25. The current basis in this scenario therefore is -0.20. A grower who plans to sell 75,000 pounds worth of FCOJ is long 75,000 pounds of FCOJ in the cash market. He would take a short position with 5 contracts to manage the price risk held with his current cash position.

In this third scenario shown in Figure 2-4, the prices in the spot and futures markets rise to $2.40 and $2.55, respectfully, at the time of maturity. In this example the basis has gone from -0.2 to -0.15, thus the basis has strengthened. In this case, the grower has gained 35 cents per pound solid from the increase in spot market price, and has lost 30 cents per pound solid in the futures position after liquidation. With basis strengthening by 5 cents per pound solid, the grower has now gained 5 cents per pound solid, and the realized price is the original $2.05 plus the 5 cents gained, resulting in a realized price of $2.10. At 75,000 pound solids worth, this is a net gain of $3,750.

Figure 2-5 demonstrates the outcome of a hedging transaction when prices in the spot and futures markets fall from $2.05 and $2.25 to $1.25 and $1.55, respectfully. The basis in this scenario has weakened from -0.2 to -0.3. The outcome of the weakening basis results in an 80 cent loss per pound solid in the spot market and a 70 cent per pound solid gain on the short position in the futures market. Subtracting the 10 cent net loss between the two positions on the original $2.05, the new realized price that the grower receives has decreased from $2.05 to $1.95. With 75,000 pounds of product to sell, the grower lost $7,500.

While the transaction costs were ignored in these examples, it is not hard to see how important basis is in hedging. It is easy to see how understanding basis, and being able to predict it's behavior can be important to the grower. Taking a futures position at the right time and gaining additional returns from strengthening in the basis can be the difference between a successful harvesting season and a failure.

To account for transaction costs, we can assume the cost of taking a futures position round trip (meaning the cost for taking to original position, plus the opposite position to liquidate) is $30 per contract. In the third example, the realized price increased from $2.05 to $2.10, a 5 cent increase per pound solid. With a $30 round trip transaction cost for the futures position, the per pound solid transaction cost is $0.002 per pound. Now the realized price is the $2.10, minus the 00.002 of transaction costs, and the realized price is $2.098 per pound solid. At 75,000 pound solids, this is a $150 transaction cost loss.

The spread between the futures and spot market price can be explained in part by the net marginal outlay for storage, which is defined as the marginal outlay for physical storage plus a marginal risk-aversion factor minus the marginal convenience yield on stocks (Ward, 1977). This is consistent with storage theory, which holds that the basis equals the marginal costs of carrying stocks through time (Malick). Historically, the futures basis has been judged by how well it reflects the market fundamentals; however the basis may yield discounts and premiums if it reflects anticipation of future events or the potential for such events (Ward, 1977).

Product Information	
Symbol:	OJ
Exchange:	New York Board of Trade
Description:	FCOJ - A (Frozen Conc OJ - BZ&FL)
Call Symbol:	OJ
Put Symbol:	OJ
Amount:	15,000
Unit:	Pounds (lbs)
Start Time:	10:00 EST
End Time:	13:30 EST
Last Day Start Time:	10:00 EST
Last Day End Time:	13:30 EST
Option Start Time:	10:00 EST
Option End Time:	13:30 EST
Option Last Day Start Time:	10:00 EST
Option Last Day End Time:	13:30 EST
Unit String:	Dollars per Pound
Conversion Factor:	0.0100
Conversion Factor Unit:	Dollars per Pound
Product Type:	Commodity

FCOJ-A contract specifications provided by FACTSim (www.FACTSIM.org)

Figure 2-1 FCOJ Contract Information

Date	Cash	Futures	Basis
June	Cash market price of $2.05	Sell 5 contracts at $2.25	**-0.2**
September	Sell 75,000 lbs at $2.30	Buy 5 contracts at $2.50	**-0.2**
Gains Losses	Gain of $0.25	Loss of $0.25	
Realized Price	Sold 75,000 lbs at $2.05		

Figure 2-2 Hedging Outcomes with Increasing Prices

Date	Cash	Futures	Basis
June	Cash market price of $2.05	Sell 5 contracts at $2.25	**-0.2**
September	Sell 75,000 lbs at $1.65	Buy 5 contracts at $1.85	**-0.2**
Gains Losses	Loss of $0.40	Gain of $0.40	
Realized Price	Sold 75,000 lbs at $2.05		

Figure 2-3 Hedging Outcomes with Decreasing Prices

Date	Cash	Futures	Basis
June	Cash market price of $2.05	Sell 5 contracts at $2.25	-0.2
September	Sell 75,000 lbs at $2.40	Buy 5 contracts at $2.55	-0.15
Gains Losses	Gain of $0.35	Loss of $0.30	
Realized Price	Sold 75,000 lbs at $2.10		

Figure 2-4 Hedging Outcomes with Strengthening Basis

Date	Cash	Futures	Basis
June	Cash market price of $2.05	Sell 5 contracts at $2.25	-0.2
September	Sell 75,000 lbs at $1.25	Buy 5 contracts at $1.55	-0.3
Gains Losses	Loss of $0.80	Gain of $0.70	
Realized Price	Sold 75,000 lbs at $1.95		

Figure 2-5 Hedging Outcomes with Weakening Basis

CHAPTER 3
REVIEW OF THE LITERATURE

This chapter reviews the most highly related studies to risk management in citrus. Previous studies in this field are generally divided into two themes: basis and hedging in the citrus industry. Basis refers to the difference between the spot market price and the price of the same commodity in the futures market. Specifically, basis is calculated as the cash price less the futures price. Hedging refers to the risk management processes of citrus growers.

Malick and Ward (1987) studied the stock and seasonality effects of FCOJ. They used a Constant Period from Maturity (CPM) model to measure seasonality. They concluded that when stocks are relatively low, cash prices are pushed up relative to futures prices, encouraging stock holders to draw down existing inventories. Seasonality became more pronounced in the later months of the citrus harvesting season when inventories approached their maximum levels. According to these authors, one of the largest seasonal effects that arise is very unique to the citrus industry. This is the large swings in FCOJ prices due to freeze losses.

"Freeze bias", as termed by Frank Dasse and Ronald Ward (1977), refers to the bidding up of the futures contract relative to spot prices before the end of a freeze period due to potential speculative gains that could be achieved in the event of a freeze. These authors used bulk FCOJ wholesale price (that is the price after processing the oranges into Frozen Concentrated Orange Juice) as the spot price for basis calculating (futures – cash), as opposed to the spot market price. Current stock levels play a large part in determining the level of price adjustments; indirectly related, larger stock levels result in smaller price adjustments because of the ability to compensate for losses.

Using the Malick and Wards CPM model set to 5 months, a graph of the seasonal nature of FCOJ basis residuals is shown in Figure 3-1 using 3 different levels of stock,. 1.0, 1.2, and 0.8

stock levels were used, where 1.0 is the ‘norm’ or average. At stock level 1.2 for example, the stock level is 120 percent of the average stock. The basis residuals are a calculated deviation from the average season basis. For example, with stock levels set at 1.0, the basis residual in Figure 3.1 in April is just below 1. This means that the seasonality effect at that moment causes basis to be higher by 1 than would otherwise be predicted without seasonality.

The basis residual turns positive in the October period for this model. This is generally attributed to the potential for freezes. Since the migration of the citrus industry to the south, lower freeze risk can attribute to the stock levels deviating slightly at the December peak as opposed to the merge seen in Figure 3-1 The decline in the basis residual during the summer months through August can be attributed to diminishing stock levels, which is why basis is so accentuated with the lowest stock level in the example of 80 percent.

Hurricane seasons now have a very similar effect on basis due to their ability to destroy large portions of a crop. Also, since Dasse and Ward published their work, Florida has played a much smaller role in the overall market for FCOJ, causing the effects of weather to be less elastic. There are many contributing factors to this, which include a loss of Florida crop due to hurricanes, canker, greening, and tristeza, while Brazil and Mexico have increased production to compensate. This has caused a decrease in the price sensitivity to freeze / hurricane destruction possibilities.

Malick and Ward reference the basis turning to zero at maturity, but there have been changes since they published their work that might suggest otherwise. For instance, the delivery points were all in Florida when Malick and Ward conducted their research, while FCOJ can now be delivered to many other areas of the United States. This in combination with the lowering proportion of citrus that comes out of Florida compared to other areas of the country and world can result in much higher delivery costs than in the past for producers. This would tend to have the effect of keeping basis from disappearing at maturity.

Ronald Ward and Frank Dasse present the uniqueness of each commodity, and how it deviates from a generalized theory for storage and basis. In this particular article, the commodity being analyzed is FCOJ. Storage theory suggests that a futures basis should reflect the marginal cost of physical product plus a risk premium minus a convenience yield. Ward and Dasse bring out ideas that might disrupt this theory, such as premiums and discounts as it reflects anticipation of future events, such as the case with freezes and hurricanes.

Ward and Dasse bring up other interesting points that affect the market. While the season officially begins December 1st, the first crop estimate by the United States Department of Agriculture (USDA) is released in October. However the December to February time period has the higher probability for possible freeze and the late crop harvest isn't until July. Towards the end of the season there is also added speculation about the next year's crop. This may be reflected in contracts that span over these months.

Ward and Dasse show the basis residuals over a 7 year timeframe in Figure 3-2. The July contract was selected by Ward and Dasse for analysis in their basis study because it extends over the complete harvesting period and therefore should reflect a storage cost while being far enough from the next season to not be heavily influenced by the expected crop.

Ward and Dasse use 6 major variables that are hypothesized to contribute to the FCOJ basis residual. These include: measure of risk premium, convenience yield, market liquidity, freeze bias, bias adjustments, and actual freezes. Ward and Dasse concluded that "The basis model developed clearly supports both the theory of storage and establishes the necessity for measuring market bias." (page 79). While Ward and Dasse say that much of the basis theory cannot be clearly related to the practicing hedger nor is it necessary, they do feel that it is essential that traders using the market have confidence in its economic performance.

It should be noted that like Ward and Malick, the article does not reference other crop-destroying variables such as hurricanes and diseases. This is most likely due to when the article was written, i.e., prior to many of the hurricanes and diseases seen in recent years.

Behr (1981) aims to "develop the conceptual net benefit model characterizing futures market behavior in terms of hedging open interest, speculation open interest, and volume." In this dissertation, Behr examines the cross-sectional, as well as time-based influences that can affect market behavior. Included is market structure, government involvement in commodity markets, price risk, and commodity perishability.

Salnars (2004) addresses the idea of capitalizing on price volatility as contracts approach maturity. This can provide great opportunities for hedging. This high reward comes with an equally large risk, as the small volume of trading can lead an unprepared hedger into an unwanted hedging position. Salnars discusses the convergence of the futures and cash prices as the contracts approach maturity. One of the reasons for this convergence (also known as narrowing of the basis, or strengthening) is due to available information. As the maturity of a contract approaches, the amount of information increases and the uncertainties about the future that cause futures and cash prices to differ become fewer. Also, as the contract approaches maturity, if there is not convergence between the cash and futures prices, speculators may arbitrage between the two, causing the prices to merge while they take in a profit. In Salnars' example of this, a scenario where futures prices are higher than cash prices as the contract approaches maturity; profit could be made by buying the commodity in the cash market and selling it in the futures market, making delivery of the commodity.

Ward and Niles prepared a report for the Futures Committee of the Florida Department of Citrus, which contains a very well rounded approach to the varieties of hedging strategies that were available to citrus growers (as of 1975). The report includes background information about the futures markets, the contract specifications, types of hedging, price data and statistics, and margin requirements. It then goes into a “Hedging Decision” section, in which it includes information about risks, types of goods that can be hedged, basis patterns, and broker selection.

The final section discusses alternative hedging programs. In this section Ward and Niles include eleven different “Hedging Cases”. Included are: Cash Grower With Opportunity Cost, Grower With Product Uncertainty, Premature Termination of Hedge, and Forward Contracting With Foreign Importers. This report provides a foundation for growers that are not familiar with hedging strategies.

One of Wards (1974) most emphasized concepts is how speculation creates the liquidity necessary to hedge. According to Ward, trading volume from speculative traders is necessary “to facilitate establishing futures positions without realizing a cost from market entry or exit.” It is argued that if a trade cannot be easily executed at any point in time, then the risk from futures trading is greatly increased. While many of these liquidity points may be considered common knowledge, Ward not only discusses the causes and effects of speculation that create liquidity, but also the effects of other scenarios, such as questioning whether there can be excess speculation and what potential consequences could arise.

Ward also addresses lack of complete identification of the composition of open interest, such as the affect on liquidity when the composition of traders is altered. For example, a report might proclaim that a major portion of the open interest is held by small traders; however the intent of small traders is not always identifiable. Ward takes a mathematical approach to testing the liquidity within the FCOJ market. According to the conclusions of Ward, “The speculative index and its relationship to price distortion provide a clear signaling mechanism to alert policy makers of any needed structural changes in this futures market. Likewise, the methodology reveals the need for improvements in the present system for monitoring futures commitments in general.”

Ranney (1993) discusses the level of inefficiency in the FCOJ option market “because the market has low trading volumes”. Ranney also provides examples with the Black model and standard arbitrage condition tests. According to Ranneys’ thesis, the Black model test “indicated inefficiency in every month due to the violation of put-call parity.” The arbitrage conditions test also indicated that there was inefficiency due to high percentages of violations of arbitrage conditions for every contract month. Ranney found that levels of inefficiency were higher than those found for any previously studied commodity option market, and that the level of inefficiency is significant and may adversely affect citrus industry hedging operations.

Staying with the subject of efficiency as a necessity for a good hedging strategy, Ward and Behr (1983a) take a look at liquidity in the futures market in general, not within a specific commodity. The article deals with two main questions: (1) What criteria are to be used to measure liquidity, and (2) what level of liquidity is considered optimum. One of the methods that is employed is using the spreads between bid and ask prices as input data for calculating a liquidity index. An index of liquidity is developed by Ward and Behr and factors leading to adjustments in the index are evaluated.

Ward and Behr (1983b) also provide an all around summary on futures commitments. Both the problem with lack of commitment information and the costly and impractical reasoning for the lack of information are presented. The ability to increase the accuracy of market performance from knowledge of open-interest allocation is proved undeniable. At the time Ward and Behr's article was written, the CFTC had begun providing a month-ending classification of futures traders that hold large (excess of 25 contracts) positions. The data included the numbers of long and short commitments reported by hedgers and speculators, and also included the long and short position of non-reported open interest.

Ward and Behr present 4 alternative schemes for allocating non-reported short and long positions to hedging and speculation. Two of the procedures, known as the Larson and the Rutledge models, are based on estimates from data obtained through special market surveys. The other two, denoted in the article as "Scheme 1" and "Scheme 2", are based on numerical weighting procedures with the weights derived theoretically rather than from econometric estimates.

Ward and Behr show that all but the Larson's model give very similar allocations over a broad range of commodities, and also note that both the Larson's and Rutledge models occasionally "lead to allocations that were clearly impossible." All four models did share 2 things of common interest: first, a general procedure is suggested that is to be applied across all commodity futures, and, second, the procedures are based on some weighting of the reported futures data.

Rolls (1984) provides an in-depth look at the relationship between the interaction of prices and "a truly exogenous determinant of value, the weather". Due to the highly centralized and concentrated area of orange groves in central Florida, the ongoing weather in a particular spot market can have enormous consequences on the value of the product.

Rolls explains that not only is weather a huge determinant in value because of the centralized location, but there is so little affect on price from other supply and demand factors.

The demand may have very subtle movements due to price changes in substitutes such as apple juice or grape juice, but national income and tastes generally will not fluctuate enough to explain any significant daily movements. On the same note, short term variations in supply caused by planting decisions would be very low because oranges grow on trees that require five to fifteen years to mature.

Rolls also went into detail about daily movements that are allowed within the FCOJ contracts daily fluctuations, and how extreme circumstances, such as freezes and hurricanes, can cause a necessity for price movements beyond the daily limits. In this case, the limits cause price inefficiency.

Muraro and Oswalt (2003) published an extensive report on Florida citrus in September 2003. The report is statistically based with only a short introduction and mentions of data collection methods as well as necessary assumptions. While the study holds many points and lays a great foundation for understanding the percentages of risk, it appears to serve much better as a reference tool.

Spreen, et al (2006) prepared a report on the current status and future prospect of the Florida citrus industry. The article explains the cause and effects of current citrus problems such as citrus canker as well as citrus greening. Both have become an increasing concern regarding tree health despite the decline of tristeza.

The report covers four main sections: 1) analysis of the economic impact of the industry on the Florida economy; 2) assessment of the future structure of the Florida citrus tree nursery industry; 3) analysis of the future prospects for new investment in Florida citrus; and 4) long-run production and price forecasts for Florida citrus under varying assumptions that relate to supply issues. According to Spreen et al, the estimated economic impact of the citrus industry on the

Florida economy for 2003-2004, was over $9.25 billion, and accounted for over 76,000 jobs in the state.

This significant impact of the citrus industry in Florida provides strong motivation for work related to helping citrus growers. Previous research helps provide an understanding of basis, its patterns, causes and effects. It also provides a fundamental knowledge regarding hedging, however it falls short of analyzing alternative marketing strategies employed in a risk management.

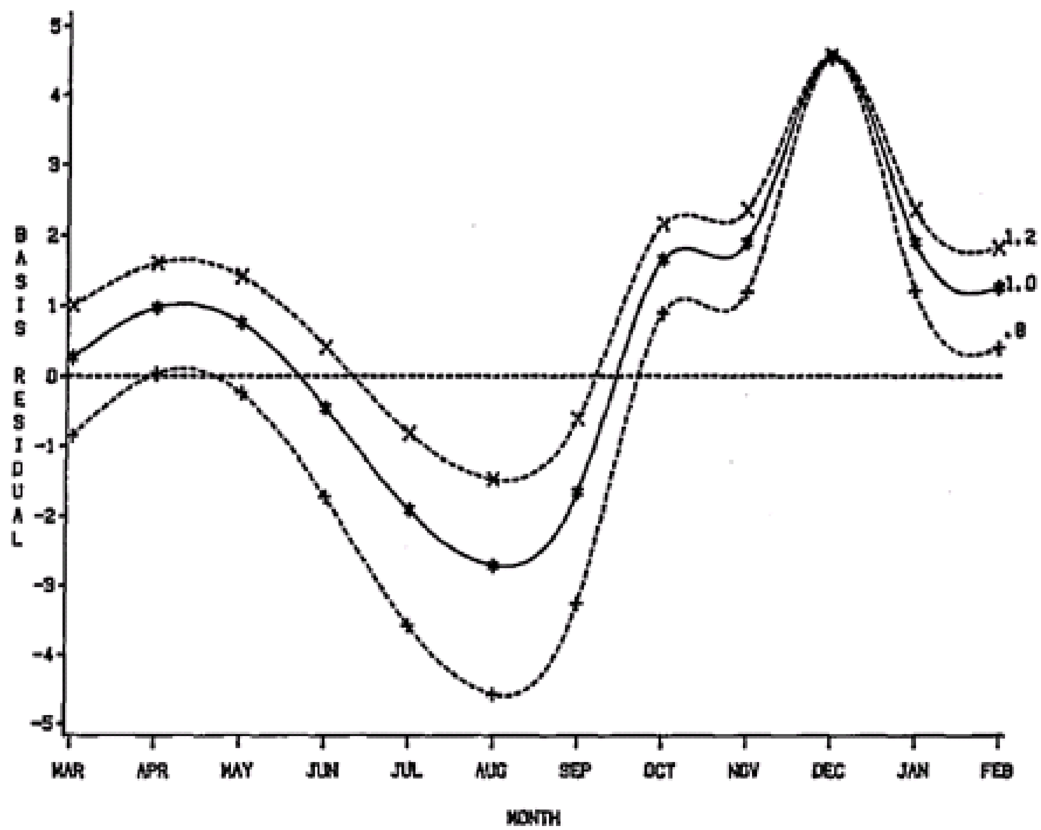

Figure 3-1 Seasonality of Basis Residuals

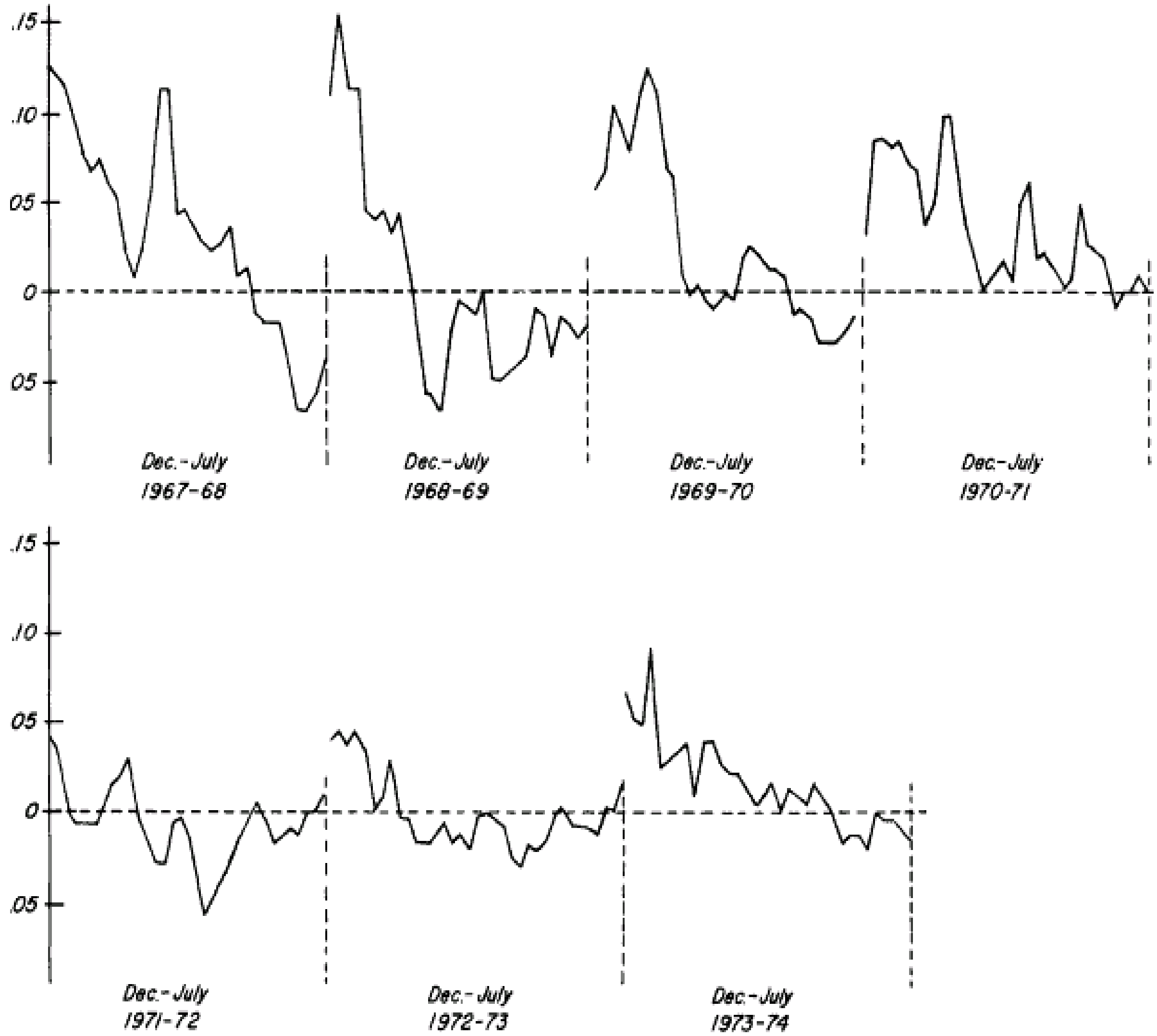

Figure 3-2 Basis Residuals over Time

CHAPTER 4
METHODOLOGY AND DATA

The Model

The model used in this study is developed by modifying the orange production model developed by Weldon, et al. (2004). An analysis of the impact of the marketing efforts for citrus producers must explicitly examine the variability or risk of future returns. Simulation is a technique that analytically models or replicates an actual system and is used in many areas of study. In agriculture it has been used to model plant growth, market conditions, animal growth and reproduction, environmental and ecological systems, intergenerational farm transfers, and many other situations. Simulation modeling can be used to examine farm income under alternative risk scenarios and provides insights into how various firm decisions influence firm survival. Simulating the production and economic activities over a multi-year planning horizon also allows for examination of the impact of federal policy or programs, such as the Florida citrus disaster program, on the profitability and survival of the citrus operation. In this study, the simulations examine the risks and returns associated with various methods of marketing citrus.

Simetar© (Simulation for Excel to Analyze Risk), an Excel add-in that was developed explicitly for stochastic simulation modeling by Dr. James Richardson, is used to simulate risks and returns to a Valencia and early, midseason (hereon referred to as early-mid) orange grower. The risk and return framework for a representative ‘Valencia’ orange and early-mid orange grower are modeled to simulate financial results over a twelve-year time horizon ending in 2020. The model is based on annual cash flows including operating and fixed costs, and forecasted prices and yields. It generates an annual income statement, pro forma cash flow statement, and pro forma balance sheet statement. Since this is a stochastic simulation each iteration, the pseudo-random prices and yields are drawn from a multivariate empirical distribution using a

Latin Hypercube sampling method. The forecasted random data is correlated based on historical correlations.

For each iteration, the simulator provides the ending net worth at the end of the twelve-year time horizon. The Net Present Value (NPV) is calculated as

$$NPV = We \text{ for year } 2020 / (1+ i)^{13} - Wb \text{ for year } 2008 \quad (4\text{-}1)$$

where i is the real discount rate, We is the ending net worth, and Wb is the beginning net worth. The NPV is a measure of the amount of wealth that is acquired over the twelve-year period in present dollars and assumes that all excess cash flows remain in the business and are reinvested with a return equal to the discount rate. For each simulation, 500 iterations are run to yield a distribution for the NPV. The mean NPV is the average of these 500 iterations, or the expected wealth generated or lost for that particular scenario. Because the objective of this study is to contrast the reward with the risk inherent in the scenario, the standard deviation for NPV is used to assess the risk associated with that reward. The standard deviation measures the dispersion of a probability distribution.

In the simulations, we estimate the mean NPV, the standard deviation for the NPV, and a Yearly Average standard deviation. The NPV standard deviation measures the variation of the net present value. The yearly standard deviation measures the volatility from year to year associated with the income stream in each iteration of the simulation. The yearly average standard deviation is the average of the yearly standard deviation's measured from the simulation.

For each scenario, the acreage of the representative grower is assumed to be the average acreage of a citrus farm in Florida in 2002 (Guci, 2007). It is assumed that the farmer owns the entire acreage. It is also assumed that the farmer is not in debt.

The following comparisons are made for each citrus variety. First, an NPVbaseline is calculated as the expected gain in wealth projected for the next twelve years assuming the producer enters their entire harvest into a pool. Three alternative NPVscenarios are simulated for both early-mid and Valencia citrus varieties. The results of the simulations for the three alternative scenarios are compared to the pooling NPVbaseline to evaluate the risk and return of the alternative marketing strategies.

The first alternative scenario that is included in the analysis assumes that the producer sells the entire crop in a single week in the cash market when the oranges are harvested. The second alternative scenario assumes that the producer sells the crop in the cash market equally throughout three consecutive weeks following harvest. The third and final alternative scenario assumes the producer takes a short position in the futures market for the next crop at the end of the current harvest season, and liquidates that position when the following crop is harvested.

Forecasting Market Prices

The simulations require a forecast of price and yield for each season in simulation. Pooling return price forecasts are calculated using an index ratio of Valencia pooling price and early-mid pooling price relative to the all orange value[1]. Pool data for Valencia ranges from $0.982 to $1.71, while pool data for Early-mids ranges from $0.789 to $1.63. This data covers the seasons 1987-1988 to 2002-2003.

Pooling returns represent the annual value received as opposed to a weekly price, so an annual index ratio is used to forecast pooling returns instead of a weekly index. A stochastic normal distribution of the index ratio (derived from the historical annual index) is used with the

[1] Historical pool price data was obtained via interview process from Dr. John J. VanSickle, professor at the University of Florida who originally obtained this data through Florida’s Natural.

forecasted all orange value obtained through Spreen et al. (2006) to derive stochastic forecasted Valencia and Early-mid pool prices.

A discrete empirical formula is used to select a harvest week for the first alternative scenario, where the entire crop is sold in the cash market in a certain week within a season. The Simetar program randomly selects a harvest week within the projected season based on the probability distribution for harvest weeks in prior seasons[2]. Using those probabilities, Simetar chooses a particular harvest week and the stochastic price of that week to calculate receipts and all the other necessary components of the forecasted financial model. Because of the large number of stochastic calculations involved, it is necessary to use a large number of iterations to get a clearer picture of the probabilities associated with the final value. Simulating these data with a large number of iterations yields NPV and standard deviation statistics that allow an examination of the risk-return framework for the marketing strategy's.

The same methodology is used for selecting the harvest week for the other alternative scenarios with changes in the model to reflect the alternative marketing scenarios. In scenario two the crop is sold equally over three weeks. The simulation is the same as for scenario one, except that when Simetar chooses a harvest week based upon the probability distribution for harvest weeks, it uses the average of the price for that week plus the next two weeks to use as the average selling price. In the event that the week chosen is the second-to-last week of the season, the price is an average of the last two weeks. In the event that the week chosen is the last week within a season, the price for that week alone is used.

A hedge scenario with the futures market requires specification of a time to implement the hedge and a time to liquidate, or offset, the hedge. It is assumed that a hedge is initiated when the

[2] These data were collected from "Utilization of Florida Citrus Fruit" reports from the Citrus Administrative Committee and can be found through their website, www.citrusadministrativecommitee.org.

prior crop season is closing and lifted when the crop is sold in the cash market. A decision is added in this scenario in which if at the time of implanting the hedge, the spot price multiplied by the per-yield acre is greater than the production costs per acre, the hedge is implemented, otherwise the grower takes their chances, and sells directly into a single week in the cash market at harvest. For this scenario, a random week based on an empirical distribution is used for liquidation of the hedge. The gain/loss from the futures position is taken in conjunction with the spot market price at the time of harvest to determine net receipts for that year.

Forecasted spot market prices are required to simulate the returns for the three alternative scenarios. To do this, historical "seasonal index" is calculated from the weekly spot market prices for Valencias and early-mids relative to the average all-orange spot market price of that season. Spot market data for both Valencias and early-mids were obtained through the USDA National Agricultural Statistics Service (NASS)[3]. The Valencia spot market prices range from \$0.550 to \$2.15 per pound solid, with an average of \$1.193 for the years 1983 to 2006. Early-mid spot market prices range from \$0.425 to \$1.75 per pound solid, with an average of \$0.992 for the years 1982 to 2006.

The all-orange price per box on tree and all-orange concentrate yield were also obtained from NASS. The on tree price per box ranges from \$2.89 to \$7.58 with an average of \$4.722. A standard conversion rate of 4.156 (Citrus Reference Book, 41) is used to derive an all-orange price per pound solid by dividing the all-orange on tree price per box by the product of the all-orange concentrate yield and the conversion rate.

A seasonal index is derived for Valencias and early-mids prices by calculating the ratio of the weekly Valencias or early-mid price over all-orange annual price. This product gives a

[3] These data are available through their website: http://www.nass.usda.gov/Statistics_by_State/Florida, as well as through the hard copies of their annual Citrus Summary reports.

distribution of weekly index values for each product. For example, in week 13 the mean seasonal index value of the Valencia spot price over the all-orange spot price from the years 1983 to 2004 is 1.599 with a standard deviation of 0.358 (Figure 4-1).

The distribution of weekly seasonal index values is assumed to be normally distributed, and a stochastic function is used to create a random index for each week in each season to be simulated. The series of weekly seasonal index values are then correlated with a correlation matrix to insure continuity of prices within a season.

Using forecasted all-orange spot market prices, these stochastic seasonal indexes (along with the forecasted price) are used to obtain weekly forecasted stochastic spot prices for valencia and early-mids over the projected seasons. The forecasted all-orange spot price used in this analysis is derived from Spreen, et al (2006). The forecasted all-orange spot price (converted into per pound solid units) covers the seasons of 2007-2008 to 2019-2020 and ranges from \$0.846 to \$1.472 with an average of \$1.263.

Using weekly historical futures price data and weekly historical spot market price data, a historical Valencia basis and an early-mids basis are calculated. This yields a weekly Valencia basis which is used to calculate a mean and standard deviation. These two statistics are used to produce a normally distributed basis for each week. These values are also used to derive a correlation matrix for the weekly basis to insure seasonal consistency from week-to-week. For example, with the correlation in place, there is a much smaller probability of the basis swinging from one tail of the normal distribution to the other tail over the course of a week.

When the forecasted stochastic Valencia spot price in a given week is combined with the stochastic Valencia basis, a stochastic forecasted Valencia based futures market price can be developed. This process is repeated with the early-mid spot market price and basis data to develop the forecasted futures market price.

For the final marketing strategy, hedging using futures, historical nearby contract data was collected. Nearby futures contract data was received from the New York Board of Trade (NYBOT), which is now the Intercontinental Exchange (ICE). The period of the data run from October, 1982 to May, 2007, with prices ranging from $0.551 to $2.072.

To develop a discrete empirical distribution for the harvesting time, data was collected through the Citrus Administrative Committee. This data contains the past 3 years of quantity of data processed weekly for both Valencia and early-mid. Using this data, the percentages were broken into the necessary number of categories needed, 10 for Valencia, and 17 for early-mid.

Using the Dempirical and Hlookup functions, a system is set in place for the model, in any given year, to choose a harvesting week based on historical probabilities, and the stochastic forecasted price from that week for the necessary year is used. For the scenario involving a distribution of harvesting over three consecutive weeks, a system is set in place for any given price to be chosen in which an average of the given week plus the next two weeks is used. In the event that the 2nd to final week is chosen, it retrieves an average of the last two weeks. In the event that the final week is chosen, that value is used. This process is done for both Valencia and early-mid prices.

Forecasting Futures Prices for the Hedge Model

The hedging scenario, for both Valencias and early-mids requires a few key assumptions. The first assumption is that the hedge is implemented at the end of the previous year's harvest season. It is at the end of the previous harvest season that the following crop development begins and the grower incurs production costs. The growers hedged amount comes from an average of his forecasted yield for the upcoming year, and the realized yield of the two previous years. The basic hedge formula uses the spot price when the hedge is implemented, and adds the change in basis and subtracts transaction costs (brokerage fees) for trading futures contracts. The transaction cost (each way) is assumed to be $20 per contract (at 15,000 pound solid per contract), a citrus industry norm.

Like reality, the process of hedging an amount based on previous years yields leaves the chance of over and under hedging. In the situation in which the crop is under-hedged, the excess, un-hedged portion of the crop is assumed to be sold into the cash market at the week at harvest. In the event that the crop is over-hedged, the gains or losses accumulated from the excess futures position are added or subtracted from the final revenue for the given year.

Forecasted Yields

Historical farm-level yield data (boxes per acre) from southwest Florida were used to calculate an average yield for a given year across all farms, as well as a standard deviation of the yield from year-to-year within a single farm. The standard deviation of the yearly averages is used as an 'annual standard deviation' while forecasting yields. This annual standard deviation is calculated to be 48.6 for Valencia and 63.9 for early-mid.

Within each farm, from year-to-year a deviation from that particular years average yield is calculated, and an average of those standard deviations is taken as a 'farm level deviation'. This is done with both Valencia and early-mid data. This farm level deviation for Valencia is 70.3, and 85.1 for early-mid. The farm level deviations were expected to be much higher than the annual standard deviation because this annual standard deviation averages the yields across all farms, lowering the volatility.

Using historical Valencia, early-mid, and all-orange yield data, an average ratio of Valencia to all-orange, and early-mid to all-orange yields are calculated. Using the average and normal distribution of these data, combined with the low-level greening forecasted yields found in Spreen, et al. (2006), stochastic forecasted yields for Valencia and early-mid are derived. A stochastic normal distribution for historical Valencia and early-mid concentrate yields, are used with the conversion rate to convert from boxes per acre to pound-solids per acre.

The final yield numbers are calculated using the historical ratio of Valencia to all-orange yield, combined with the forecasted yields provided by Spreen, et al. By using a stochastic normal distribution of the Valencia to all-orange ratio, combined with the calculated 'annual standard deviation' as the standard deviation, we arrive at our forecasted yields across all farms. To add in the final volatility associated with farm level yield, one more stochastic normal distribution is added. This normal distribution is calculated with an average of zero, and the 'farm level deviation' as the standard deviation. This last value adds in the farm-level volatility necessary for this model. This process is repeated for the early-mid yield. Finally, the correlation matrix based on historical prices and yields, provides the price-yield correlation necessary to keep the values practical.

Valencias Spot / All Orange value						
Year/Week	10	11	12	13	14	15
1982						
1983				1.346	1.346	1.358
1984	1.514	1.514	1.514	1.561	1.561	1.631
1985			1.349	1.329	1.268	1.268
1986	1.127	1.127	1.090	1.090	1.134	1.163
1987		1.471	1.591	1.621	1.621	1.651
1988		1.256	1.235	1.278	1.278	1.299
1989	1.228	1.163	1.185	1.185	1.336	1.400
1990	1.600	1.600	1.579	1.579	1.538	1.764
1991	1.206	1.180	1.154	1.180	1.180	1.205
1992	1.562	1.590	1.590	1.590	1.573	1.573
1993	1.037	1.037	1.131	1.179	1.320	1.348
1994		1.752	1.752	1.752	1.673	1.673
1995	1.746	1.746	1.788	1.804	1.779	1.829
1996	1.977	2.013	2.049	2.049	2.049	2.013
1997	1.568	1.661	1.568	1.568	1.568	1.568
1998	1.954	1.999	2.176	2.221	2.176	1.954
1999						1.543
2000					1.577	1.577
2001						
2002	1.733	1.705	1.705	1.705	1.686	1.705
2003	2.015	2.015	2.015	2.015	2.015	2.015
2004	1.567	1.567	1.567	1.567	1.567	1.567
2005	2.357	2.357	2.357	2.357	2.357	2.357
2006					1.982	1.982
n	15	18	19	20	22	23
V Spot / All Orange AVG		1.597	1.600	1.599	1.617	1.628
Std Dev		0.358	0.365	0.358	0.330	0.300
correlation		0.209	0.238	0.234	0.312	0.240
normal distr		**1.306**	**1.339**	**1.338**	**1.456**	**1.416**

Figure 4-1 Valencia Spot Index

CHAPTER 5
RESULTS AND DISCUSSION

Results

The results from the simulations can be seen in Tables 5-1 and 5-2. A probability distribution function (PDF) graph of the Valencia baseline and scenarios can be seen in Figure 5-1. A similar PDF displaying the results of the early-mid baseline and scenarios be seen in Figure 5-2.

Valencia

Baseline scenario

The baseline scenarios for the Valencia and early-mid oranges assume the entire crop is sold through a pooling program. The mean net present value (NPV) for the Valencia baseline scenario is $845,722, with a standard deviation of 1,032,299. The minimum NPV obtained during any single iteration is less than $-1.3 million, while the maximum NPV obtained is over $4.5 million. A graph of this baseline scenario showing the probability distribution function (PDF) for Valencia can be seen in Figure 5-3. As seen in Table 5-5, the average yearly standard deviation (the average of the yearly standard deviation’s measured from the simulation) for this scenario is 77,182.

Critical NPV values can be seen in Table 5-3. This table shows that the Valencia baseline scenario holds a 79 percent chance of producing a NPV of 0 (breakeven) or better. There is a 10 percent chance of losing at least $500,000, and a 4 percent chance of losing at least $750,000. On the positive side, there is a 44 percent chance of making at least $750,000, and a 15 percent chance of making at least $1.5 million.

One-week cash market scenario

In the scenario involving the entire harvest being sold into the cash market in a single week (hereby referred to as ‘Scenario 1’), the mean NPV is $835,567 with a standard deviation of 853,462. The minimum NPV obtained during any single iteration is less than $-1.25 million, while the maximum NPV obtained is almost $3.5 million. A PDF graph of Scenario 1 for Valencia can be seen in Figure 5-4. As seen in Table 5-5, the average yearly standard deviation for this scenario is 74,482.

As seen in Table 5-3, Valencia Scenario 1 holds an 83 percent chance of producing a NPV of at least 0 (breakeven). This scenario holds a chance of losing $500,000 or more of 13 percent, and a 3 percent chance of losing $750,000 or more. On the positive side, Scenario 1 has a 53 percent chance of producing a NPV of at least $750,000, and a 22 percent chance of making at least $1.5 million.

Three-week cash market scenario

In the scenario involving the entire harvest being sold in the cash market the three weeks following harvest (hereby referred to as ‘Scenario 2’), the mean NPV is $800,552, with a standard deviation of 841,486. The minimum NPV obtained during any single iteration is less than $-1.25 million, while the maximum NPV obtained is over $3.25 million. A PDF graph of Scenario 2 for Valencia can be seen in Figure 5-5. As seen in Table 5-5, the average yearly standard deviation for this scenario is 52,164.

This Valencia Scenario holds an 82 percent chance of producing at least a breakeven NPV (Table 5.3). This scenario has a chance of losing at least $500,000 of 7 percent, and a 3 percent chance of losing $750,000 or more. On the positive side, this Valencia scenario holds a 52 percent chance of producing a NPV of at least $750,000, and a 20 percent chance of making at least $1.5 million.

Hedging scenario

In the scenario involving hedging in the futures market (hereby referred to as 'Scenario 3'), the mean NPV is $547,506, with a standard deviation of 742,264. The minimum NPV obtained during any single iteration is just under $-1.2 million, while the maximum NPV obtained is over $2.7 million. A PDF graph of this scenario can be seen in Figure 5-6. The average yearly standard deviation for this scenario is 65,594 (Table 5-5).

This Valencia scenario holds a 77 percent chance of producing at least a breakeven NPV (Table 5-3). This scenario has a 10 percent chance of losing at least $500,000, and a 3 percent chance of losing $750,000 or more. On the positive side, Valencia Scenario 3 holds a 39 percent chance of producing a NPV of at least $750,000, and a 10 percent chance of making at least $1.5 million. A PDF graph of the change in basis associated with Valencia Scenario 3 can be seen in Figure 5-7.

Early-mid

Baseline scenario

The baseline scenario for early-mid assumes the entire crop is sold through a pooling program. The mean NPV for the early-mid baseline scenario is $633,507 with a standard deviation of 844,480. The minimum NPV obtained during any single iteration is less than $-1.3 million, while the maximum obtained is over $4.5 million. A PDF graph of the early-mid baseline scenario can be seen in Figure 5-8. The average yearly standard deviation for this scenario is 65,393 (Table 5-5).

The early-mid baseline scenario holds a 75 percent chance of producing at least a breakeven NPV (Table 5-4). This scenario has a 10 percent chance of losing $500,000 or more, and a 4 percent chance of losing $750,000 or more. On the positive side, the early-mid baseline scenario produced a 44 percent chance of producing a NPV of at least $750,000, and a 15 percent chance of producing a NPV of at least $1.5 million.

One-week cash market scenario

The mean NPV of the early-mid Scenario 1 is $364,364, with a standard deviation of 674,524. The minimum NPV obtained during any single iteration is less than $-1.2 million, while the maximum is over $2.3 million. A PDF graph of Scenario 1 for early-mids can be seen in Figure 5-9. The average yearly standard deviation for this scenario is 65,393 (Table 5-5).

The early-mid Scenario 1 has a 70 percent chance of producing at least a breakeven NPV (Table 5-4). This scenario has a 13 percent chance of producing a NPV of negative $500,000 or less, and a 4 percent chance of producing a NPV of negative $750,000 or less. On the positive side, early-mid Scenario 1 has a 28 percent chance of producing a NPV of at least $750,000, and a 5 percent chance of producing a NPV of at least $1.5 million.

Three-week cash market scenario

The mean NPV of the early-mids Scenario 2 is $369,187, with a standard deviation of 674,213. The minimum NPV obtained during any single iteration is under $-1.2 million, while the maximum obtained is almost $2.4 million. A PDF graph of Scenario 2 for early-mids can be seen in Figure 5-10. The average yearly standard deviation for this scenario is 56,993 (Table 5-5).

This early-mid Scenario 2 holds just a 70 percent chance of producing at least a breakeven NPV (Table 5-4). This scenario also holds a 13 percent chance of losing at least $500,000, and a 4 percent chance of losing at least $750,000. On the positive side, early-mid Scenario 2 holds a 29 percent chance of producing a NPV of at least $750,000, and a 5 percent chance of making at least $1.5 million.

Hedging scenario

In the early-mid scenario involving hedging in the futures market (hereby referred to as 'Scenario 3'), the mean NPV is $169,851, with a standard deviation of 761,105. The minimum NPV obtained during any single iteration is under $-1.5 million, while the maximum NPV obtained is over $2.7 million. A PDF graph of Scenario 3 can be seen in Figure 5-11. The average yearly standard deviation for this scenario is 69,199 (Table 5-5).

This early-mids Scenario 3 holds a 55 percent chance of producing at least a breakeven NPV. This scenario has a chance of losing at least $500,000 of 23 percent, and a 7 percent chance of losing $750,000 or more. On the positive side, this scenario holds a 22 percent chance of producing a NPV of at least $750,000, and a 5 percent chance of making at least $1.5 million. A PDF graph of the change in basis associated with Valencia Scenario 3 can be seen in Figure 5-12.

Discussion

Valencia

Preliminary expected results would lead us to believe that the baseline scenario with pooling would provide the lowest volatility, that is, the lowest standard deviation. However, contrary to this belief, the baseline scenario in fact provided the highest NPV with the highest level of volatility. Scenario 1 yielded the second highest NPV, with the second-to-least amount of volatility. Scenario 2 yielded the third highest NPV, with slightly less volatility than scenario 1. Scenario 3, the hedging scenario, in fact provided the lowest NPV by a large margin, combined with the lowest standard deviation.

While return vs. risk is stated to be determined by NPV vs. standard deviation, the minimum and maximum potential values are relevant as well. The Valencia baseline scenario yielded the highest maximum at over $4.5 million, while scenario 1 reached $3.4 million, and scenario 2 fell about $150,000 short of scenario 1. Scenario 3 had the lowest maximum, falling short of $3 million. The most favorable minimum was obtained by scenario 3 with negative $1.2 million, followed by scenario 2 at just under negative $1.25 million, while scenario 1 fell about $3,000 below that, and the baseline scenario fell over $100,000 below that of scenario 1.

Having the highest chance of not being able to break even, at 23 percent, the Valencia scenario 3 held the second highest chance of losing at least $500,000. Scenario 3 however fell short only to the Valencia baseline which held a 5 percent chance of losing at least $750,000. This, however, can be attributed to risk, as this same baseline scenario held the highest chance of making $1.5 or 2.5 million at 25 percent and 6 percent respectively. This baseline scenario clearly produces the higher risk complimented by a higher reward. The most risk averse Valencia grower would be much better off utilizing Scenarios 2 or 3, which produced the highest chances of at least breaking even (83 and 82 percent, respectively), as well as the highest chances of making at least $750,000 (53 and 52 percent). Also, these scenarios generated the lowest chances of losing $500,000 at 3 percent for each. In no categories shown in Table 5-3 did Scenario 1 perform the worst. Scenario 2 held the lowest year-to-year volatility with a standard deviation of 56,993, almost 10,000 lower then the next closest scenario.

Early-mid

Again, we would expect the baseline scenario of pooling to yield the lowest volatility, and in fact, it again held the highest NPV with the highest level of volatility. As far as early-mid oranges go, the baseline scenario yielded the most favorable results in other areas as well, having the both the highest maximum and highest minimum. Scenario 3 yielded the second highest maximum at over $2.7 million, followed by scenario 2 and lastly scenario 1. The minimums obtained also favored the baseline scenario, with scenario 2 being the second best option.

The early-mid baseline scenario clearly outperformed the other scenarios for all critical values. In no category was any other scenario favorable to the baseline (Table 5-4). In fact, many categories are not even close. The early-mid baseline scenario holds a 15 percent better chance of producing an NPV of at least $750,000. The next closest scenario (Scenario 2) was 3 times more likely to produce a NPV of at least $1.5 million than any other scenario. Only the baseline and scenario 3 showed any chance of reaching $2.5 million, at 2 and 1 percent, respectively. The early-mid scenario 4 was not competitive in any category, and was the least-favored scenario in all but a single category, obtaining a NPV of at least $2.5 million.

Changes in basis

A change in basis model, shown in Figure 5-7 and Figure 5-12 could provide some insight into the detriment of the early-mid scenario 4. After 1,000 iterations, with an average of -0.0907, this negative change in basis(i.e., weakening) hurts the citrus growers' net returns. The Valencia change in basis, averaging a positive 0.0039, helps the citrus grower. This strengthening of the basis helps move the net price higher for the producer.

The early-mid change in basis also produced a much higher variation than that of the Valencia. While the Valencia iterations provided a positive change in basis 48 percent of the time, the early-mid change in basis was only positive 30 percent of the time.

Table 5-1 Scenario Results (Valencia)

Scenario	V Pool	V 1-week	V 3-week	V Hedge
Mean NPV	$845,722	$835,567	$800,552	$547,506
Std Dev	1,032,299	853,462	841,486	742,264
Min	$-1,371,947	$-1,264,171	$-1,261,862	$-1,205,965
Max	$4,536,464	$3,401,561	$3,251,220	$2,788,583

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Table 5-2 Scenario Results (Early-mid)

Scenario	EM pool	EM 1-week	EM 3-week	EM Hedge
Mean NPV	$633,507	$364,364	$369,187	$169,851
Std Dev	844,480	674,524	674,213	761,105
Min	$-1,252,346	$-1,262,639	$-1,261,849	$-1,541,493
Max	$3,429,396	$2,376,623	$2,397,002	$2,780,505

Table 5-3 Critical Points (Valencia)

Scenario	Baseline	Scenario 1	Scenario 2	Scenario 3
NPV of $-750,000 or less	5 percent	3 percent	3 percent	3 percent
NPV of $-500,000 or less	9 percent	7 percent	7 percent	10 percent
Breaking even or better	79 percent	83 percent	82 percent	77 percent
NPV of At Least $750,000	51 percent	53 percent	52 percent	39 percent
NPV of At Least $1,500,000	25 percent	22 percent	20 percent	10 percent
NPV of At Least $2,500,000	6 percent	3 percent	3 percent	1 percent

Table 5-4 Critical Points (Early-mid)

Scenario	Baseline	Scenario 1	Scenario 2	Scenario 3
NPV of $-750,000 or less	4 percent	4 percent	4 percent	7 percent
NPV of $-500,000 or less	10 percent	13 percent	13 percent	23 percent
Breaking even or better	75 percent	70 percent	70 percent	55 percent
NPV of At Least $750,000	44 percent	28 percent	29 percent	22 percent
NPV of At Least $1,500,000	15 percent	5 percent	5 percent	5 percent
NPV of At Least $2,500,000	2 percent	0 percent	0 percent	1 percent

Table 5-5 Average Yearly Standard Deviations

Scenario	V Pool	V Scenario 1	V Scenario 2	V Scenario 3	EM Pool	EM Scenario 1	EM Scenario 2	EM Scenario 3
Average Yearly Std Devs	77,182	74,482	52,164	65,594	65,393	65,140	56,993	69,199

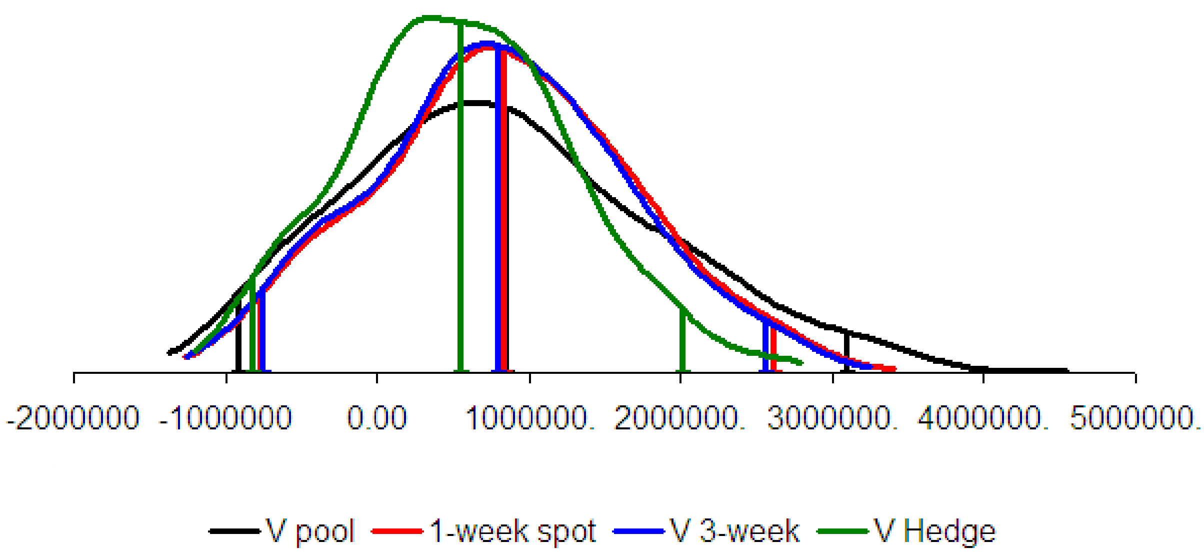

Figure 5-1 All Valencia Scenarios

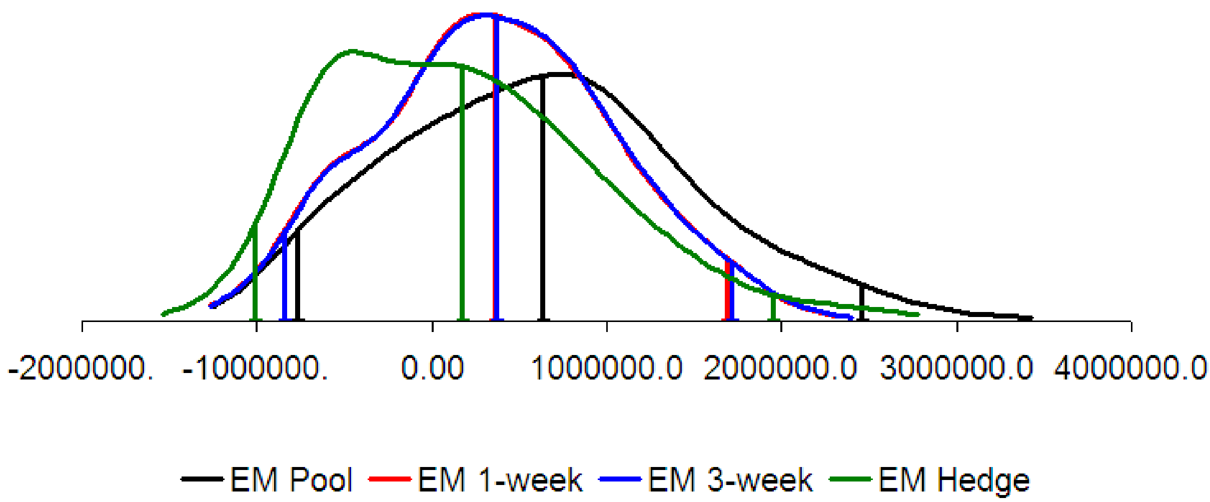

Figure 5-2 All Early-mid Scenarios

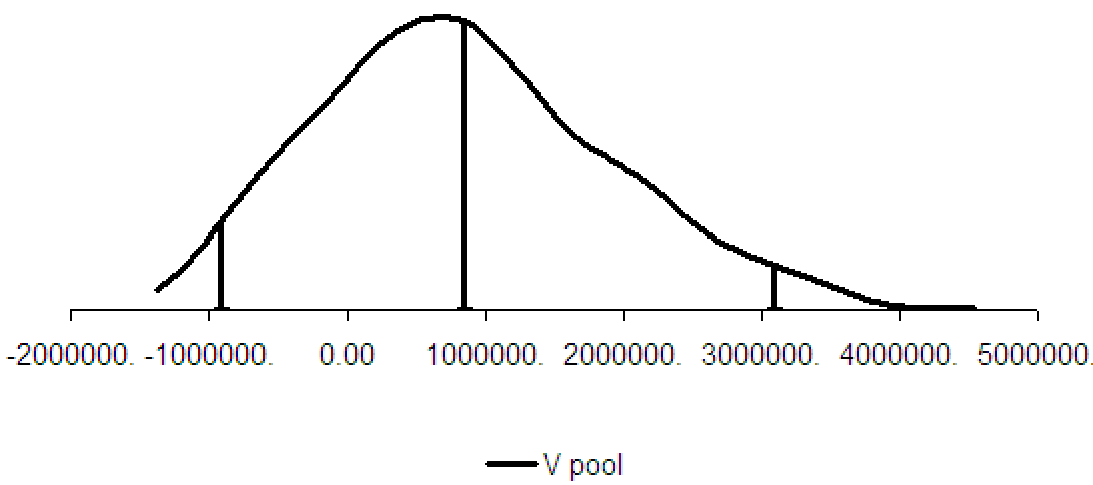

Figure 5-3 Valencia Pool

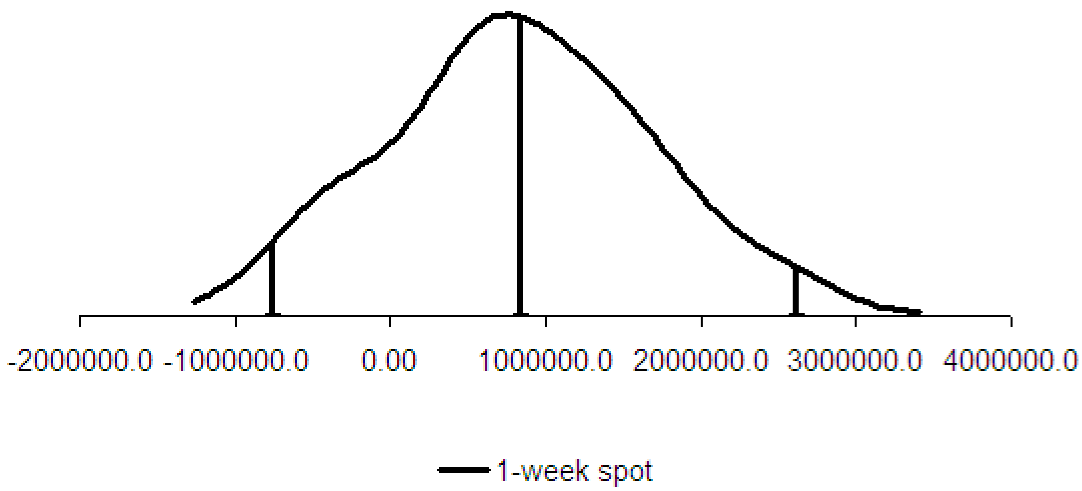

Figure 5-4 Valencia Scenario 1

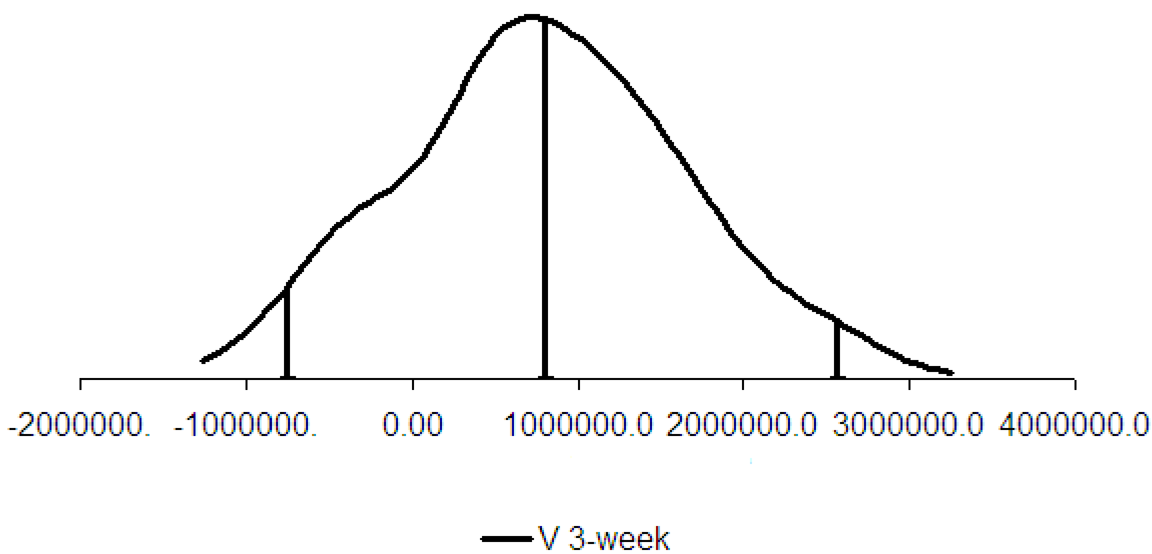

Figure 5-5 Valencia Scenario 2

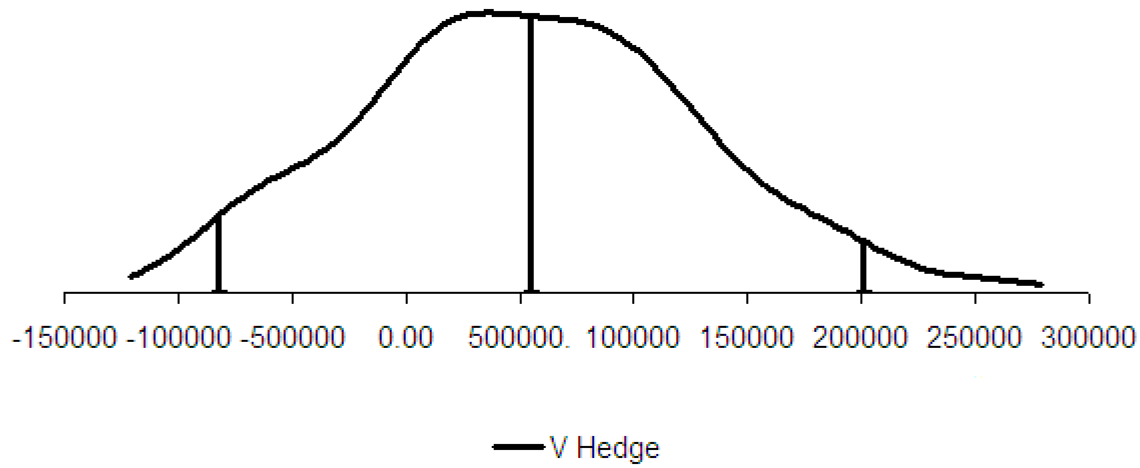

Figure 5-6 Valencia Scenario 3

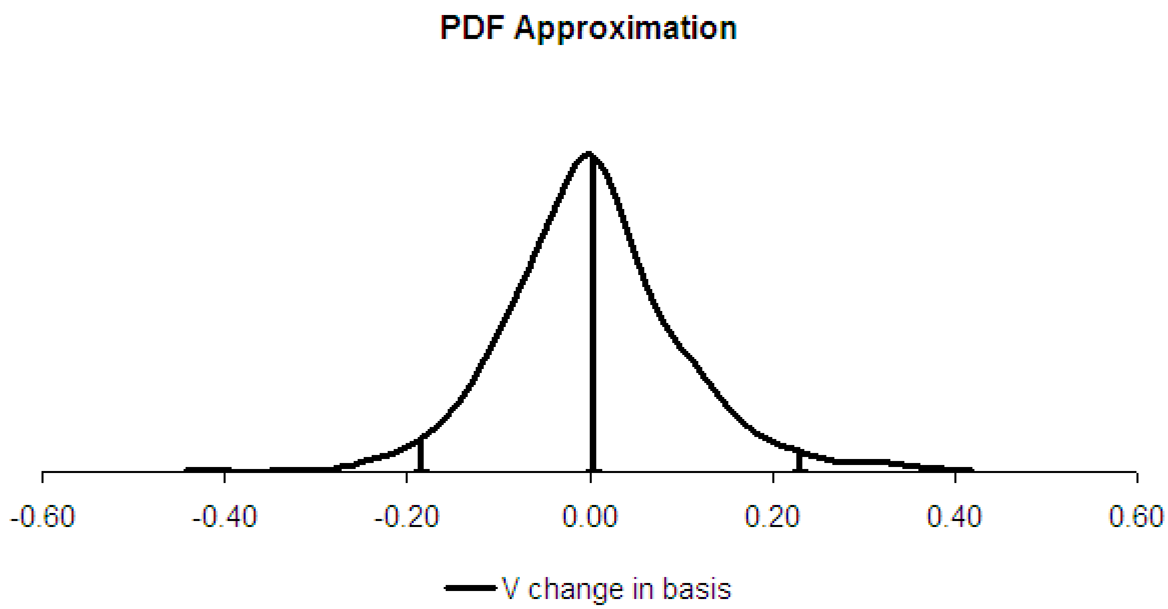

Figure 5-7 Valencia Change in Basis PDF

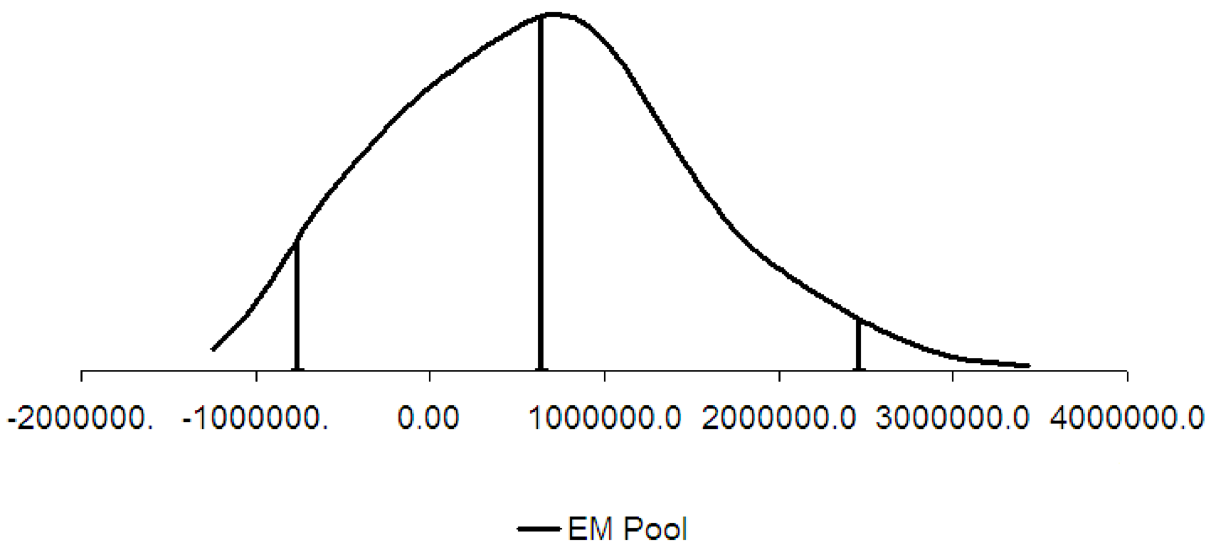

Figure 5-8 Early-mid Pool

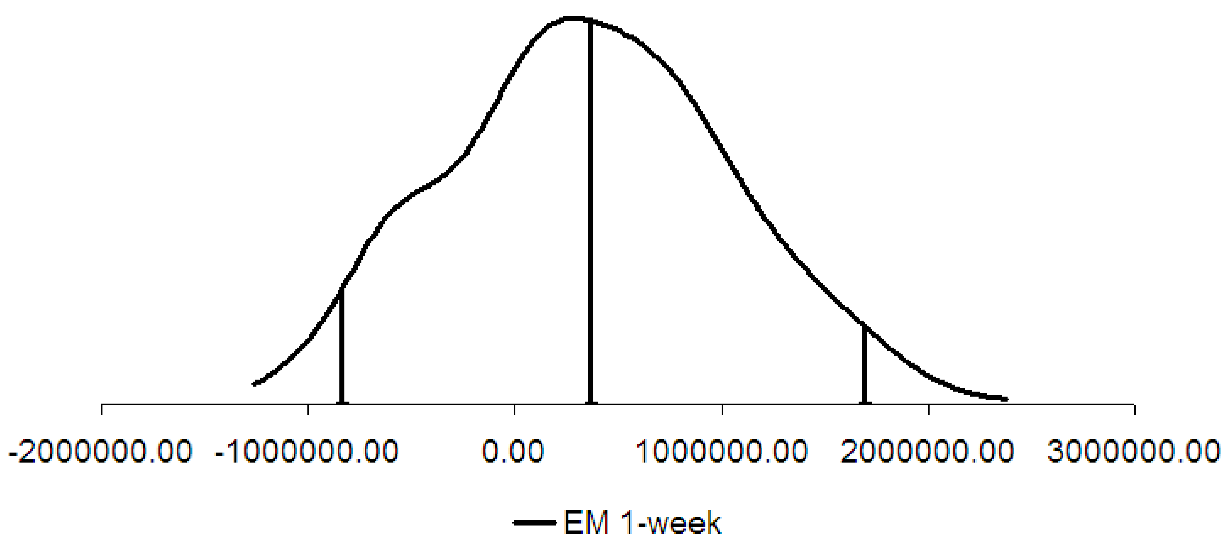

Figure 5-9 Early-mid Scenario 1

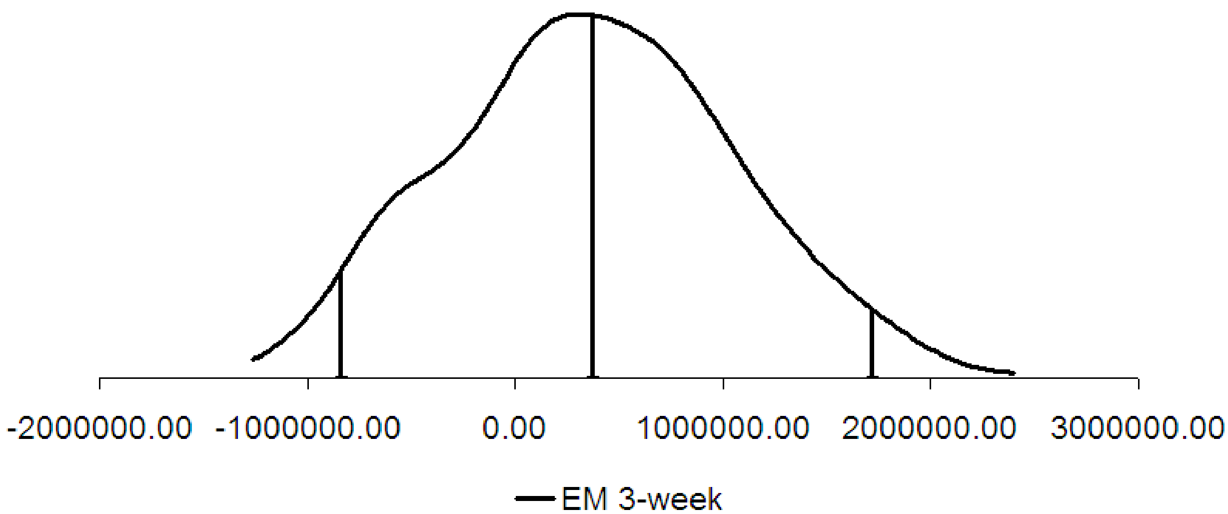

Figure 5-10 Early-mid Scenario 2

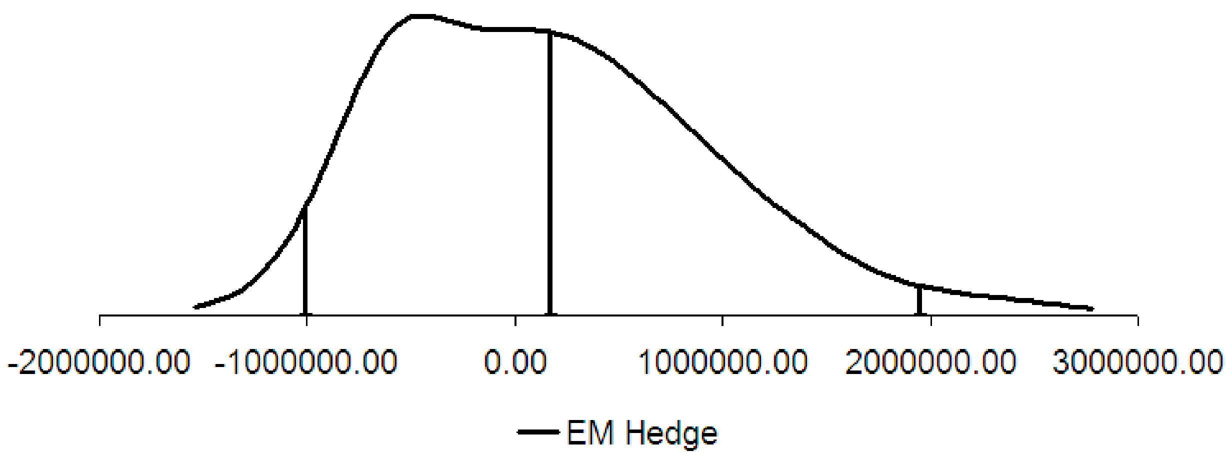

Figure 5-11 Early-mid Scenario 3

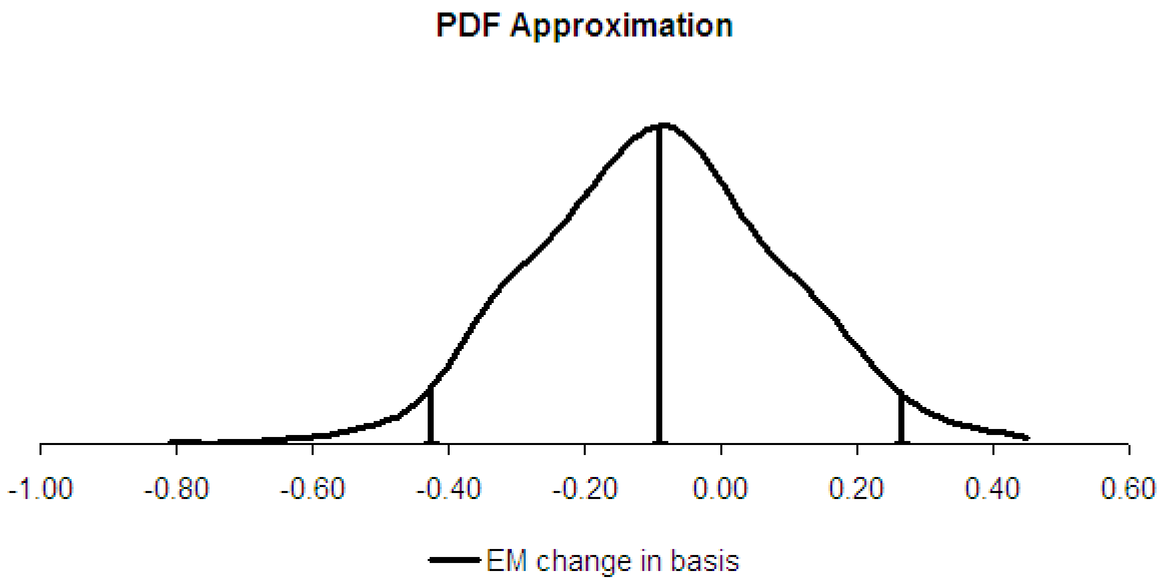

Figure 5-12 Early-mid Change in Basis

CHAPTER 6
SUMMARY AND CONCLUSIONS

Summary

With the citrus industry being the largest agricultural sub-sector in the state of Florida at over 719,000 acres in use, the state of Florida accounts for over 67 percent of the total U.S. production for oranges. Over 95 percent of the oranges grown in Florida are grown for processing, and over 90 percent of that comes from two types of citrus, Valencia and early, midseason oranges. Volatility in the citrus industry caused by weather, disease, and other factors causes concern to citrus growers whose goal is to secure profitable returns. With various marketing strategies available to growers, an impartial examination of the various strategies and forecasted outcomes provides citrus growers with the tools to further their knowledge on available marketing strategies including their forecasted returns and the risks associated with those strategies.

This study examines the risks and returns associated with 4 scenarios for each of the two types of citrus. The baseline scenario is the pooling method, in which growers pool their crops and receive payment based on the average price received for the entire pooled crop. This scenario is an estimate of the average cash market price received in a single harvest season. The first alternative scenario compared to this baseline assumes the producer sells the entire crop into the cash market at once. The second scenario assumes the grower sells the entire crop into the cash market over the course of three weeks. The final scenario assumes that the producer hedges the crop utilizing the FCOJ contract in the futures market when the previous harvest season ends.

Simetar© (Simulation for Excel to Analyze Risk), an Excel add-in that was developed explicitly for stochastic simulation modeling was used to create stochastic forecasts for price and yield, utilizing observed probabilities. Using the stochastic forecasted prices along with stochastic forecasted yields in conjunction with a pro-forma financial statement model, we are able to view the net present value (NPV) of discounted revenues through the year 2020. By running a large number of iterations, we can see the expected return (NPV) and volatility associated with the various marketing methods.

The baseline scenario of pooling for Valencia oranges provided the highest volatility (as measured by standard deviation) along with the highest NPV. The one-week cash market scenario (scenario 1) yielded the second highest NPV, with the least amount of volatility. Selling the crop into three consecutive cash market weeks (scenario 2) yielded the second lowest NPV, with slightly more volatility than scenario 1. Scenario 3, the hedging scenario, provided the lowest NPV by a large margin, and the highest volatility.

For early-mid oranges, the baseline was clearly the most successful scenario, providing the highest NPV combined with the lowest volatility. This baseline scenario also yielded the highest maximum NPV obtained for early-mid oranges and the most favorable minimum as well.

Conclusions

Florida citrus growers are challenged every year to choose a marketing strategy that will be the most favorable to them. As opposed to other commodities such as corn and wheat, the physical area that is designated to growing citrus is very concentrated. This high concentration causes much higher price volatility than is observed for most other commodities, in turn causing citrus growers to spend large amounts of time and energy looking for marketing strategies that can benefit them. This study provides growers information about various marketing alternatives available to them, as well as an estimate on the forecasted risks and rewards associated with these various methods.

For the Valencia grower, pooling is expected to provide the highest net present value along with the highest volatility. This is the essence of a high risk to reward relationship. Scenario 1, selling directly in the cash market in a single week, yielded the second highest net present value with the lowest volatility. Despite contrary preliminary expectations, this scenario provided a great lower risk alternative to the pooling strategy. The final scenario, hedging, proved to be an unfavorable strategy, providing high volatility with a low net present value.

For the early, midseason grower, the baseline scenario of pooling provided the most favorable alternative in almost every way. This scenario outperformed the three alternatives with a higher net present value, a lower volatility, a higher maximum, and the most favorable minimum. The low risk and high reward of the baseline scenario makes pooling a clear choice for the early-mid citrus grower.

Implications

Marketing strategies continue to evolve for citrus growers. This study assumes that a citrus grower will utilize a single marketing strategy for 100 percent of their crop. The information for this study can be used as a base even though some citrus grower will utilize multiple strategies, each regarding portions of their harvested crop. There are also other issues in the analysis that can influence the results. For example, a higher discount rate will result in lower net present values and vice versa. With various risk adversity levels of a particular farmer calculated, the ability to utilize multiple strategies for various amounts of their harvested crop is available.

Recent hurricane events in Florida as well as the presence of greening, canker, tristeza, and urban development of farm land serve as reminders that the production risk associated with Florida citrus growers is valid and must be addressed. The financial implications including potential losses due to these factors indicate great loss potential for citrus growers who do not utilize some type of risk management. For instance, a farmer that takes a short position in the futures market to offset the downside price risk they face from plant to harvest, is at risk to be hurt twice as hard if a hurricane takes out his crop. A hurricane can cause a farmer to lose his crop and to lose on a short position in a futures market that could see dramatic increases in price following the hurricane. A season of losses at the level brought upon by these two consequences of one event could put many farmers out of business.

Further Research Needs

There are many areas of this study that are left open for further research. The availability of utilizing a combination of strategies can potentially add another level of practicality on this study. An econometric study could provide great insight into the optimized combinations of these marketing strategies for citrus growers with various risk adversity levels.

A study including the use of options along with futures contracts for a hedging could also yield interesting results that would be useful for the citrus grower. However, the ‘random walk’ of futures prices renders great problems in the hedging scenario. Market theory would suggest that if futures prices were able to be forecast with any accuracy, the speculator arbitrage of the information would in fact distort the futures price away from the predicted price and render the forecasted price useless.

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BIOGRAPHICAL SKETCH

Evan Marc Shinbaum, the son of Amy and Kyle Shinbaum, was born in Fort Myers, FL, on March 9th, 1983. After graduating from Fort Myers High School in 2002, he spent time studying at Florida International University in Miami before transferring to the University of Florida. After completing the Bachelor of Science (B.S.) degree in food and resource economics, he entered the graduate program in the same field to pursue the Master of Science (M.S.) degree.