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Optimal Market Contracting In the California Lettuce Industry

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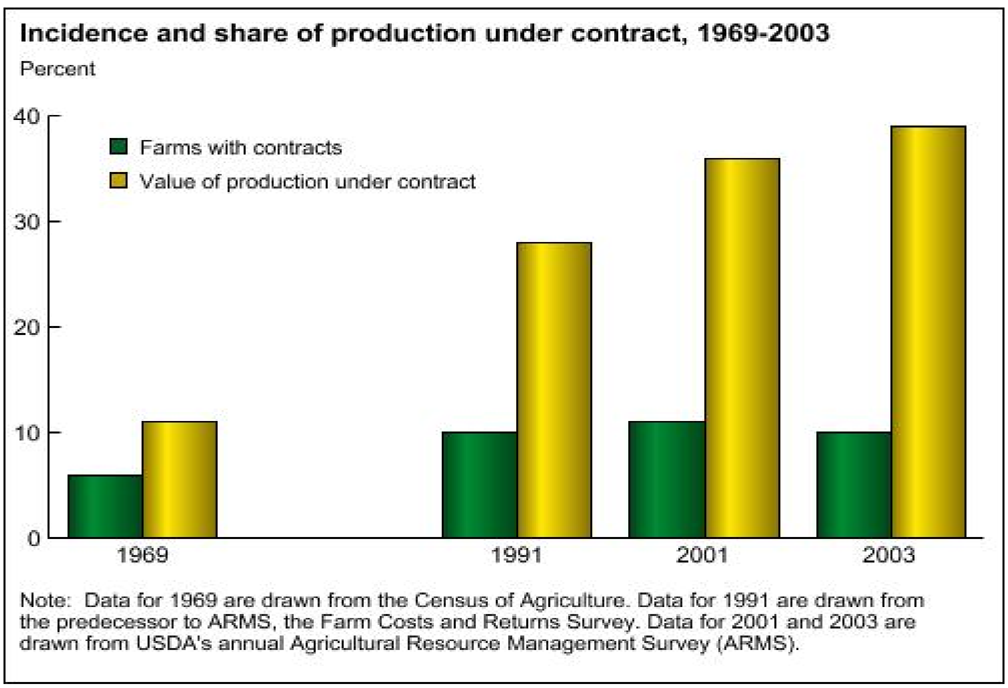
Introduction

Marketing and production contracts are a widely used risk mitigating strategy in the agricultural industry. Marketing contracts guarantee a market and focuses on the product at time of delivery. The producer owns the crop until time of delivery and is paid a premium based on quality and quantity predetermined in the contract. Production contracts create long term relationships between the producer and contractor. The producer will provide predetermined services to grow the crop. The contractor will provide inputs for the producer, giving the contractor some control over the production process and ownership of the crop. Graph 1 illustrates the growth in incidence and share of production under contract from 1969-2003

Graph 1



Source: Agricultural Contracting: Trading Autonomy for Risk Reduction, Amber Waves, February 2006

Contracts covered 39 percent of the value of U.S. agricultural production in 2003, up from 36 percent in 2001. Over the long term, contracting shows a strong upward trend; contracting covered 11 percent of the value of production in 1969 and 28 percent in 1991. The increased reliance on contracting is closely tied to shifts of production to larger farms, increased specialization on farms, and greater product differentiation. Contracts can ease the production and marketing of more specialized product varieties, and can help create lower costs and increased efficiency throughout the food marketing system. They may also reduce risks for farmers and ease access to credit. But contracts reduce farmers' autonomy and may harm the efficacy of some spot market institutions that are used for both spot market and contract transactions (McDonald and Korg)

While marketing contracts are the prevalent contract form for most crop production, a large percentage of vegetable production is grown under some type of production contract. An example is the California lettuce production. Industry sources indicate that a significant percentage, if not 100%, of the California lettuce producers enter into production contracts.

California produces seventy-five percent of the nation's head lettuce, followed by Arizona at twenty-three percent (NASS). The majority of California's head lettuce is grown in the Salinas Valley. Producers in that area enter into production contracts with packer-shippers. The California lettuce production contract is somewhat unique since the producer and packer-shipper share both production and marketing risks. The standard California lettuce production contract is a cost share percentage- net proceeds share contract. The cost share percentage is the percentage of culture costs incurred by the lettuce producer that will be paid for by the packer-shipper. A typical cultural cost-share arrangement found in the industry is a 50-50 share. A packer-shipper can contract for a proportion of a specific producer's production but the norm is a packer-shipper will contract for all of a producer's lettuce production in any single growing season. The packer-shipper pays for the harvest, packing, and marketing/sales costs for the contracted lettuce. The packer-shipper makes the determination of when or if to harvest the lettuce crop and determines what percentage of the contracted production should be forward contracted to wholesale and retail outlets and what percentage should be sold on the spot market. Once the contracted production has been sold by the packer-shipper the total proceeds are adjusted by the cultural cost share borne by the packer-shipper and by the harvest, packing and marketing/sales costs. The net proceeds are then split by the cultural cost share percentage.

The objective of this paper is to determine the optimal amount of a forward contracting that should be entered by the packer-shipper to maximize the economic returns to a representative California lettuce producer. The industry standard is for the packer-shipper to forward contract 65% of contracted production and sell the remainder on the cash market. This study was conducted to determine if the industry standard of 65% forward contracting- 35% cash market marketing combination is optimal in terms of maximizing a representative California lettuce producer's economic returns on his lettuce production or if there is another forward contracting-cash market marketing combination that would provide higher economic returns for equal or less risk. Several measures are used. The first is a year-to year comparison of representative California lettuce producer net proceeds on his lettuce production under differing forward contract percentages; a second is the net present value of five years of net proceeds under differing forward contract percentages; and the third is a comparison of the ending five year cash flow. The analysis concludes with determining the stochastically dominant forward contracting strategy based on maximization of net present value by using the Stochastic Efficiency with Respect to a Function (SERF) method.

Methodology

Representative farm simulation models have been used to study the impact of marketing and policy changes at the farm level. Duncan, Richardson, and Schwart (2004) conducted a study to determine the probability of success for a Netherland Dairy Farmer to immigrate to the U.S. Gustafson (2004) used a simulation model to examine the value of social capital generated when a farmer purchased inputs locally rather than from wholesalers at a discounted rate. Batz (2005) created a simulation model to determine the impact of various policies on shade-coffee plantations in Oaxaca, Mexico. Anton (2005) analyzed the impact of risk reducing policies and market strategies on a producer's welfare, risk, and production. In general, these models are used to analyze how changes in markets and policies impact a farm's financial indicators, welfare, risk, or decision making behavior.

The basic structure of the more general mixed vegetable simulation is that of similar representative farm models[1]. The mixed vegetable farm model has five vegetables included for analysis: head (iceberg) lettuce, leaf lettuce, broccoli, cauliflower, and celery. We concentrate on head lettuce for this particular analysis. The model consists of an income statement, statement of cash flows, and balance sheet for the representative

[1] Richardson, et al (2004) provides a overview of the development of base line representative farm model. The mixed vegetable model was developed by CISSC using SIMETAR. SIMETAR (Simulation & Econometrics to Analyze Risk) is an Excel Add-In developed in 1997 at Texas A&M. University by James W. Richardson, Keith D. Schumann and Paul A. Feldman.

farm operation. Inputs to the model include variable and fixed costs of production, and stochastic prices and yields. Data necessary to complete the three financial statements and analysis was obtained from University of California cost of production studies, input from Salinas Valley lettuce producers and packer-shippers, and the California Agricultural Statistic Service; costs are inflated with projected inflation rates for 2006-2010. The producer and packer-shipper panels supplied information on market dynamics such as differences between California average lettuce yields and prices and Salinas Valley yields and prices, producer and packer-shipper contractual terms and forward contract pricing.

The forward contract base price is a negotiated price between the packer-shipper and the wholesale or retail buyer. The base price is adjusted up and down based on current market prices at the time the production is delivered to the wholesale or retail buyer. A typical forward contract allows for a $0.25 per CWT increase for each $2.00 per CWT the current market price is over the base contract price and for a $0.25 per CWT decrease for every $2.00 per CWT the current market price at time of delivery is below the forward contract price. This forward contract pricing is captured in the mixed vegetable representative farm model by adjusting the forward contract price during the model simulation runs.

Prices and yields are stochastic variables in the mixed vegetable model. Stochastic variables are a combination of a forecast mean price and yield and deviation about the forecasted means. The deviations about the mean are based on historical California lettuce price and yield variation[2]. Forecasted prices were obtained from the National Food and Agricultural Policy Project at Arizona State University. Forecasted

[2] Twelve years of historical data was used to simulate the variability about the projected mean values.

yields were generated from ARIMA models developed for each crop. The forecasted yields were validated against NFAPP forecasted yields. A multivariate empirical distribution was generated using 1992-2004 historical data from the California Agricultural Statistic Service (CASS). The Anderson-Darling test rejected the hypothesis that historical prices and yields were normally distributed; therefore an empirical distribution was developed. Prices and yields have a strong correlation, as determined by a correlation matrix, therefore a multivariate empirical, instead of a univariate empirical distribution was used.

The multivariate empirical distribution is calculated in percent deviations from either a mean or trend. If the historical data showed a strong linear trend, percent deviations from the trend were used. Increasing or decreasing the forecasted values by the simulated percent deviation generates the stochastic prices and yields. The forecasted prices and yields were based on California averages; therefore the forecasted mean values are adjusted to better capture the prices and yields in the Salinas Valley. The grower and packer-shipper panelists indicated that Salinas Valley has higher yields and lower prices than the California average.

Five different marketing combinations were analyzed for their impact on the economic return to a representative Salinas Valley lettuce producer: 40% contracted-60% cash market; 50% contracted-50% cash market, 65% contracted-35% cash market; 80% contracted-20% cash market, and 100% contracted production.

Economic returns that were analyzed include net income, ending cash flow, and net present value. Net income was analyzed for two different income ranges. The first was a break even analysis to determine the market combination that minimized risk in terms of having the lowest probability of losing money. Secondly, the market combination with the highest probability of a net income greater than $300,000 was determined. Cash flow position was analyzed to determine the market combination with the highest probability of returning a positive cash flow at the end of the five year period.

Net Present Value (NPV) was calculated using a 5% discount rate for 2006-2010. The stochastically dominant NPV was determined using the Stochastic Efficiency with Respect to a Function (SERF) method. SERF ranks the NPVs for all five marketing combinations over a range of risk preferences, represented by absolute risk aversion coefficients (ARACs). Certainty equivalents (CEs) from a given utility function are calculated at 25 intervals between the lower and upper ARAC[3]. CEs provide a numerical representation of which market combination(s) are dominate; the market combination with the highest CE, for a given ARAC, dominates all other alternatives. Hardaker, et al. (2004) provides a thorough explanation of how CEs are calculated and used to determine which alternative dominates over the range of risk preferences using the SERF method

A negative exponential utility function was used for this study with a lower ARAC of 8.0E-06 and upper ARAC of 2.0E-04. The upper and lower ARACs were determined by the scale defined by Anderson and Dillon (1992) and a formula suggested by McCarl and Bessler (1989). The lower ARAC represents hardly risk averse and the upper ARAC is extremely risk averse according to Dillon's scale.

[3] See Richardson, J "Simulation for Applied Risk Management", (2004) for a discussion on how upper and lower ARACs are determined

Results

This section contains the results from the analyses conducted. Net income probability tables are presented for net incomes with a lower bound of $0 and an upper bound of $300,000. Net Incomes are analyzed in five year averages. The Cash Flow analysis is presented in five year average cash flow positions. The SERF results for NPV are shown in the graph generated by SIMETAR along with a table containing the range of risk premiums between the alternative market combinations.

Net Income

Annual Net Income for 2006-2010 were analyzed to determine the probability of generating a negative net income, net income greater than $0 and less than $300,000, and a net income greater than $300,000. The results are shown in tables 1-3. Table 1 contains the five year average probabilities for each market combination and income interval. The average mean net income in each income interval for each market combination is given in Table 2. Table 3 combines Table 1 and Table 2 to give the expected value of five year average net income. The bolded row in each table indicates the base market combination.

Table 1. Five Year Average Probability

Market Combination	< $0	>$0 and <$300,000	>$300,000
40% Contract 60% Cash Market	56.2%	35.8%	8.0%
50% Contract 50% Cash Market	42.6%	50.6%	6.8%
65% Contract 35% Cash Market	**12.6%**	**83.4%**	**4.0%**
80% Contract 20% Cash Market	2.8%	94.4%	2.8%
100% Contract	0%	98.2%	1.8%

As seen in Table 1, the base market combination has an 83.4% probability of achieving an average net income between $0 and $300,000, a 4.0% probability of a net income greater than $300,000, and a 12.6% probability of a negative net income. Compared to the base market combination, both 40%-60% and 50%-50% market combinations have a higher probability of a negative net income but also a higher probability of a net income greater than $300,000. A producer would have to be willing to risk an additional 30% probability of losing money to gain a 2.8% probability of making greater than $300,000 to switch from the base to a 50%-50% market combination. To change from the base to a 40%-60% market combination, the producer is taking on an additional 43.6% probability of losing money to gain an additional 4% probability of making greater than $300,000.

Comparing the base to 80%-20% and 100% market combinations, the probability of generating a negative net income is less, as well as the probability of a net income greater than $300,000. However, the probability of a net income between $0 and $300,000 is greater with 80%-20% and 100% market combinations. The producer would give up 1.2% probability of hitting the upper end to gain an additional 11% probability of making a net income between $0 and $300,000, lessening the probability of a negative net income by 9.8% by changing from the base to an 80%-20% market combination. A producer contracting 100% gives up 2.2% probability of making greater than $300,000 to gain 14.8% probability of a net income between $0 and $300,000, lessening the probability of a negative net income by 12.6%.

Table 2. Five Year Average Mean Net Income			
Market Combinations	<$0	>$0 and <$300,000	>$300,000
40% Contract 60% Cash Market	($119,669.31)	$121,837.89	$394,182.32
50% Contract 50% Cash Market	($80,454.52)	$107,059.90	$362,923.48
65% Contract 35% Cash Market	**($54,634.55)**	**$120,466.53**	**$348,587.84**
80% Contract 20% Cash Market	($13,624.71)	$136,476.55	$268,328.41*
100% Contract	($0)	$189,849.35	$256,134.63*

* One of the five years had a zero dollar amount, dropping the average below $300,000.

Table 2 shows the five year average mean net income within each interval. For example, if a producer loses money one year between 2006 and 2010 with a 65%-35% market combination, the average loss would be $54,634.55. This table is combined with the probabilities given in Table 1 to generate the expected value of the five year average net income for each market combination; the results are given in Table 3.

Table 3. Expected Value Five Year Average Net Income	
Market Combination	Net Income
40% Contract 60% Cash Market	$7,898.35
50% Contract 50% Cash Market	$44,577.48
65% Contract 35% Cash Market	**$107,528.65**
80% Contract 20% Cash Market	$135,965.57
100% Contract	$191,042.49

A rational producer will contract the market combination with the highest expected returns. The base market combination shows an expected five year average net income of $107,528.65. However, according to the results, 100% contracting is the market combination with the highest expected returns. Even though the 80%-20% market combination has a higher probability of a net income greater than $300,000, the five year average net income between $0 and $300,000 for 100% contracting is over $50,000 greater than the five year average for 80%-20%. Contracting 80% or 100%, if possible, exceeds the expected net income of the base by at least $25,000. Therefore, 100% forward contracting is the optimal market combination according to net income.

Cash Flow

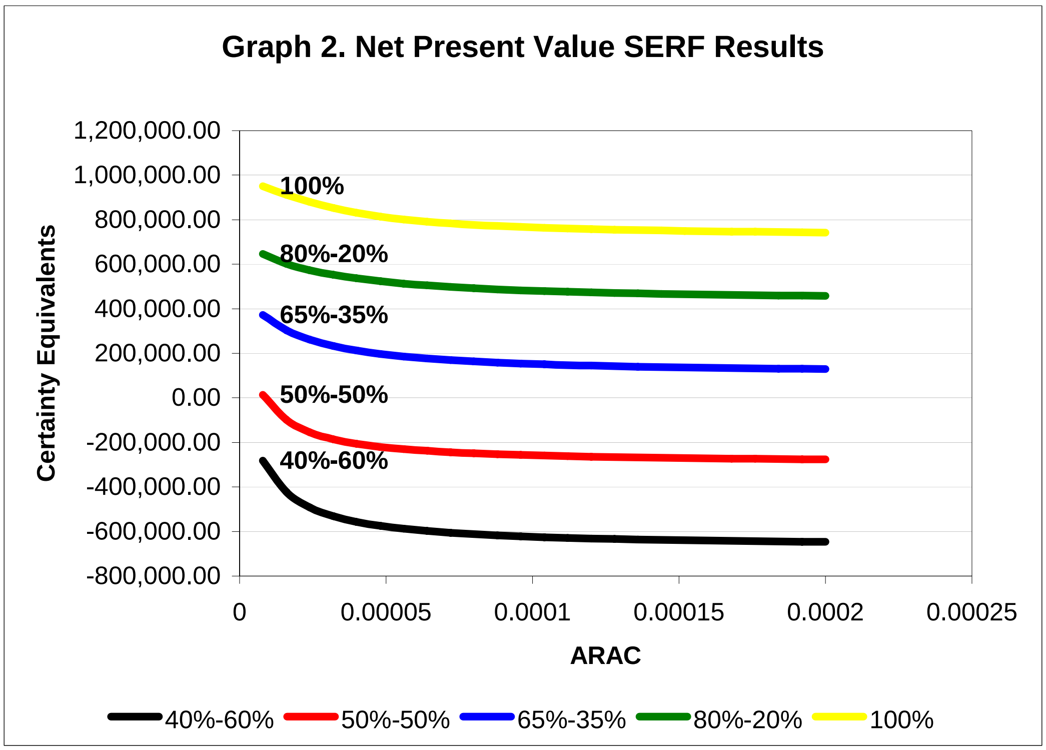
Break even analysis of the cash flow position shows the 40%-60% market combination to be the only market combination with a probability of a negative cash flow position at the end of the five year period (2006-2010). Even though all other market combinations have a positive cash flow, the distribution of the various cash flow positions varies. Table 4 shows the mean cash flow position for each market combination except the 40%-60%.

Table 4. Average Cash Flow Position in 2010

Market Combination	Cash Flow
50% Contract 50% Cash Market	$933,162.51
65% Contract 35% Cash Market	**$1,263,986.05**
80% Contract 20% Cash Market	$1,557,147.61
100% Contract	$1,928,241.21

Compared to the base market combination, 80%-20% and 100% show a higher average cash flow position. The 50%-50% market combination shows a slightly lower average cash flow position than the base model. Here again the optimal market combination, according to the average cash flow position, is 100% contracting.

Graph 2 shows the graphical representation of the SERF analysis for NPV. As previously mentioned, the NPV is for 2006-2010 using a 5% discount rate. Shown below, the NPV with 100% forward contracted production dominates all other alternatives across all risk preferences, followed by 80%, 65%, 50%, and 40% respectively. According to the SERF results, all packer-shippers should be forward contracting 100% based on NPVs.



Risk premiums are the amount of money/utility a producer would have to receive to become indifferent between two alternatives. Table 5 contains risk premiums between the industry standard and all other alternatives at the lower and upper ARACs. A positive value indicates the value the alternative scenario has over the base, the base being 65% contracted. For example, a producer would accept between $273,365 and $328,781, depending on their risk preferences, to become indifferent between 80% and 65% forward contracting by the packer-shipper.

Table 5. Risk Premiums with 65% as Base Alternative

ARAC	NPV 40%	NPV 50%	NPV 80%	NPV 100%
2.25E-05	(654,784)	(359,216)	273,365	578,430
1.25E-04	(776,420)	(406,236)	328,781	613,392

As seen in Table 5, 80%-20% and 100% market combinations have a positive risk premium when compared to the base market combination. 40%-60% and 50%-50% have a negative risk premium when compared to the base market combination. The risk premiums and the SERF analysis both show the base market combination is stochastically dominated by 80%-20% and 100% market combinations; 80%-20% is dominated by 100%.

Conclusions

The industry standard of 65% contract – 35% cash market is not the optimal market combination for Salinas Valley lettuce packer-shippers to choose if their objective is to maximize economic returns to lettuce producers. According to net income, the base market combination has a higher probability of a negative net income than 80%-20% and 100% market combinations. Although it does have a higher probability of a net income greater than $300,000, the five year average expected net income is $28,437 less than 80%-20% market combination and $83,514 less than 100% contracted production. When compared to 40%-60% and 50%-50% market combinations, the base combination has a higher average expected net income.

Cash flow and NPV analyses also indicate the 65%-35% market combination to be less than optimal. The five year average cash flow for the 80%-20% market combination is $293,162 more than the base combination; 100% contracting is $664,255 more than the base combination. The stochastically dominate NPV is 100% forward contracting , followed by 80%-20%, 65%-35%, 50%-50%, and 40%-60% respectively. 100% contracted production dominates all other market combinations across all ARACs, reaffirming 100% to be the optimal market combination.

According to industry sources, there are two reasons why the packer-shipper does not contract 100% production. First, it is extremely difficult to forward contract 100% of production, forcing a less than optimal market combination. There are not enough buyers to contract all of production and a packer-shipper never knows the total yield that would need to be forward contracted until harvest time. Secondly, lettuce producers are willing to take some risk by selling on the cash market in hopes to hit high market prices. Producers, along with the packer-shippers, are willing to take more risk in order to slightly increase the chances of generating a net income greater than $300,000. However, the producers minimize risk by having the joint contract with packer-shippers and by diversifying their operation. While the optimal market combination is nearly impossible to obtain, contracting more the current industry standard of 65% is more optimal in all financial indicators.

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