must be adjusted to a gross land basis. The net land transaction gain required on a gross acre basis would then be approximately $380 if the land was acquired immediately or $590 if there would be a lag of one year between sale and purchase. Current land values suggest that such land transaction gains are possible and that relocation to the Southwest region would be economically feasible. However, as the percent of land utilized for actual planted acreage decreases, the net land transaction gain required to equate the profitability of the Central and Southwest regions will increase.

Summary

This paper has analyzed the profitability of two investments in groves of 'Hamlin' oranges; one to be replanted on land in Central Florida and one to be newly established in Southwest Florida. The intent of the analysis is to identify the contribution to establishment costs that would be required from a net gain from the sale of old grove land and the purchase of new land to equate the two investments. The results indicate that the net gains required per planted acre would be in the $400-$600 range for 'Hamlin' oranges if planted in the same year of land transactions and $540-$840 if planted one year later.

Growers must understand that the results of the analysis presented in this paper rely on several specific assumptions and may only hold specifically for 'Hamlin' oranges. Citrus growers considering a move to the Southwest region should analyze their own grove information in a similar way to assess the profitability of such a move. An analysis of other cultivars and changes from one cultivar to another e.g., 'Hamlin' orange in Central region with 'Valencia' orange in Southwest region, could also be handled in the same manner.

Growers should also recognize that there are additional risks associated with production in the Southwest that may outweigh the risk associated with the possibility of freeze in the Central region. The Southwest is not totally immune to freeze risk and also faces production risk from environmental and water policy regulation. Further, since the Southwest region is a relatively new production region, not all risks may be known at this time. An analysis of the relative profitability of citrus production in the Southwest, however, is the first step in the decision to relocate.

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PROFITABILITY OF CITRUS CULTIVARS BY REGION AND MARKETS

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Abstract. **Many Central Florida citrus growers now face replanting and/or expansion decisions as a result of the 1989 December freeze. Little analysis on the profitability of many of the citrus varieties has been done in recent years. The research presented in this paper looks at the profit potential of several citrus varieties in different geographic regions of Florida. Costs of production, crop yields, and fruit prices are used to determine profits for mature groves over a fifteen-year investment planning horizon beginning when trees are set. Once this budget work has been completed, risk factors associated with *varieties*, regions and product marketed can be accounted for in the profitability analysis.**

Florida citrus production consists of a large number of cultivars grown in several locations in the state. Citrus can also be marketed as processed or fresh fruit. Little work has been done, however, to quantify the relative profitability and risk associated with a particular cultivar/market/region combination. The research presented in this paper compares the historic profitability of 48 such combinations and ranks them accounting for their relative riskiness. The information resulting from a comparison of relative profitability and risk among citrus varieties, markets, and locations should provide insight for growers deciding which cultivars to establish in either newly established or replanted locations.

In summary, the results of this paper indicate that cultivars marketed fresh are usually preferable to processed market fruit from a risk efficiency viewpoint. Early and mid-season oranges and 'Valencia' oranges are the more risk efficient cultivars for the processed market in all three regions. Early and mid-season oranges and tangerines are the dominate cultivars for fresh markets in all three regions. The Indian River region appears to be more-risky/less-profitable for citrus production than the central and southwest regions except for colored grapefruit for the fresh markets. And last, the difference in the profitability and risk across the three regions is that the variability in gross returns arises from yield differences. Historically, the

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Indian River region had the lowest coverage per acre yields for all eight cultivars.

Data

This paper looks at a firm's response to risk using the best regional industry information available. Historic net returns per acre of bearing citrus grove were calculated over the nine years from the 1981-82 through the 1989-90 crop year for eight citrus cultivars in three Florida production regions. Returns were calculated for both fresh and processed market sales for each cultivar in each region. The eight cultivars considered were: early and mid-season oranges, 'Valencia' oranges, 'Temple' oranges, tangelos, white seedless grapefruit, colored seedless grapefruit, 'Honey' tangerines, and all tangerines. The three production regions were the central, southwest, and Indian River regions. The counties included in each production region are specified in Table 1.

Net returns per bearing grove acre were calculated for each cultivar/market/region combination based on average yields for the counties in each region as reported in the Florida Agricultural Statistics Citrus Summary series (3). Average cultivar yields per acre for the production region were then calculated by dividing the county yield averages by the bearing acreage of each cultivar within each region. Gross returns for oranges and mandarins were calculated by multiplying the average yield per acre by the state season average price for each cultivar. Grapefruit prices were available by region, so that returns for grapefruit could be regionalized using those prices (2,3).

Net returns were calculated by subtracting the historic variable costs of production from the gross returns. The variable costs of production were calculated based on costs of grove caretaking operations and recommended practices for each production region (5). Fresh market returns were also adjusted by an average packout of 66.7 percent (range was 56.6% for 'Honey' tangerines to 71.0% for grapefruit) (4,6). The calculation of net returns resulted in a set of historic returns over a nine-year period for eight cultivars in 3 production regions marketed in 2 markets for a total of 48 different distributions.

Methodology

The comparison of distributions of returns for 2 or more enterprises is not always straightforward. For example, it is fairly obvious that 'Honey' tangerines are more profitable and less risky than 'Temple' oranges for the 2 historic series of net returns presented in Figure 1. However, the relationship of the 2 series of net returns presented in Figure 2 is less obvious. In the second example,

Table 1. Counties Included in Florida Citrus Production Regions.

Region		
Central	*Southwest*	*Indian River*
Highlands	Charlotte	Brevard
Osceola	Collier	Broward
Polk	Glades	Indian River
	Hendry	Martin
	Lee	Palm Beach
	Okeechobee	Saint Lucie

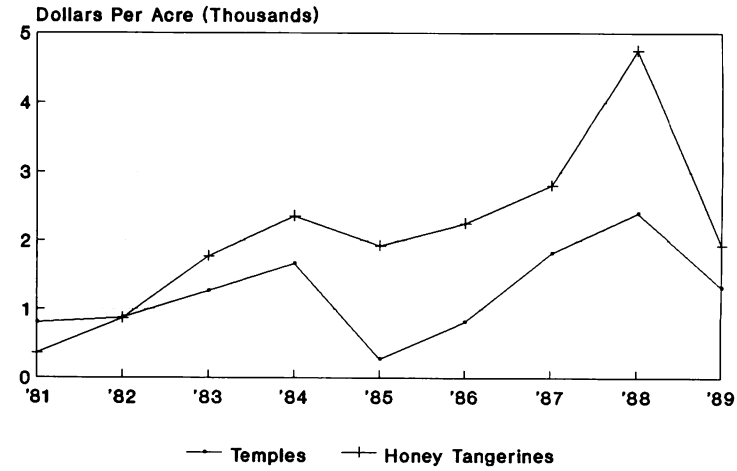

Fig. 1. Per acre returns for two cultivars. Central region—fresh market.

early and mid-season oranges prove to be more-profitable/less-risky than tangelos. The analytical technique used in this paper to determine the set of risk-efficient cultivar/market/region combinations in situations similar to that in Figure 2 is stochastic dominance (1,7).

Stochastic dominance methodology has been used quite extensively in agricultural economics analysis because it allows the comparison of a set of distributions. In this case, distributions of net returns with very mild assumptions about the behavior and preferences of individual producers. The required assumptions are: 1) more is better, and 2) the producer is risk averse. Unfortunately, because of the general nature of stochastic dominance analysis, often no single distribution associated with a particular strategy will be identified as one that dominates the other distributions in the group being compared. Consequently, a subset, or smaller group, of distributions may be identified as being more risk-efficient than the others in the complete group, but no further discrimination may be possible among the members of the dominant group.

Stochastic dominance analysis was used in this research to identify the set of risk-efficient cultivar/market/region strategies of the 48 possible combinations. Typically, a group of 2 or 3 combinations dominated the others in the

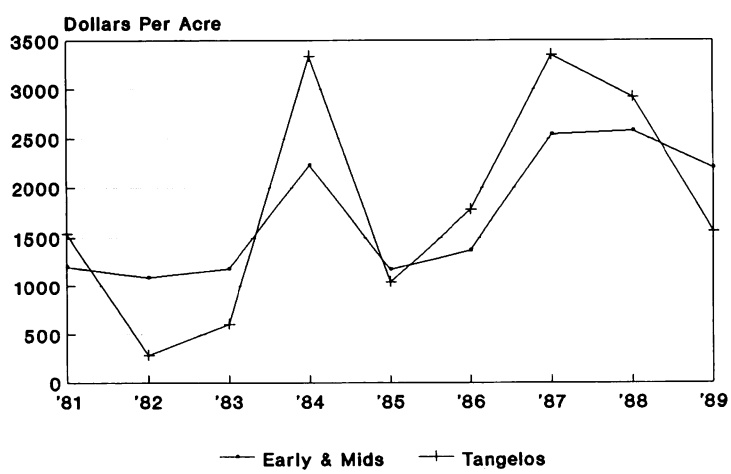

Fig. 2. Per acre returns for two cultivars. Central region—fresh market.

comparison group. Comparisons were made for all possible combinations, all fresh market combinations, all processed market combinations, and the combinations for each production region. Also, it should be remembered that this is a firm level analysis using the best regional industry information available.

Results

The resulting set of cultivar/market/region combinations that dominates other combinations in a risk-efficient sense includes only cultivars produced for fresh market sales. The combinations included in the dominant set are listed in Table 2. The results of the analysis suggest that of all 48 distributions of net returns considered in this research, the five listed in Table 2 have the greatest profit potential when tempered by the variability of net returns (risk).

Several interesting insights arise from these results. The first is that historic returns to fresh market citrus have been more-profitable/less-risky than those to processed citrus. The second insight is that early and mid-season oranges and tangerines appear to have been the best selections over the 1980s. A further insight suggests that the southwest region does not dominate the central region, despite the increased risk of freeze in production areas further north. This result may be due to higher yields experienced in mature groves on the Ridge.

Separating out only the fresh marketing of these cultivars (24 combinations) results in the same dominant set of cultivar/region combinations as for all 48 combinations since only fresh market alternatives were included in the dominant set for the whole. However, when processing market combinations are examined alone, early and mid-season oranges and 'Valencia' oranges produced in the central or the southwest regions dominate all other processing market combinations.

A comparison of the profitability and riskiness of the eight cultivars was also performed for each of the 3 production regions. The dominant cultivars for the fresh and processed markets produced in the Indian River region are presented in Table 3. Early and mid-season oranges, tangerines, and colored grapefruit are the dominant cultivars for the fresh market in that region. Early and mid-season oranges and 'Valencia' oranges dominate for the processed market. Note also, that fresh market cultivars always dominated the processed market cultivars in these comparisons. This result carries through to the other regions as well.

Table 4 contains a list of the dominant cultivars for the 2 markets in the central region. Again, early and mid-season oranges and 'Valencia' oranges dominate the other cultivars for the processed market, while early and mid-season oranges and tangerines dominate the fresh market. The same results hold for the southwest region (Table 5) with the exception of the exclusion of 'Honey' tangerines from the fresh market dominant set.

Finally, the different production regions were compared by cultivar and market to determine the appropriate region in which to produce a specific cultivar, given the historic data used in this study. The results of this analysis are presented in Table 6.

The results can be summarized as follows. First, the central region dominates for all cultivar/market combinations except for 'Temple' oranges for which the southwest region has an advantage. Second, the southwest region dominates for each cultivar/market combination except for tangelos, 'Honey' tangerines, and 'Valencia' oranges for the processed market.

Perhaps the most interesting result is that the Indian River region does not dominate any other region for any cultivar/market combination. The Indian River region is a member of the dominant set for fresh market, colored grapefruit, but so are the other two regions. The implica-

Table 2. Dominant Cultivar/Region Combinations from All 48 Choices

	Choices
Central Region —	Early and Mid-Season Oranges
	All Tangerines
	Honey Tangerines
Southwest Region —	Early and Mid-Season Oranges
	All Tangerines

Table 3. Dominant Cultivars for the Indian River Region

	Choices
Fresh Market —	Early and Mid-Season Oranges
	All Tangerines
	Colored Grapefruit
Processed Market —	Early and Mid-Season Oranges
	Valencia Oranges

Table 4. Dominant Cultivars for the Central Region

	Choices
Fresh Market —	Early and Mid-Season Oranges
	All Tangerines
	Honey Tangerines
Processed Market —	Early and Mid-Season Oranges
	Valencia Oranges

Table 5. Dominant Cultivars for the Southwest Region

	Choices
Fresh Market —	Early and Mid-Season Oranges
	All Tangerines
Processed Market —	Early and Mid-Season Oranges
	Valencia Oranges

Table 6. Dominant Production Regions by Cultivar and Market

Cultivar	*Fresh Market*	*Processed Market*
Early and Mid-Season	Central	Central
Oranges	Southwest	Southwest
Valencia Oranges	Central	Central
	Southwest	
Temple Oranges	Southwest	NA
Tangelos	Central	Central
White Grapefruit	Central	Central
	Southwest	Southwest
Colored Grapefruit	All Regions	Central
		Southwest
Honey Tangerines	Central	NA
All Tangerines	Central	NA
	Southwest	

NA—Not Applicable

tion of this result is that, based on historic average per acre yields and net returns, all 8 cultivars of citrus except colored grapefruit can be grown more risk efficiently in the central and southwest regions than they can be grown in the Indian River region. However, colored grapefruit producers in Florida face approximately the same profit/risk situation in all regions. Further, the Indian River region's competitiveness in colored grapefruit is due primarily to higher prices received in that area because of the brand name recognition of Indian River fruit. These higher prices have compensated for lower average yields in that region.

Implications and Conclusions

Several conclusions can be drawn from the results of the historic net returns analysis. First, the results indicate that cultivars marketed in the fresh market are usually preferable to processed market fruit from a risk efficiency viewpoint. The fresh market offers higher profit potential for some varieties even with an overall average 66.7 percent packout rate.

Second, early and mid-season oranges and 'Valencia' oranges are the more risk efficient cultivars for processed markets in all 3 regions. Growers should consider that on average these cultivars have historically outperformed other cultivars.

Early and mid-season oranges and tangerines are the dominant cultivars for fresh markets in all three regions. Colored grapefruit also dominates other cultivars in the Indian River region.

The dominance of the early and mid-season oranges and tangerines in this analysis may arise from the ability of growers to harvest these cultivars prior to any fruit-damaging freeze. Thus, yield risk is reduced and average profits will be insulated from that risk.

Another implication from the results is that the Indian River region appears to be more-risky/less-profitable for citrus production than the central and southwest regions, except for the production of colored grapefruit for fresh markets. This does not mean that the Indian River region is an unprofitable production area. However, it does mean that the other two areas have some advantage in all the cultivars examined in this research with the exception of colored grapefruit.

One further insight into the profitability and risk issue in citrus production across these regions is that the variability in gross returns arises mainly from yield differences. Historically, the Indian River region had the lowest average per acre yields for all eight cultivars. For example, the lowest average per acre yields for colored grapefruit occurred in the Indian River region except during the 1984-85 and 1989-90 seasons when a devastating freeze substantially reduced the Central Region's fruit crop (Fig.3). Costs of production did not vary greatly across regions. Also, with the exception of grapefruit prices, state average prices were used for all cultivars in each region.

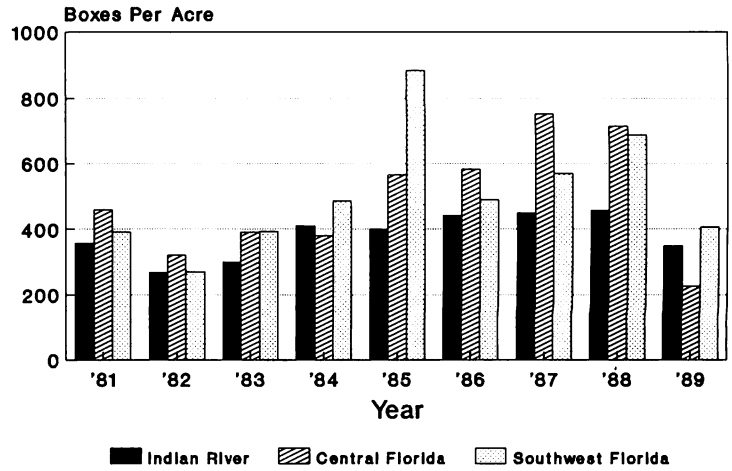

Fig. 3. Per acre yields for colored grapefruit, 1981 through 1989.

Two additional comments are needed to put the results and conclusions presented above in the proper context. The first is that the data used in this analysis is average data. The process of averaging data removes much of the variability in observed prices, yields, and costs of production. Consequently, although the results presented should hold on average, individual farm situations may show different results due to differences in management decisions, grove conditions, and local site characteristics (eg. proximity to water). There is a great need, then, for the collection and analysis of grove-level data for representative groves in each region if this type of analysis will prove useful to individual citrus producers.

The other contextual comment reinforces the notion of this analysis as an historic examination of risk and profitability in Florida citrus production. The future ten years may not be exactly the same as the past ten years. Consequently, citrus producers should weigh any use of this information appropriately when planning new plantings.

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