A Comparative Analysis of Citrus Costs and Returns, 1980-2000: Florida, U.S.A. and Sao Paulo, Brazil

Mark A. Wade, Cristiano C. Ramos, and Evaristo M. Neves

WORLD FOOD AND AGRIBUSINESS SYMPOSIUM

International Food and Agribusiness Management Association (IAMA)
Sydney, Australia
June 27-28, 2001

Mark A. Wade, Assistant Professor, University of Florida, Fort Pierce, FL, USA
Email: MWade@gnv.ifas.ufl.edu

Cristiano C. Ramos, Former Student, University of Sao Paulo & University of Florida, Piracicaba, SP, Brazil

Evaristo M. Neves, Professor, Department of Economics, University of Sao, Piracicaba, SP, Brazil

A Comparative Analysis of Citrus Costs and Returns, 1980-2000: Florida, USA and Sao Paulo, Brazil

Abstract

Cost and return data for processed oranges in Florida and Sao Paulo during the 1980's and 1990's were analyzed. Results indicate that Florida growers had higher costs of production, higher productivity and higher profits during this time period, relative to Sao Paulo growers. Over the two decades studied, Brazilian input efficiency increased as their use of chemicals and fertilizers increased, narrowing the cost of production gap between the two regions. The main determinant of profitability in Florida has been productivity and prices received, while in Sao Paulo, cost of production has been the primary determinant of profitability.

The economic importance of the citrus industry, especially to the major growing regions, is well known. Cultivated for over 4,000 years and grown on five continents under a wide array of conditions, citrus producers continue to struggle with market price, consumer demand, global supply, and cost and return issues (Albrigo and Davies). Citrus is the world's largest commercially produced fruit by volume, and while grown in over 150 countries, it is concentrated in only a few. Brazil and the United States alone accounted for over 62% of worldwide orange production in the 1998-99 season, with the state of Florida producing 84.53% of the U.S. orange crop (FASS, September 2000) and the state of Sao Paulo producing 82.9% of Brazil's orange production (Neves). These two regions combine to produce more than 85% of the world's orange juice (Trippensee).

However, methods of production, marketing, and costs vary dramatically between these two countries, issues that greatly influence profitability and resource allocation. Unlike in Florida, there are few irrigated groves in Sao Paulo. This factor, associated with the lesser use of inputs, such as chemicals and fertilizers, by Brazilian growers, justifies, in part, the different levels of productivity between the two States (Muraro and Amaro).

The abundance of labor in Brazil, when compared to the United States, provides cost advantages to Sao Paulo's growers, especially during harvest. The high cost of U.S. labor has provided ample incentive for researchers to develop new labor saving technologies, such as equipment for harvest mechanization. Additional differences in the social and economic environment between the two regions, and differences in prices received by growers, have resulted in similar, yet different industries in the United States and Brazil.

Objectives

The objective of this study was to examine production costs and returns for processed oranges in Florida, U.S.A. and Sao Paulo, Brazil from 1980 to 2000. Included in this analysis is a discussion of the socioeconomic, demographic, cultural, and technological factors that influence the production and marketing practices utilized by growers in these two countries. Emphasis is placed on the profitability of citrus production and the changes in productivity that has occurred over this twenty-year period. This analysis is important because of the climatic factors that limit commercial citrus production to selected regions of the world, and the globalization of supply and demand pressures faced by growers.

Florida's Citrus Industry

The citrus industry is the main agricultural activity in Florida. During the 1999-2000 season, 85.4 million orange trees produced 233 million boxes of fruit in Florida. Citrus production accounted for 27.1% of all agricultural cash receipts in the state in 1999 (FASS, August 2000). Florida's citrus groves are bound to the north by Putnam County and the Everglades to the south. Orange production is located mainly in the central part of the state, including Polk, Hendry, Highlands and DeSoto counties (Jackson and Davies). Approximately 31 of the 67 counties in Florida produce and transport citrus in commercial amounts. To the north, lower winter temperatures limit commercial citrus production, while to the south, groves frequently have problems with urban competition or poorly-drained soils. The citrus industry is the most important economic activity in many of these 31 counties (Jackson and Davies).

The state of Florida is divided into 5 citrus production regions: Indian River, South, Central, West and North. While the differences between regions are almost imperceptive,

environmental conditions, scion and rootstock adaptation, cultural practices and market opportunities vary considerably in different parts of the "Citrus Belt " (Jackson and Davies).

In the 1980's, multiple freezes occurred in Florida, significantly reducing orange tree acreage and production in the state. Post-freeze orange acreage in 1990 was 25.61 percent lower than 1980 levels, rising to 106 percent of 1980 levels in 2000. Production levels ranged from 46.69 percent below 1980 levels in 1990, to 113 percent of 1980 production in 2000 (FASS, September 2000). This reduction in domestic orange production provided foreign growers, mainly Brazilian, with an opportunity to expand into previously unavailable U.S. orange juice markets (Muraro and Amaro).

More than climate and phytosanitary factors, increasing urbanization present risks to the expansion of groves throughout Florida. Although it is estimated that the rate of growth of Florida's population will diminish, large urban centers will continue to expand, implying competition for natural resources like land and water, but also for political power, that might concentrate in the non-agricultural sectors. Even so, the area planted to oranges in the state continues to increase.

Throughout the 1990's, more than 90 percent of the oranges produced in Florida were destined for the process market. Fresh market oranges accounted for 4.5 to 8.3 percent of total production between 1990 and 1999 (FASS, 2000).

Sao Paulo's Citrus Industry

The growth of Sao Paulo's citrus industry occurred in the 1960's, with the construction of frozen concentrated orange juice processing plants in the interior of the state. Since then, groves expanded throughout Sao Paulo, especially in regions near the processing plants.

The state of Sao Paulo consists of 40 agricultural regions, all but one involved in commercial citrus production. However, Sao Paulo's citrus industry is mainly located in the north and northeast portions of the state, where 56 percent of all fruit is produced (IEA, 1996). The Sao Paulo citrus region encompasses 849,215 hectares containing 224 million orange trees which produced 365.8 million boxes of fruit during the 1999-2000 season (IEA, 2000).

Recent low prices received by growers and the incidence of diseases such as CVC and Citrus Canker have slowed the rate of new plantings throughout the state. Productivity increases, expressed in boxes per hectare, from the second half of the 1990's, reflect the tendency for increasing tree densities in the state (Amaro). Decreases in productivity in 1998 and 2000, were due to adverse climate conditions and phytosanitary problems. The reduction of Sao Paulo grower's income in recent years has reduced the use of productive inputs, which must also be considered as a cause for reduced productivity.

Compared to the Florida juice industry, orange juice production in Sao Paulo is much more concentrated. The four largest processing plants are responsible for more than 75 percent of juice production in the state (Trippensee). During the 1990's, 71 to 88 percent of Sao Paulo's orange production was destined for the process market.

Procedures

The Florida and Sao Paulo citrus producing regions were profiled in historic, geographic, climatic and cultural context using a variety of sources. Survey data collected by the University of Florida, USDA's Florida Agricultural Statistics Service, and Brazil's Instituto de Economia Agricola (IEA) and Coordenadoria de Assistencia Tecnica Integral (CATI), among others, were

aggregated for the time period to be examined. Special attention was paid to the survey methodologies utilized in collecting the data and to differences in terminology and definitions. Production data was calculated on a per tree and hectare basis with all costs and prices in terms of real U.S. dollars.

Process market orange cost and return data was then distributed into categories allowing for the calculation of total revenue, operational costs, fixed costs, total costs, partial profit, and net profit. Relationships between various production inputs, total costs, market price and profits were examined by region and by year. Finally, a direct comparison between Florida and Sao Paulo cost and returns was made with implications on productivity, technological innovation and profitability.

Cost of production data on Brazilian orange growers was unavailable for four years during the 1990's. While the absence of cost data for these time periods limited some analysis, it does not clearly disrupt general trends that exist during the periods studied.

The 1980's

The revenues of Florida growers producing oranges for process markets tended to trend upward throughout the time period. The lowest level of revenue was generated in the 1980-81season ($2,301 per hectare) and the highest revenue was the $6,922 earned in 1987/88. The average revenue for the decade was $4,415 per hectare (Table 1 and Figure 1).

During this period, costs of production, represented by total costs, also increased, but at a much slower rate. Total costs per hectare increased from $2,052 in the 1980-81 season to $2,741 in the 1987-88 season. Total costs averaged $2,450 for the decade.

The fluctuation observed in the revenue values in Figure 1, reflect variations in the prices received by growers and in the productivity of growers during the time period studied. At the same time, it can be observed that there was little variation in the costs of production between seasons during the 1980's. Florida growers did not dramatically alter their cultural practices from year to year, and were not overly influenced by market prices as a means of determining production activities. The low 1980 revenue figure was a result of low prices paid for fruit (pre-freezes) and low productivity, relative to others years.

Labor was, among other operational costs, responsible for higher costs incurred by Florida growers, with an average of $589 per hectare over the 10 year period. Depreciation of groves and machines constituted the largest average portion of fixed costs, at $767 per hectare. This figure helps to explain the emphasis on mechanization and the high cost of investment in Florida groves.

Examination of cost and return data for the state of Sao Pablo (Table 2 and Figure 2), indicates great fluctuation in both revenues and the costs of production. The revenue fluctuation, as was observed in Florida, can be justified by variations in productivity and orange prices during the 1980's. Muraro and Amaro explained the cost of production variation as the effect of protectionism on inputs, like fertilizers and chemicals, that results in variation in the prices of inputs and consequently, in the amounts to be applied in accordance with the profitability of the activity. In Figure 2, revenues during the 1980's tend to trend upward, while the costs of production remain practically constant.

In Table 2, revenues are shown to be lowest during the 1982-83 season ($388 per hectare) and highest during the 1988-89 season ($1,855 per hectare). For the decade, revenues averaged $935 per hectare. Costs for the decade averaged $650 per hectare.

In Sao Paulo, fertilizers and dolomites, listed as an operational cost, represented the largest cost for growers, with an average of $161 per hectare over the 10 years. The average of expenses in Sao Paulo, including labor, was almost eight times smaller than those incurred in Florida. Mechanization and irrigation expense was also much smaller in Sao Paulo (about five times smaller) due to the fact that fewer Brazilian groves are irrigated and that little mechanized agriculture is utilized in Brazilian citrus production, relative to the United States.

As already alluded to, in Sao Paulo, fertilizer and chemical use tended to diminish in seasons following periods of low grower revenues. Although the use of these inputs is also influenced by the market price of the input, this data indicates a relationship between the prices received by growers and the use of costly factors of production. In the state of Florida, input use (and expense) is almost constant throughout the decade and appears to be unrelated to grower revenues.

When cost of production results are calculated on a per box basis, differences between average costs in Florida and Sao Paulo are reduced (Tables 3 and 4). While overall production costs are lower in Brazil, when costs are allocated on a per box basis, price per box falls dramatically. This is due to the high level of productivity found in U.S. groves. Florida orange yields per tree are much higher than those in Sao Paulo because of the consistently high level of inputs used in fruit production. This constitutes an indicator of efficiency relative to the allocation of inputs by Florida's growers.

Analysis of the cost-per-box data indicates an important relationship between production, cost, and profitability values during the 1980's. In Brazil, profits derived from orange production are influenced primarily by the prices received by growers. In the U.S., both fruit prices and productivity have been the main determinative factors of profitability.

Orange production for process markets in Florida was profitable in each of the 10 years between 1980 and 1989. This was not the case in Sao Paulo, where low prices resulted in negative profit margins during the 1981-82, 1982-83, 1985-86 and 1989-90 seasons

Tables 3 and 4 list the average composition of Florida's and Sao Paulo's costs of production for oranges in process markets during the 1980's. It can be seen that operational costs correspond to over 65 percent of total costs in Florida. While operational costs range from 46 percent to 81 percent of total costs in Sao Paulo, average operational costs are similar to those found in Florida (71 percent). In Florida, labor represents 36.9 percent of operational costs, followed by mechanization and irrigation (29.4 percent), chemicals (20.1 percent), and fertilizers (15.9 percent). In Sao Paulo, fertilizer and dolomite account for 34.9 percent of total operational costs, followed by chemicals (31.1 percent), mechanization and irrigation (16.98 percent), and labor (16.98 percent).

Table 1: Process market orange costs and returns in Florida, 1980-81 to 1989-90 (US$/hectare)[1].

Item	Season										Aver.
	80/81	81/82	82/83	83/84	84/85	85/86	86/87	87/88	88/89	89/90	
Total revenue [2] (A)	**2,300.81**	**3,124.35**	**4,170.87**	**4,538.06**	**3,065.07**	**4,138.83**	**6,778.37**	**6,921.83**	**4,076.69**	**5,032.87**	**4,414.78**
Operational costs (B)											
Labor	500.18	529.00	561.31	575.16	607.35	609.97	630.47	666.31	588.09	624.32	589.22
Fertilizers e dolomites	232.08	252.09	247.96	248.43	247.32	231.41	241.42	160.26	293.34	287.32	244.16
Chemicals	255.69	262.91	266.36	316.09	320.80	333.35	332.22	370.55	369.61	367.72	319.53
Mechanization/irrigation	362.84	385.94	399.13	430.25	457.42	455.72	475.13	503.93	457.05	467.86	439.53
Total (B)	**1,350.77**	**1,430.30**	**1,474.76**	**1,569.93**	**1,632.87**	**1,630.75**	**1,679.23**	**1,810.05**	**1,708.09**	**1,747.22**	**1,603.40**
Partial profit: (A)–(B)	**950.04**	**1,693.58**	**2,696.10**	**2,968.12**	**1,432.20**	**2,508.38**	**5,099.14**	**5,120.78**	**2,368.59**	**3,285.65**	**2,812.26**
Fixed costs (C)											
Depreciation[3]	633.31	671.82	691.11	730.60	765.28	787.61	814.78	849.90	874.08	854.80	767.33
Interest costs	67.35	72.53	73.73	78.50	81.63	81.51	83.96	90.06	85.40	87.36	80.20
Total (C)	**700.84**	**743.35**	**764.84**	**809.10**	**846.91**	**867.56**	**898.73**	**939.96**	**959.48**	**942.16**	**837.29**
Net profit: (A)–(B)–(C)	**249.17**	**950.23**	**1,931.27**	**2,159.03**	**585.29**	**1,640.82**	**4,200.41**	**4,180.82**	**1,409.11**	**2,343.49**	**1,964.96**
Total costs: (B) + (C)	**2,051.63**	**2,174.12**	**2,239.60**	**2,379.03**	**2,479.78**	**2,498.01**	**2,577.96**	**2,741.01**	**2,667.57**	**2,689.39**	**2,449.81**
Productivity[4]	555	615	743	664	800	805	896	953	682	889	760

[1]: Values not corrected.
[2]: Sale on-tree.
[3]: Machines and groves.
[4]: Boxes (90 pounds)/hectare.
Source: Muraro and Amaro, and Muraro (1994).

Figure 1: Florida's process market orange costs and returns evolution in the 1980's.

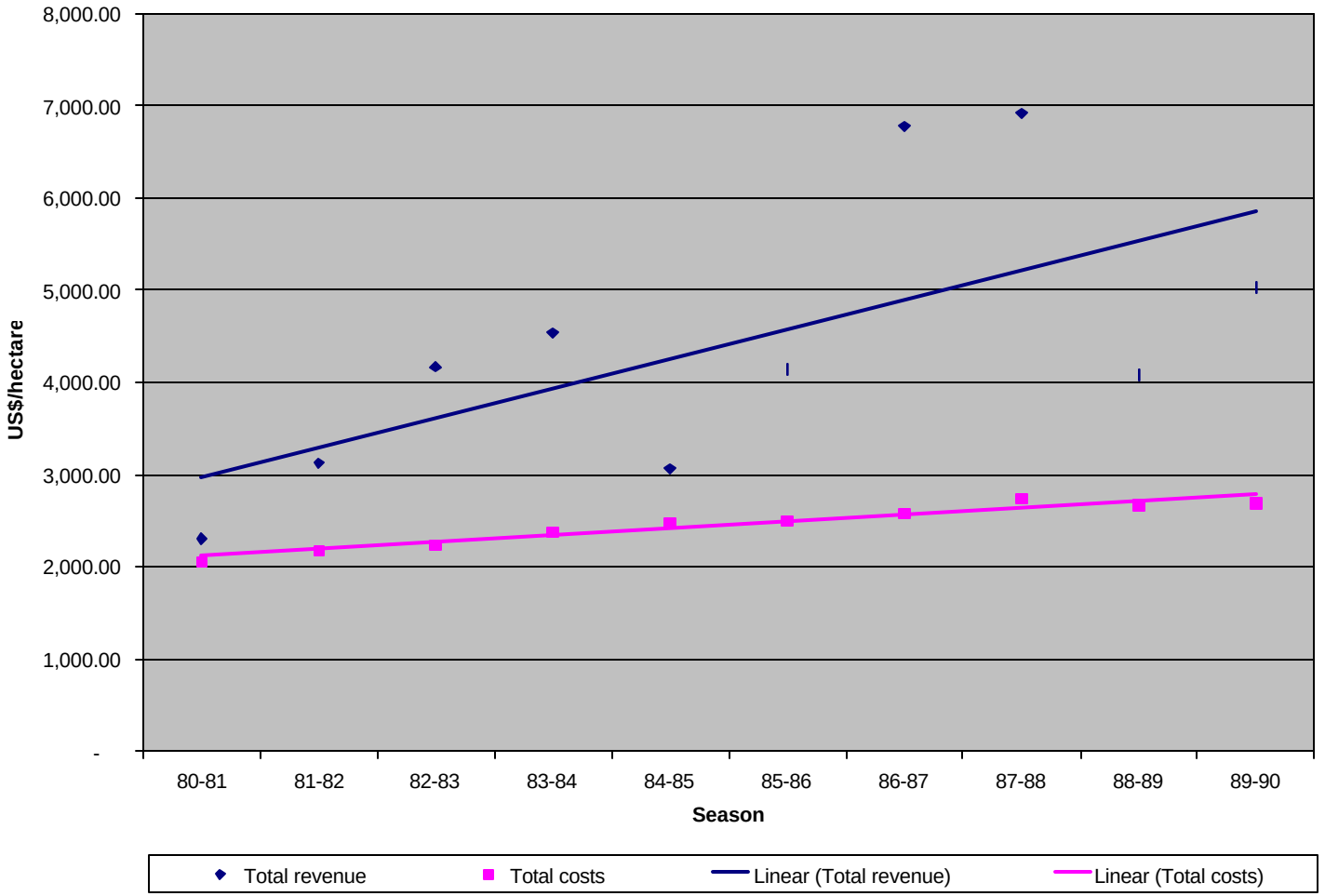


Table 2: Process market orange costs and returns in Sao Paulo, 1980-81 to 1989-90 (US$/hectare)[1].

Item	Season										Aver.
	80/81	81/82	82/83	83/84	84/85	85/86	86/87	87/88	88/89	89/90	
Total revenue [2] (A)	**890.41**	**508.00**	**388.01**	**882.01**	**1,505.00**	**415.16**	**913.75**	**1,387.50**	**1,854.96**	**609.39**	**935.42**
Operational costs (B)											
Labor	104.93	116.83	89.12	47.18	54.98	55.25	137.41	28.33	42.98	74.58	75.16
Fertilizers and dolomites	163.24	197.45	128.56	74.89	135.58	152.42	126.83	165.69	201.63	264.56	161.09
Chemicals	154.00	252.66	154.15	101.52	104.75	120.44	99.96	84.20	154.28	167.46	139.34
Mechanization/irrigation	63.65	85.83	70.59	66.64	55.99	59.48	112.98	56.22	111.09	115.14	79.76
Total (B)	**485.85**	**652.75**	**442.43**	**290.23**	**351.31**	**387.59**	**477.18**	**334.44**	**509.98**	**621.74**	**455.35**
Partial profit: (A) – (B)	**404.56**	**(144.74)**	**(54.41)**	**591.79**	**1,153.69**	**27.54**	**436.57**	**1,053.00**	**1,344.98**	**(12.35)**	**480.06**
Fixed costs (C)											
Depreciation [3]	78.15	89.96	81.61	65.06	96.06	109.84	111.82	64.20	105.46	163.00	96.52
Interest costs	35.40	120.46	65.48	106.90	215.06	339.55	26.82	5.73	25.63	37.30	97.83
Total (C)	**113.55**	**210.39**	**147.09**	**171.96**	**311.12**	**449.39**	**138.64**	**69.93**	**131.09**	**200.30**	**194.35**
Net profit: (A) – (B) – (C)	**290.99**	**(355.16)**	**(201.50)**	**419.83**	**842.57**	**(421.83)**	**297.93**	**983.16**	**1,213.89**	**(212.65)**	**285.72**
Total costs: (B) + (C)	**599.39**	**863.14**	**589.49**	**462.19**	**662.43**	**836.98**	**615.80**	**404.34**	**641.07**	**822.04**	**649.69**
Productivity [4]	420	400	400	420	430	360	424	370	524	549	429

[1]: Values not corrected.
[2]: Sale on-tree.
[3]: Machines and grove.
[4]: Boxes (90 pounds)/hectare.
Source: Muraro and Amaro, and Muraro (1994).

Figure 2: Sao Paulo's process market orange costs and returns evolution during the 1980's.

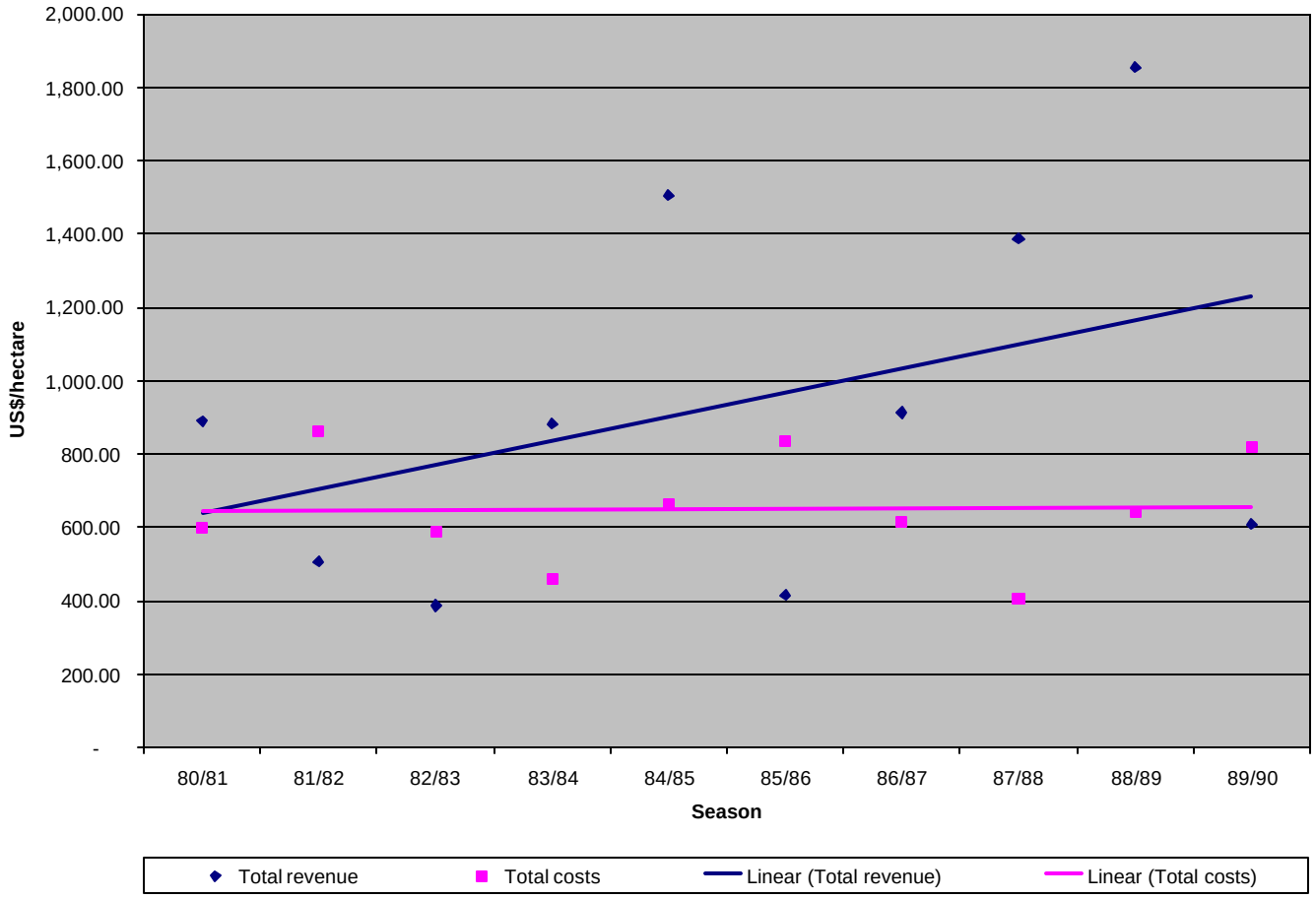


Table 3: Process market orange costs and returns in Florida, 1980-81 to 1989-90 (US$/box)[1].

Item	Season										Aver.
	80/81	81/82	82/83	83/84	84/85	85/86	86/87	87/88	88/89	89/90	
Total revenue[2] (A)	**4.14**	**5.08**	**5.61**	**6.83**	**3.83**	**5.14**	**7.56**	**7.26**	**5.98**	**5.66**	**5.79**
Operational costs (B)											
Labor	0.90	0.86	0.75	0.87	0.76	0.76	0.70	0.70	0.86	0.70	0.79
Fertilizers and dolomites	0.42	0.41	0.33	0.37	0.31	0.29	0.27	0.27	0.43	0.32	0.34
Chemicals	0.46	0.43	0.36	0.48	0.40	0.41	0.37	0.39	0.54	0.41	0.43
Mechanization/irrigation	0.65	0.63	0.54	0.65	0.57	0.57	0.53	0.53	0.67	0.53	0.63
Total (B)	**2.43**	**2.33**	**1.98**	**2.36**	**2.04**	**2.02**	**1.87**	**1.89**	**2.50**	**1.96**	**2.14**
Partial profit: (A) – (B)	**1.71**	**2.75**	**3.63**	**4.47**	**1.79**	**3.12**	**5.69**	**5.37**	**3.48**	**3.70**	**3.57**
Fixed costs (C)											
Depreciation[3]	1.14	1.09	0.93	1.10	0.96	0.98	0.91	0.89	1.28	0.96	1.02
Interest costs	0.12	0.12	0.10	0.12	0.10	0.10	0.09	0.09	0.13	0.10	0.11
Total (C)	**1.26**	**1.21**	**1.03**	**1.22**	**1.06**	**1.08**	**1.00**	**0.98**	**1.41**	**1.06**	**1.13**
Net profit: (A) – (B) – (C)	**0.45**	**1.55**	**2.60**	**3.25**	**0.73**	**2.04**	**4.68**	**4.39**	**2.07**	**2.64**	**2.44**
Total costs: (B) + (C)	**3.69**	**3.53**	**3.01**	**3.58**	**3.10**	**3.10**	**2.88**	**2.87**	**3.91**	**3.02**	**3.27**
Productivity[4]	555	615	743	664	800	805	896	953	682	889	760

1: Values not corrected.
2: Sale on-tree.
3: Machines and grove.
4: Boxes (90 pounds)/hectare.
Source: Muraro and Amaro, and Muraro (1994).

Table 4: Process market orange costs and returns in Sao Paulo, 1980-81 to 1989-90 (US$/box)[1].

Item	Season										Aver.
	80/81	81/82	82/83	83/84	84/85	85/86	86/87	87/88	88/89	89/90	
Total revenue [2] (A)	**2.12**	**1.27**	**0.97**	**2.10**	**3.50**	**1.15**	**2.15**	**3.74**	**3.54**	**1.11**	**2.17**
Operational costs (B)											
Labor	0.25	0.29	0.22	0.11	0.13	0.15	0.32	0.08	0.08	0.14	0.18
Fertilizers and dolomites	0.39	0.49	0.32	0.18	0.32	0.42	0.30	0.45	0.38	0.48	0.37
Chemicals	0.37	0.63	0.39	0.24	0.24	0.33	0.24	0.23	0.29	0.31	0.33
Mechanization/irrigation	0.15	0.21	0.18	0.16	0.13	0.16	0.27	0.15	0.21	0.21	0.18
Total (B)	**1.16**	**1.63**	**1.11**	**0.69**	**0.82**	**1.07**	**1.12**	**0.90**	0.97	**1.13**	**1.06**
Partial profit: (A) – (B)	**0.96**	**(0.36)**	**(0.14)**	**1.41**	**2.68**	**0.08**	**1.03**	**2.84**	**2.57**	**(0.02)**	**1.11**
Fixed costs (C)											
Depreciation [3]	0.19	0.22	0.20	0.15	0.22	0.30	0.26	0.17	0.20	0.30	0.22
Interest costs	0.08	0.30	0.16	0.25	0.50	0.94	0.06	0.02	0.05	0.07	0.24
Total (C)	**0.27**	**0.53**	**0.37**	**0.41**	**0.72**	**1.25**	**0.33**	**0.19**	**0.25**	**0.36**	**0.47**
Net profit: (A) – (B) – (C)	**0.69**	**(0.89)**	**(0.50)**	**1.00**	**1.96**	**(1.17)**	**0.70**	**2.65**	**2.32**	**(0.39)**	**0.64**
Total costs: (B) + (C)	**1.43**	**2.16**	**1.47**	**1.10**	**1.54**	**2.32**	**1.45**	**1.09**	**1.22**	**1.50**	**1.53**
Productivity [4]	420	400	400	420	430	360	424	370	524	549	430

1: Values not corrected.
2: Sale on-tree.
3: Machines and grove.
4: Boxes (90 pounds)/hectare.
Source: Muraro and Amaro, and Muraro (1994).

The 1990's

An analysis of the data contained in Table 5, and graphically illustrated in Figure 3, demonstrates the general downward trend in revenue received by Florida orange growers during the 1990's. This reduction can be explained by lower fruit prices in response to global increases in processed orange supplies. The largest revenues of the decade were generated during the 1990-91 season ($4,582 per hectare) and the smallest were during the 1996-97 season ($3,120 per hectare). Average revenue per hectare for the decade was $3,573.

Cost of production increases in Florida during the decade were almost non-existent and exhibited little variation from the generally flat trend line. Costs of production averaged $2,865 per hectare during the decade.

Labor continued to be the most expensive component of operational costs, with an average of $696 being spent on labor per hectare. The depreciation of machines and groves averaged $896 per hectare over the 10-year period.

The 1990's saw continued fluctuation in both revenue and costs of production for Sao Paulo growers (Table 6 and Figure 4). Total revenue ranged from a high of $1,350 per hectare in 1997-98 to a low of $441 per hectare in 1999-2000. While total revenue seemed to bounce wildly through the decade, an overall downward trend was evident. Cost of production variation was less radical in the 1990's, relative to revenues, but also decreased over the decade. Costs ranged from $982 per hectare in 1993-94 to $711 per hectare in 1991-92.

In Sao Pablo, during the 1990's, chemicals were the largest of all expense categories, surpassing all components of operational and fixed costs. Chemical means to control diseases like CVC, canker, leaf miner and black spot were important elements in the attempt by Brazilian growers to increase the productivity of their groves. The increase in chemical use, and hence expense, replaced spending on fertilizer and dolomite as the largest cost of production. However, the use of fertilizer and dolomite also increased during the 1990's relative to the 1980's. The increase in expenditures on chemicals, fertilizers and dolomites is a major factor in the noticeable increase in productivity of Brazilian groves. Average box per hectare increased from 429 in the 1980's to 515 in the 1990's (Tables 7 and 8).

Figure 5 provides a graphic depiction of the changes in Brazilian grove productivity that occurred from 1980 to 2000. Operational costs are plotted per hectare and per box. Prior to the 1989-90 season, the costs per hectare curve lies below the costs per box curve. This indicates that yields per hectare were relatively lower and therefore, costs were distributed over fewer boxes of fruit. In essence, each box of fruit cost more to produce. However, after the 1989-90 season, input use was increased, resulting in an increase in tree production levels. More boxes of fruit were produced, spreading costs over more boxes of oranges. In essence, each box of fruit cost less to produce. This relationship is indicated by that fact that the costs per box curve falls below the costs per hectare curve after the 1989-90 season.

Table 5: Process market orange costs and returns in Florida, 1990-91 to 1999-00 (US$/hectare)[1].

Item	Season										Aver.
	90/91	91/92	92/93	93/94	94/95	95/96	96/97	97/98	98/99	99/00	
Total revenue [2] (A)	**4,582.42**	**3,425.76**	**3,255.86**	**3,498.42**	**3,355.44**	**3,667.30**	**3,120.06**	**3,633.30**	**3,672.68**	**3,518.08**	**3,572.93**
Operational costs (B)											
Labor	673.69	714.64	711.57	722.67	680.90	713.62	676.28	679.86	688.98	700.94	696.32
Fertilizers and dolomites	280.24	280.24	279.03	283.39	294.75	308.91	292.75	294.30	298.24	303.42	291.53
Chemicals	386.89	389.60	387.92	393.98	367.46	385.12	364.97	366.90	371.82	378.28	379.29
Mechanization and irrigation	495.50	499.00	496.85	504.61	507.16	531.53	503.72	506.38	513.18	522.08	508.00
Total (B)	**1,836.32**	**1,883.48**	**1,875.37**	**1,904.65**	**1,850.27**	**1,939.18**	**1,837.72**	**1,847.44**	**1,872.22**	**1,904.72**	**1,875.14**
Partial costs: (A) – (B)	**2,746.10**	**1,542.28**	**1,380.49**	**1,593.77**	**1,505.17**	**1,728.12**	**1,282.34**	**1,785.86**	**1,800.46**	**1,613.36**	**1,697.80**
Fixed costs (C)											
Depreciation [3]	866.76	871.25	900.80	914.86	888.74	931.75	882.71	887.38	899.28	914.90	895.84
Interest costs	91.82	94.71	93.77	95.23	92.52	96.96	91.90	92.37	93.61	95.23	93.81
Total (C)	**958.58**	**965.96**	**994.57**	**1,010.09**	**981.26**	**1,028.71**	**974.61**	**979.75**	**992.89**	**1,010.13**	**989.66**
Net profit: (A) – (B) – (C)	**1,787.52**	**576.32**	**385.92**	**583.68**	**523.91**	**699.41**	**307.73**	**806.11**	**807.57**	**603.23**	**708.14**
Total costs: (B) + (C)	**2,794.90**	**2.849.44**	**2,869.94**	**2.914.74**	**2,831.53**	**2,967.89**	**2,812.33**	**2,827.19**	**2,865.11**	**2,914.85**	**2,864.79**
Productivity	778	936	941	879	902	845	894	990	748	956	887

[1] Values not corrected.
[2]: Sale on-tree.
[3]: Machines and grove.
Source: Muraro and Amaro, Muraro (1994) and Muraro (1991-2000).

Figure 3: Florida's process market orange costs and returns evolution during the 1990's.

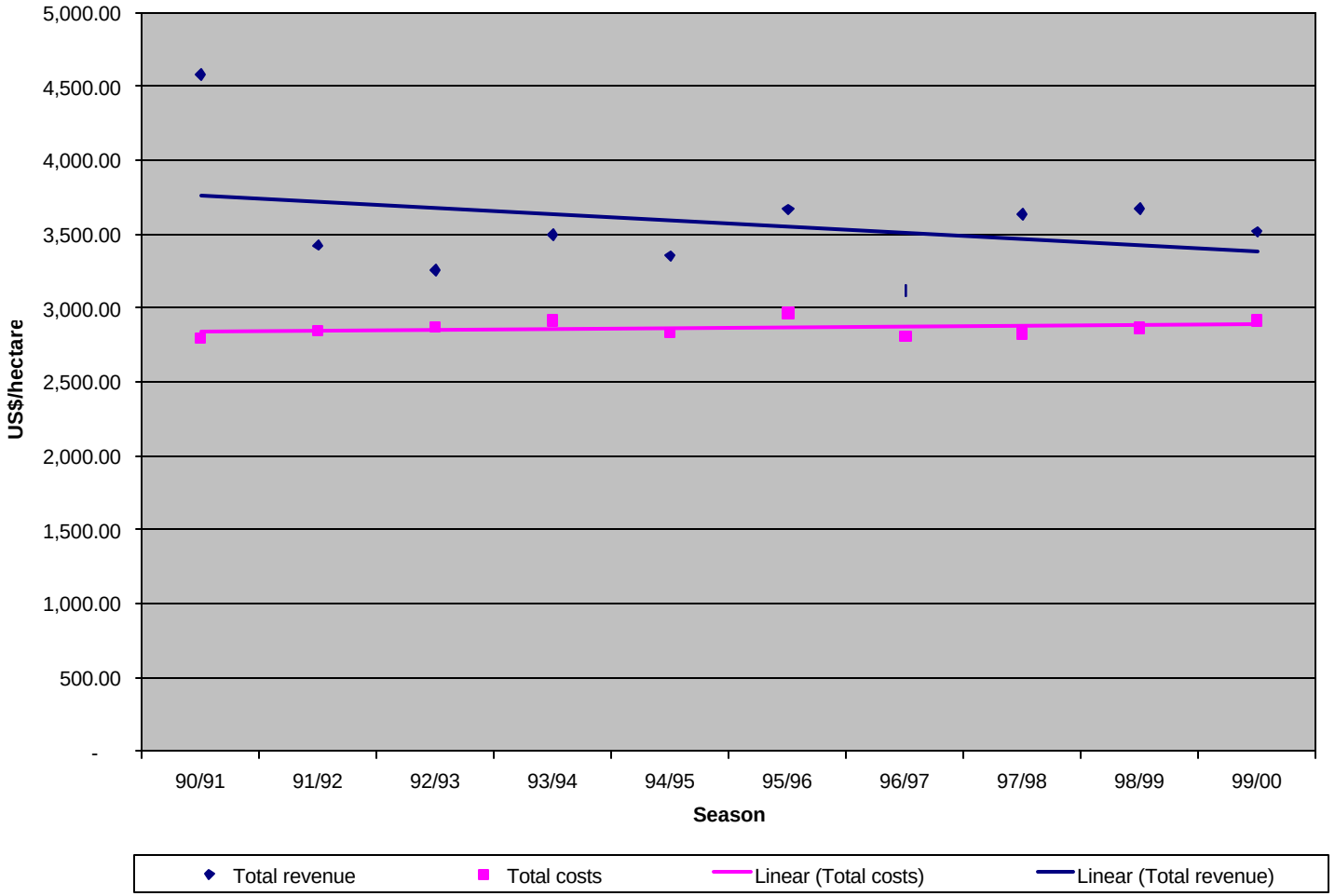


Table 6: Process market orange costs and returns in Sao Paulo, 1990-91 to 1999-00 (US$/hectare)[1].

Item	Season										Aver.
	90/91	91/92	92/93	93/94	94/95	95/96	96/97	97/98	98/99	99/00	
Total revenue (A)	**1,283.10[2]**	**549.00[2]**	**1,092.51[3]**	**1,415.50[3]**	**929,01[3]**	**782,42[3]**	**984.20[3]**	**1.349.76[3]**	**890.80[3]**	**440.68[3]**	
Operational costs (B)											
Labor	74.13	56.29	80.04	102.42	*	*	107.12	*	78.04	*	83.01
Fertilizers and dolomites	242.00	212.92	210.06	204.19	*	*	251.62	*	221.55	*	223.72
Chemicals	241.77	211.89	261.59	325.98	*	*	243.12	*	214.70	*	249.84
Mechanization and irrigation	127.89	96.37	110.71	146.00	*	*	149.10	*	131.67	*	126.96
Total (B)	**685.79**	**577.47**	**662.40**	**778.59**	*	*	**750.96**	*	**645.96**	*	**683.53**
Partial profit: (A) – (B)	**597.31**	**(28.47)**	**430.11**	**636.91**	*	*	**233.24**	*	**244.84**	*	**-**
Fixed costs (C)											
Depreciation	194.18[4]	63.73[4]	155.77[4]	157.25[4]	*	*	50.67[5]	*	42.69[5]	*	-
Interest costs	82.33	69.33	37.97	45.95	*	*	56.04	*	65.32	*	59.49
Total (C)	**276.51**	**133.06**	**193.74**	**203.20**	*****	*****	**106.71**	*****	**108.01**	*****	**-**
Net profit: (A) – (B) – (C)	**320.80**	**(161.53)**	**236.37**	**433.71**	*****	*****	**126.53**	*****	**138.83**	*****	**-**
Total costs: (B) + (C)	**962.30**	**710.53**	**856.14**	**981.79**	*****	*****	**857.67**	*****	**753.97**	*****	**-**
Productivity	546	549	549	475	519	551	518	444	524	479	515

1: Values not corrected.
2: Sale on-tree.
3: Delivered-in sale (spot market).
4: Machines and grove.
5: Machines.
***:** Data not available.
Source: Muraro (1994), Arruda, Spreen and Muraro, and Muraro et. al

Figure 4: Sao Paulo's process market orange costs and returns evolution during the 1990's.

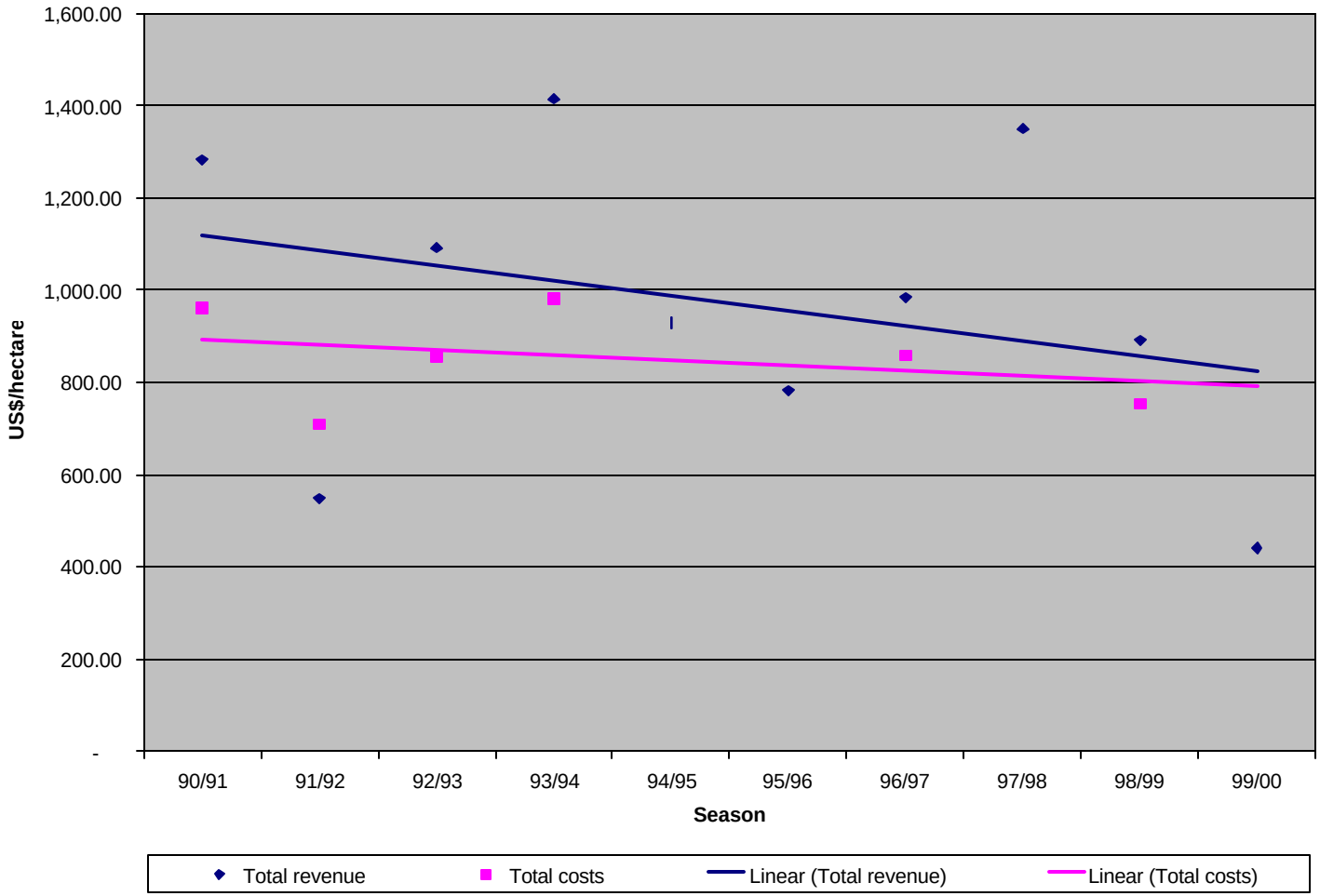


Table 7: Process market orange costs and returns in Florida, 1990-91 to 1999-00 (US$/box)[1].

Item	Season										Aver.
	90/91	91/92	92/93	93/94	94/95	95/96	96/97	97/98	98/99	99/00	
Total revenue[2] (A)	**5.89**	**3.66**	**3.46**	**3.98**	**3.72**	**4.34**	**3.49**	**3.67**	**4.91**	**3.68**	**4.08**
Operational costs (B)											
Labor	0.87	0.76	0.76	0.82	0.75	0.84	0.76	0.69	0.92	0.73	0.79
Fertilizers and dolomites	0.36	0.30	0.30	0.32	0.33	0.37	0.33	0.30	0.40	0.32	0.33
Chemicals	0.50	0.42	0.41	0.45	0.41	0.46	0.41	0.37	0.50	0.40	0.43
Mechanization and irrigation	0.64	0.53	0.53	0.57	0.56	0.63	0.56	0.51	0.69	0.55	0.58
Total (B)	**2.36**	**2.01**	**1.99**	**2.17**	**2.05**	**2.29**	**2.06**	**1.87**	**2.50**	1.99	**2.13**
Partial profit: (A) – (B)	**3.53**	**1.65**	**1.47**	**1.81**	**1.67**	**2.05**	**1.43**	**1.80**	**2.41**	**1.69**	**1.95**
Fixed costs (C)											
Depreciation[3]	1.11	0.93	0.96	1.04	0.99	1.10	0.99	0.90	1.20	0.96	1.02
Interest costs	0.12	0.10	0.10	0.11	0.10	0.11	0.10	0.09	0.13	0.10	0.11
Total (C)	1.23	1.03	1.06	1.15	1.09	1.22	1.09	0.99	1.33	1.06	1.13
Net profit: (A) – (B) – (C)	**2.29**	**0.62**	**0.41**	**0.66**	**0.58**	**0.83**	**0.34**	**0.81**	**1.08**	**0.63**	**0.83**
Total costs: (B) + (C)	**3.59**	**3.04**	**3.05**	**3.32**	**3.14**	**3.51**	**3.15**	**2.86**	**3.83**	**3.05**	**3.26**
Productivity	778	936	941	879	902	845	894	990	748	748	887

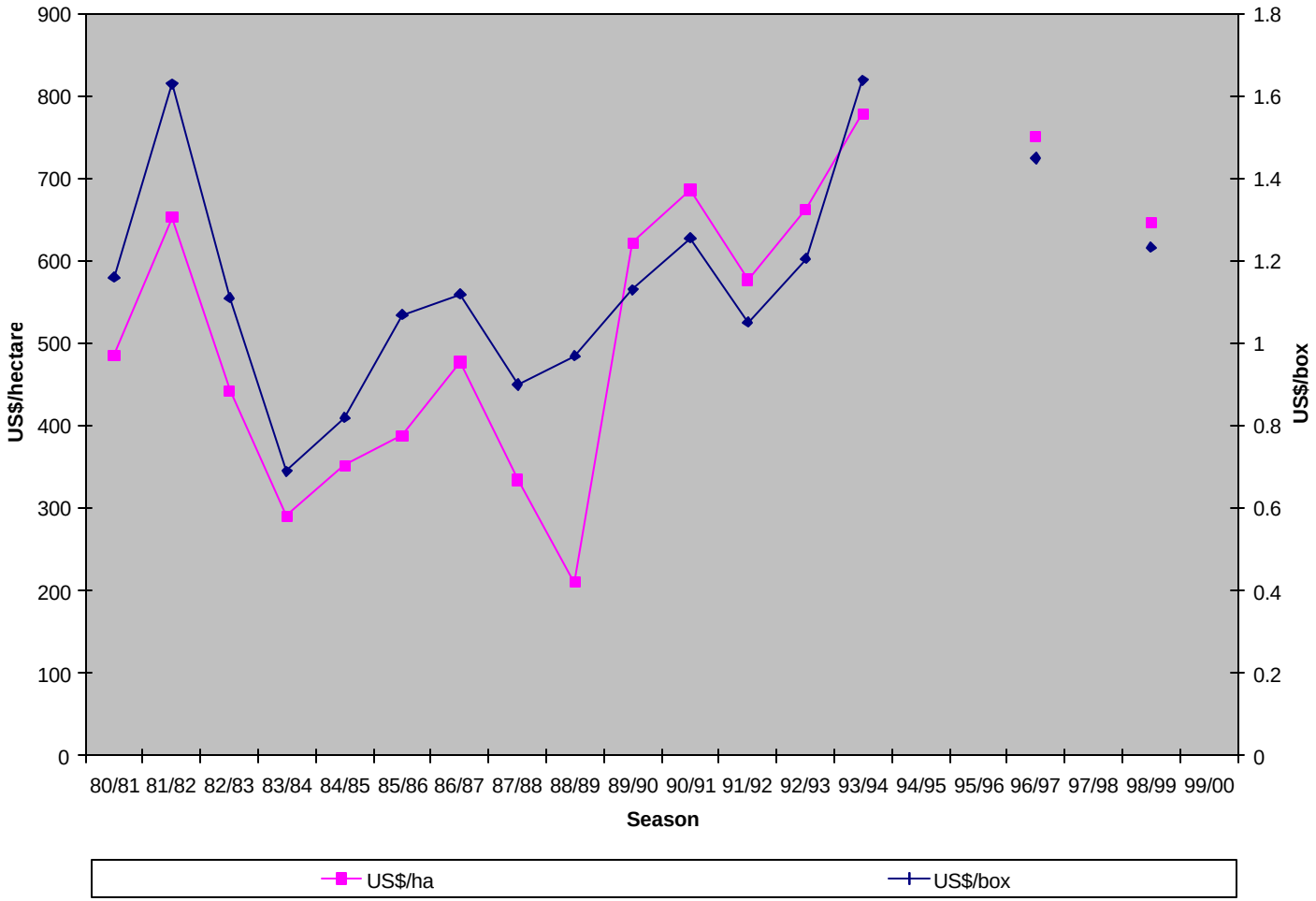
[1]: Values not corrected.
[2]: Sale on-tree.
[3]: Machines and grove.
Source: Muraro (1994), Muraro (1995), and Muraro (1991-2000).

Table 8: Process market orange costs and returns in Sao Paulo, 1990-91 to 1999-00 (US$/box)[1].

Item	Season										Aver.
	90/91	91/92	92/93	93/94	94/95	95/96	96/97	97/98	98/99	99/00	
Total revenue (A)	**2.35[2]**	**1.00[2]**	**1.99[3]**	**2.98[3]**	**1.79[3]**	**1.42[3]**	**1.90[3]**	**3.04[3]**	**1.70[3]**	**0.92[3]**	**-**
Operational costs (B)											
Labor	0.14	0.10	0.15	0.22	*	*	0.21	*	0.15	*	0.16
Fertilizers and dolomites	0.44	0.39	0.38	0.43	*	*	0.49	*	0.42	*	0.43
Chemicals	0.44	0.39	0.48	0.69	*	*	0.47	*	0.41	*	0.48
Mechanization and irrigation	0.23	0.18	0.20	0.31	*	*	0.29	*	0.25	*	0.24
Total (B)	**1.26**	**1.05**	**1.21**	**1.64**	*****	*****	**1.45**	*****	**1.23**	*****	**1.31**
Partial costs: (A) – (B)	**1.09**	**(0.05)**	**0.78**	**1.34**	*****	*****	**0.45**	*****	**0.47**	*****	**-**
Fixed costs (C)											
Depreciation	0.36[4]	0.12[4]	0.28[4]	0.33[4]	*	*	0.10[5]	*	0.08[5]	*	-
Interest costs	0.15	0.13	0.07	0.10	*	*	0.11	*	0.12	*	0.11
Total (C)	0.51	0.24	0.35	0.43	*	*	0.21	*	0.21	*	-
Net profit: (A) – (B) – (C)	**0.59**	**(0.29)**	**0.43**	**0.91**	*****	*****	**0.24**	*****	**0.26**	*****	**-**
Total costs: (B) + (C)	**1.76**	**1.29**	**1.56**	**2.07**	*****	*****	**1.66**	*****	**1.44**	*****	**-**
Productivity	546	549	549	475	519	551	518	444	524	479	515

1: Values not corrected.
2: Sale on-tree.
3: Delivered-in sale (spot market).
4: Machines and grove.
5: Machines.
***:** Data not available.
Source: Muraro (1994), Arruda, Spreen and Muraro, and Muraro et. al.

Figure 5: Evolution of operational costs of oranges for process market (per hectare and per box) in Sao Paulo, 1980-2000.



Conclusions

Overall cost of production and return differences between the states of Florida and Sao Paulo existed throughout the 1980's and 1990's. The high cost of labor, mechanization and irrigation in Florida, relative to Sao Paulo, increased the cost of growing oranges for processed markets. However, the higher level of cultural intensity in Florida resulted in much higher grove productivity than in Sao Paulo. Cost of production figures throughout the period examined showed that costs in the U.S. remained fairly constant over time, while costs in Brazil rose throughout the 1980's and 1990's. From the early 1980's, Brazilian growers increased their use of productive inputs, such as fertilizers and dolomites, raising their cost of production and improving overall grove productivity.

Although the cost of orange production is higher in Florida, relative to Sao Paulo, much higher revenues resulting from higher market prices have yielded larger profits. Despite lower costs, Sao Paulo growers have faced much lower market prices, resulting in financial losses during many of the past twenty years. The main determinant of profitability in Florida has been productivity and prices received, while in Sao Paulo, cost of production has been the primary determinant of profitability.

New plantings stimulated by high international market prices, and Florida freezes during the 1980's, have contributed to a general excess in the supply of oranges to process markets in the two States. The result has been a decrease in the price of oranges and consequently, in the revenues of Florida and Sao Paulo growers. Given these factors, it is important that Brazilian and U.S. growers continue to utilize input technologies that will improve citrus productivity and yield, raise market prices by increasing consumer demand, and minimize production costs.

References

Albrigo, L.G., Davies, F.S. 1994. Citrus. Crop Production Science in Horticulture Vol.2, Cab International.

Amaro, A. A. "Citricultura. In: Prognostico Agricola 1999/2000: culturas perenes e aviculture." Informacoes Ecnonomicas, Sao Paulo, V.29, n.12, 65-74, 1999.

Arruda, S.T. "Evolucao dos custos de producao para a cultura da laranja no Estado de Sao Paulo: 1986/87-1993/94." Laranja, Cordeiropolis, 15(1): 37-54, 1994.

FASS, USDA, Citrus 1999-00 Summary, production, price, and value production by counties and per tree**.** September, 2000, 8.

FASS, USDA, Citrus Summary 1998-99. Florida Agricultural Statistics Service, Florida, 2000, 49.

FASS, USDA, Farm cash receipts and expenditures – 1999**,** August, 2000. 8.

Instituto de Economia Agricola (IEA) e Coordenadoria de Assistencia Tecnica Integral (CATI) citados por Amaro (1996).

Instituto de Economia Agricola (IEA) e Coordenadoria de Assistencia Tecnica Integral (CATI) citados por Amaro (2000).

Jackson, L. K.; Davies, F. S. Citrus Growing in Florida. University of Florida Press, Fourth Edition, Gainesville, FL, 1999. 293.

Muraro R. P. "1990-91 Comparative Citrus Budgets." Citrus Industry Magazine. Vol.72, no. 7, July 1991, 46-52.

Muraro, R. P. "1991-92 Comparative Citrus Budgets." Citrus Industry Magazine, Vol. 73, no. 7, July 1992.

Muraro, R. P. 1992-93 Comparative citrus budgets. Citrus Industry Magazine, Vol. 74, no. 7, July 1993, 29-35.

Muraro, R. P. "1993-94 Comparative Citrus Budgets." Citrus Industry Magazine, Vol. 75, no. 7, July 1994.

Muraro, R. P. "1995-96 Comparative Citrus Budgets." Citrus Industry Magazine, Vol 77, no. 7, July 1996, 25-31.

Muraro, R. P. "1996-97 Comparative Citrus Budgets." Citrus Industry Magazine**,** Vol. 78, no. 7, July 1997, 25-29.

Muraro, R. P. "1997-98 Comparative Citrus Budgets." Citrus Industry Magazine, Vol. 79, no. 7, July 1998, 21-27.

Muraro, R. P. “1998-99 Comparative Citrus Budgets.” Citrus Industry Magazine, Vol. 80, no. 7, July 1999, 25-31.

Muraro, R. P. “1999-00 Comparative Citrus Budgets.” Citrus Industry Magazine, Vol.81, no. 7, July 2000, 29-35

Muraro, R. P. Comparative Costs of Producing Oranges in Florida (U.S.A.), Sao Paulo Brazil, Argentina, Uruguay and Vera Cruz (Mexico). International Working Paper Series IW 94-5. Food and Resource Economics Department. July 1994, 81.

Muraro, R. P. Comparative Citrus Production Costs for Florida (U.S.A.), Sao Paulo (Brazil), Veracruz (Mexico) and Other Citrus Producing Regions, 1991-92, 1992-93 and 1993-94. International Working Paper Series IW 95-7. Food and Resource Economics Department. March 1995, 23.

Muraro, R. P.; Amaro, A. A. An overview of Florida (USA) and Sao Paulo (Brazil) Processed Orange Industries with Comparative Costs and Returns, 1979-80 Through 1987-88 Seasons. Economic Information Report 274 Food & Resource Economics Department, IFAS, University of Florida, 1990. 49.

Muraro, R. P.; Spreen, T. H.; Roka, F. M. The Impact of the 1999 Brazilian Devaluation on the Delivered-in Costs of Oranges Produced in Sao Paulo, Brazil.

Neves, E. M. “Economia da producao citricola e efeitos alocativos.” Precos Agricolas: mercado e negocios agropecuarios. N.162, 2000, 9-12.

Spreen, T. H.; Muraro , R. P. The Interrelationships and Competition in the World Orange Juice Market. International Working Paper Series IW 97-14. Food and Resources Economics Department. September 1997, 24.

Trippensee, A. “The Juices Trade in the Americas.” Journal of Food Distribution Research. 28, 1 (Feb. 1997): 13-14. Food Distribution Research Society, Inc.