# MAPPING AND QUANTIFICATION OF THE BRAZILIAN CITRUS CHAIN

M Fava Neves, V. Gustavo Trombin

*The CHAINPlan developed by Neves (2007) is a practical process for developing strategic plans for production chains and was applied in several projects in Brazil. One of the initial steps of this method is mapping and quantification of production chains. This step provides knowledge of the size of the production chain analysed, in terms of social and economic magnitude of all the links that comprises it. Here this method is presented in detail, in order to be useful to researchers worldwide interested in mapping and quantifying a chain. Subsequently, we present the results of applying the method in one of the most important agribusiness chain in Brazil, the citrus sector. In this research, the GDP (Gross Domestic Product) of the citrus sector for the 2008/09 crop year was estimated at $ 6.5 billion. The Citrus GDP per hectare cultivated is twice the Sugarcane GDP per hectare. Here is probably the more updated and profound radiography of the citrus sector in Brazil. This material should serve as a stimulus to decision-making public and private, besides it shows the intimate interconnection between the links in the chain and its ability to generate revenues, taxes and jobs.*

## INTRODUCTION AND RESEARCH PROBLEM

Mapping and quantification of agribusiness chains in Brazil has been the subject of several studies. The first focused on the wheat chain by Rossi and Neves (2004), then orange juice by Neves and Lopes (2005), next milk by Consoli and Neves (2006), sugarcane by Neves, Trombin and Consoli (2010), in 2010, and again the citrus chain by Neves and Trombin (2010) whose findings is presented in this paper. In 2011, the cotton sector, and finally, the beef industry were studied.

These studies aim to generate detailed knowledge about the magnitude of economic and social development of the production chain in the country. The analyses range from orchard inputs to the products offered to consumers. This study addressed the following questions:

- how significant is the sum of sales of the various links in the supply chain and its GDP?
- How much tax revenue is generated by the production chain?
- How many direct and indirect jobs are generated in Brazil?
- How significant is the sum of wages paid to workers during a season?

The complete overview of a chain of production is justified since it provides greater transparency to the sector, clarifies and questions fallacies, as well as adds value to the image of the chain. The information collected allows for gaining market intelligence that can support the structuring of a strategic plan in order to identify innovations in business, and for exploring new opportunities and raising the competitiveness of the sector. The information may also be used to support decision-making in the public sector and companies operated individually or collectively. The goal of this paper was to provide an updated, more indepth and extensive overiew of the Brazilian Citrus Market.

## OBJECTIVES AND METHODOLOGICAL PROCEDURES

According to Malhotra (2001), to characterize and analyse a production chain it is necessary to define its objectives as well as boundaries and scope, participant subsystems of the production chain, and its environment (Malhotra, 2001). Batalha (2001) reports that for a chain analysis, the researcher must define certain conditions that are consequences of the objectives to be reached. The most important and difficult definitions are related to the analysis scope and levels that should be detailed. Zylbersztajn (2000) also comments that the definition of the Sag boundaries shall be dependent on the research purposes, which are generally focused on a product.

The aim of this paper is to present a method for mapping and quantification of production chains and discuss the results of this method in the citrus chain in Brazil, with major details in São Paulo state, focusing on citrus juices and derived products, and also citrus fruits for fresh consumption. However, in some cases data are presented that surpass this scope, in order to analyse the dependence and importance of some agents and sectors in the production chain.


Fig. 1: The CHAINPlan method for strategic planning and management of food and bioenergy chains © Neves (2007)


Fig. 2: Method for mapping and quantification of the chain © Neves *et al.* (2004)

To achieve this, the CHAINPlan method was applied, which was developed by Neves (2004) focusing on strategic planning and management of agribusiness systems. As summarized in Figure 1, the method consists of a five-step process towards implementing strategic management in a production chain.

The second step of the method consists of mapping and quantification of chains. This step comprises six stages, as shown in Figure 2. Its application is relatively simple and straightforward, and the collection of information does not depend on public sources of data, which is another advantage of this method. In addition, the figure obtained allows easy visualization of positioning and the relevance of different sectors in an existing value chain.

We will explain further in details the method CHAINPlan as this is one of the objectives of this work. The first of the six steps consists of elaborating a preliminary design of the chain based on theory and the researchers' experience. It is also necessary to scope which segments will be studied, keeping the focus on the central axis of the system, due to the objective of the research. In this paper, was opted for oranges, lemons/limes and tangerines as raw material and central object of the system, considering the Goldberg (1968) notion of commodity system approach (CSA), as well as emphasizing a product as the starting point for the system analysis.

After the production chain designed, the second step is to submit it to sector specialists and interview them, as they will have to propose possible adjustments, in order to obtain the current condition of the system. The third stage consists of the secondary data research, which according to Malhotra (2001) is collected for ends that differ from the problem of the research. For this step, data was searched from sources that have academic and statistical credibility, reputation, and integrity.

After the collection of the available secondary data we started the collection of primary data (fourth step), that is the research of data originated by the researcher for specific purpose to solve the problem in question (Mattar, 1993; Malhotra, 2001). In this work, were done deep interviews with representatives of several organizations in the citrus sector.

To select and define the interviews, we first identified which data was not found in the secondary research, and therefore, agents in the chain were selected for interviews. To be selected, the agent should have certain characteristics, i.e. must have access to the information and data of the sector in study, must have knowledge and experience about the system, must be willing to collaborate with the researchers and promote communication for future contacts, additionally, must be able to indicate possible contact agents who will contribute with unavailable data.

The quantification (fifth stage) determines the turnover of each sector in the chain, through the company revenues and estimates of several sub sectors of the citrus production chain. Therefore, it is important to delineate the period of the research evaluation. In order to ensure confidence in the data, some secondary and primary data were contrasted, attempting to find incongruous elements. In this process, at least two different data sources were used to check the results, with additional interviews with similar agents when needed.

In the sixth step, a workshop is organized for the presentation of results and discussion of numbers. As mentioned in the beginning, this method was applied numerous times by Neves. It was also applied by researchers of the University of Buenos Aires in the soybean chain (VILELLA, 2009). In our current study, the method was applied to the citrus chain in Brazil in the agriculture year of 2008/09.

## THEORETICAL BACKGROUND

Two traditional approaches to studying chains can be found in the literature. The commodity system approach

(CSA) was developed by Goldberg (1968) in the USA in studies of citrus, wheat and soybean production systems. The CSA methodology emphasizes the sequence of product transformations in the system. The merit of Goldberg's method is that it changed the focus of analysis from the orchard to the entire system, which prevented researchers from considering the agricultural sector in isolation from the overall economy.

The second approach, proposed by Morvan (1985), considers a chain ("filière") as linked operations in the transformation of a good. The chains are influenced by technology and have complementary interdependences, according to Batalha (2001). According to Morvan (1985), the filière analysis is an important tool for describing systems, for defining the role of technology in the framing of production systems, for organizing integration studies, and to analyse industrial policies, firms, and collective strategies.

The supply chain is viewed as a system that integrates raw material suppliers, factories, distribution services, and consumers (Stevens apud Omta *et al.*, 2001). Furthermore, there is the network concept in which organizations are directly involved in different processes that add value in the development of goods and services until they reach the consumer (Christopher apud Omta *et al.*, 2001). Lazzarini *et al.* (2001) integrate chain and network concepts in a study on net chains. According to these authors, the integration of these approaches allows for considering existing organizational interdependences in a network, as well as the different mechanisms of coordination (managerial plans, process standardization and adjustments), and sources of value (production and operations optimization, transaction cost reduction, diversity and „co-specialization" of knowledge).

**TAB. 1: GDP ESTIMATE FOR BRAZILIAN CITRUS PRODUCTION CHAIN BASED ON FINAL GOODS**

| Product | Internal Market (IM) US$ (millions) | External Market (EM) US$ (millions) | Total (IM + EM) US$ (millions) |
|---|---|---|---|
| Oranges | 2,232.9 | 19.1 | 2,252.0 |
| Lemons | 673.1 | 48.2 | 721.2 |
| Tangerines | 945.9 | 5.8 | 951.7 |
| FCOJ | – | 1,545.9 | 1,545.9 |
| NFC | – | 299.5 | 299.5 |
| Citrus pulp | 85.2 | 93.5 | 178.8 |
| Essential oils | – | 72.9 | 72.9 |
| Terpenes | – | 55.2 | 55.2 |
| Frozen cells | – | 9.1 | 9.1 |
| D-Limonene | – | 0.9 | 0.9 |
| Orange juice/nectar | 459.1 | – | 459.1 |
| Total | 4,396.21 | 2,150.10 | 6,546.31 |

© Neves and Trombin from data elaborated by Markestrat (2010)

**CITRUS PRODUCTION CHAIN IN BRAZIL**
**GDP: US$ 6.5 billion – Gross revenue: US$ 14.6 billion**

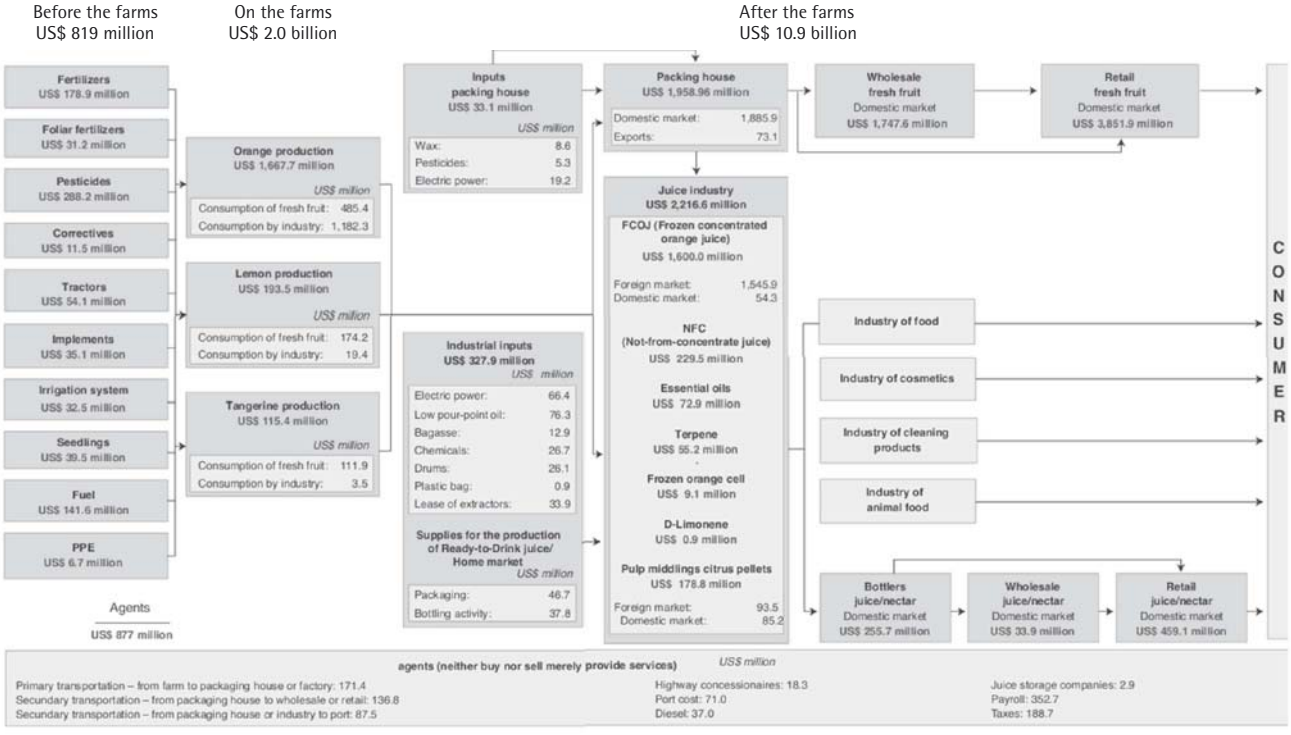



Fig. 3: The mapping and quantification of Citrus Chain

© Neves and Trombin from data elaborated by Markestrat (2010)

Hardman *et al.* (2002) demonstrated the possibility of increasing the competitiveness of South African apple chain exportations through cooperation among producers, packers, and exporters. From the ideas of CSA and the filière, it is possible to develop tools and managerial activities to improve the chains' efficiency. Thus, the concepts of Supply Chain Management (SCM) and the set of networks and net chain ideas are important theoretical concepts and empirical notions for the development of food and bioenergy chains (Batalha and Silva, 2001).

## RESULTS

This study estimated the GDP value of the Brazilian citrus production chain at US$ 6.5 billion (Table 1) for 2008/09, which corresponded to approximately 2 % of the country s agribusiness GDP. Of this total, US$ 4.39 billion were generated in the internal market and US$ 2.15 billion in the external market. Sales of fresh fruit in the internal market represented 34 % and 28 % from orange juice exports (FCOJ – Frozen Concentrated Orange Juice and NFC – Not From Concentrated). It is important to note that orange juice exports accounted for 94 % of the citrus complex exports. The citriculture GDP was estimated by the sum of the sales of final goods within the citrus agroindustry system.

Figure 3 represents the citrus chain and the value in each column indicates the gross sale of that particular item in 2008/09. The gross revenue of the citrus sector in this period was approximately US$ 14.6 billion. This value represents the sum of the estimated sales from several segments of the production chain and the financial transactions of the facilitating agents.

### *Pre Orchard*

The agricultural input industry sold US$ 819 million in the agricultural products to the citrus sector in 2008/09. The sales are detailed in Graph 1. It is important to note that 84 % of the total value comes from sales of acaricides, fungicides and pesticides due to high standards required for pest and disease control.

Citriculture is the second most intensive in use of agricultural pesticides in Brazil, behind only cotton. In 2009, citrus producers consumed 4.2 % of all commercial sales of agricultural pesticides and applied an average of 17.5 kg/hectare in active ingredients, of which 6.8 kg/hectare are acaricides and 5.1 kg/hectare of pesticides. The increasing incidence of greening and citrus variegated chlorosis (CVC) have drastically increased the consumption of pesticides in citrus crops by over 600 % from 2003 to 2009, impacting directly the total consumption of agricultural pesticides in citriculture (Graph 2).

In regards to fertilizers, citriculture is responsible for only 2 % of the total consumption in Brazil, after 11 other cultures. In terms of intensity in use, citriculture ranks sixth, applying 362 kg/hectare in 2009, a reduction of 10.2 % in relation to 2008 and of 26.3 % in relation to 2007. This is partly justified by a worsening in the exchange ratio between a ton of fertilizer and a 40.8 kg box of orange. In 2007, it took 60 boxes of 40.8 kg of oranges to buy one ton of fertilizer and in 2009 it took 95 boxes (Graph 3).

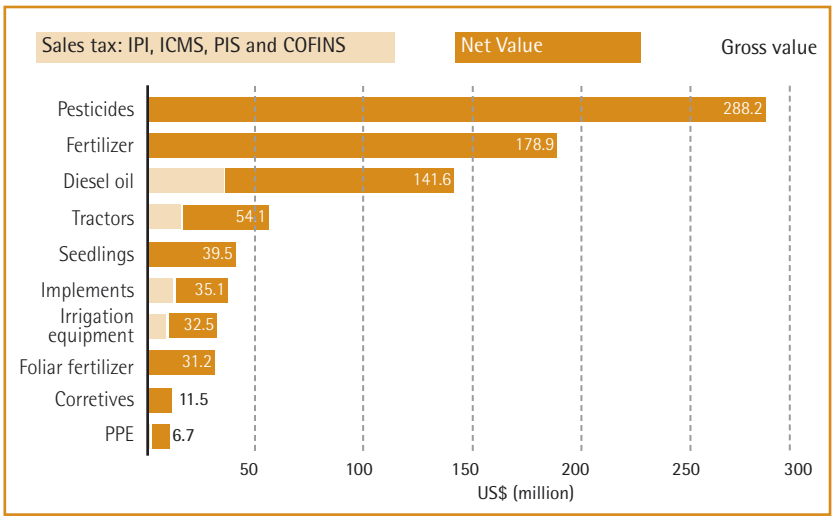
### *Orchards*

Citriculture is present in almost every Brazilian state. With over 800 thousand hectares in orchards, oranges the most cultivated fruit in the country, with an area twenty times bigger than apple orchards and 10 times larger than cropland for mangoes and grapes. The State of São Paulo concentrates 70 % of the area with orange orchards but the States of Bahia and Sergipe are the regions in which the expansion has been occurring more intensively. This is due to a rise in demand for fresh fruits from inhabitants of the north and northeast regions of Brazil and reflects a recent increase in their purchasing power.

Oranges can have three basic destinations: processing industry, internal market and external market. In the States of Bahia and Sergipe, 77 % of the production is absorbed by the fresh fruit market. In the Brazil s citrus belt 86 %, of the production is destined for the processing industry. This is due to the characteristics of the oranges, which enable the industry to have a high efficiency in its conversion into FCOJ at 66°Brix. In the agricultural year 2009/10, the processing of 257 orange boxes was needed to produce 1 ton of FCOJ at 66°Brix. In general, 70 % of Brazil s orange production is destined for the processing industry.

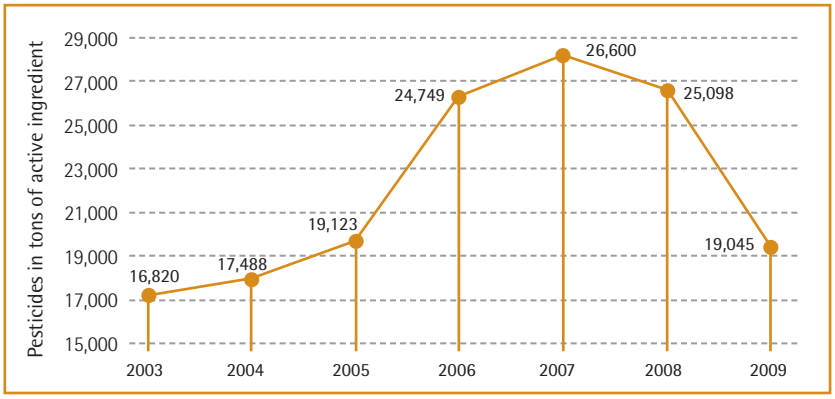
As shown in Graph 4, the citrus fruit (oranges, lemons/limes and tangerines) revenue in 2008/09 totaled US$ 2 billion. From the total production, 67 % was destined for the processing industry, 32 % to the internal fresh fruit market and 1 % was exported as fresh fruit. From the total of oranges processed by the industry, 35 % was produced by the industry, 34 % was bought from orange producers with pre-established long-term contracts and 31 % was bought from orange producers on the spot market.

Despite the fact that areas cultivated for oranges in Brazil have been reduced by 8 % since the beginning of 1990, production has increased by 22 % during the same period due to a dramatic increase in productivity. While in 1990 the national average for productivity was 380 boxes per hectare, in 2010 it increased to 475 boxes per hectare. A significant part of this increase is justified by the changes in the citriculture s technological standards,



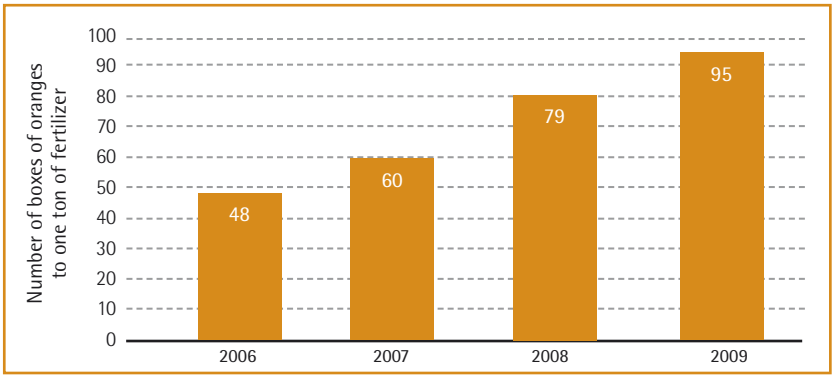

Graph 1: Sales of agricultural supplies link

© Neves and Trombin from data elaborated by Markestrat (2010)



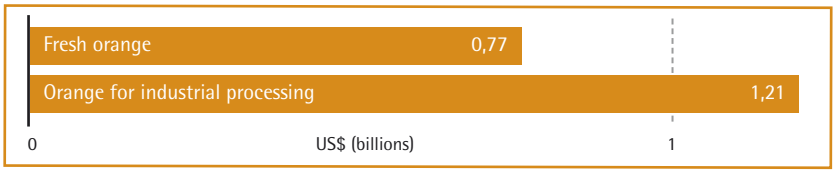

Graph 2: Evolution in pesticide consumption in citrus farming, from 2003 to 2009

© Elaborated by Markestrat with data from SINDAG




Graph 3: Exchange ratio between a ton of fertilizer and a 40.8 kg boxes of oranges

© Elaborated by Markestrat with data from ANDA.




Graph 4: Revenue from sale of citrus produce (oranges, lemons/limes and tangerines)

© Neves and Trombin from data elaborated by Markestrat (2010).

which are more enhanced in the citrus belt. This region currently contains over 80 % of the national citrus production. Although it is a continuous area, there are some particularities to each location. Therefore, to simplify the study and for a better understanding, in this research, following recommendations of specialists in the sector, the citrus belt was divided into five different production regions, illustrated in Figure 4 which also pinpoints where the processing industries are located.

Amongst the changes observed in the technological standards, it is important to note the increase in tree density within the orchards. In 1980 the average planting density was of 250 trees per hectare, in 1990 it was of 357 and in the early years of 2000 it was of 476. Currently, some of the modern orchards are planted with 833 trees per hectare. Other significant changes that positively impacted productivity include: the use of seedlings with better quality produced in nurseries following strict legislation and guidelines; advancements and application of expertise aiming at more efficient orchard management and gains in phytosanitary control quality; increase in use of irrigation systems in areas where water deficit problems are more severe; and new considerations in order to determine the optimum moment to renovate an orchard.

Within the citrus belt there was also a migration of the orchards from the regions North, Northeast and Central to the South and Castelo regions. This movement began in the year 2000 and was initially motivated by a more favorable climate condition, lower land values and an absence of threat to the orchards from diseases such as "citrus sudden death" and "citrus variegated chlorosis". Currently the main motivations for this movement include risk mitigation of the "greening disease", which has already affected 239 municipalities in the State of São Paulo, and the expansion of the sugarcane crop throughout the State of São Paulo, which has occupied citrus areas presenting lower productivity and inadequate profitability.

This reconfiguring of production location is evident in the Castelo region. Between 2005 and 2009 its number of trees has increased by 89 %, propelling the Castelo region from

| Municipality | Numbers of extractors | Industry |
|---|---|---|
| 01 Matao | 180 | Citrosuco |
| 02 Limeira | 60 | |
| 03 Bebedouro | 72 | |
| 04 Colina | 96 | Cutrale |
| 05 Araraquara | 84 | |
| 06 Conchal | 44 | |
| 07 Uchoa | 42 | |
| 08 Itápolis | 24 | |
| 09 Bebedouro | 84 | Dreyfus |
| 10 Matao | 70 | |
| 11 Eng. Coelho | 60 | |
| 12 Catanduva | 66 | |
| 13 Araras | 66 | |
| 14 Matao | 56 | |
| 15 Mirassol | 24 | Bascitros |
| 16 Dobrada | 12 | KB |
| 17 Rio Claro | 7 | Selial Citros |
| 18 Itajobi | 6 | Agromex |
| 19 Sao Carlos | 6 | Hildebrand |
| 20 Santa Cruz do Rio Pardo | 5 | Guacho |

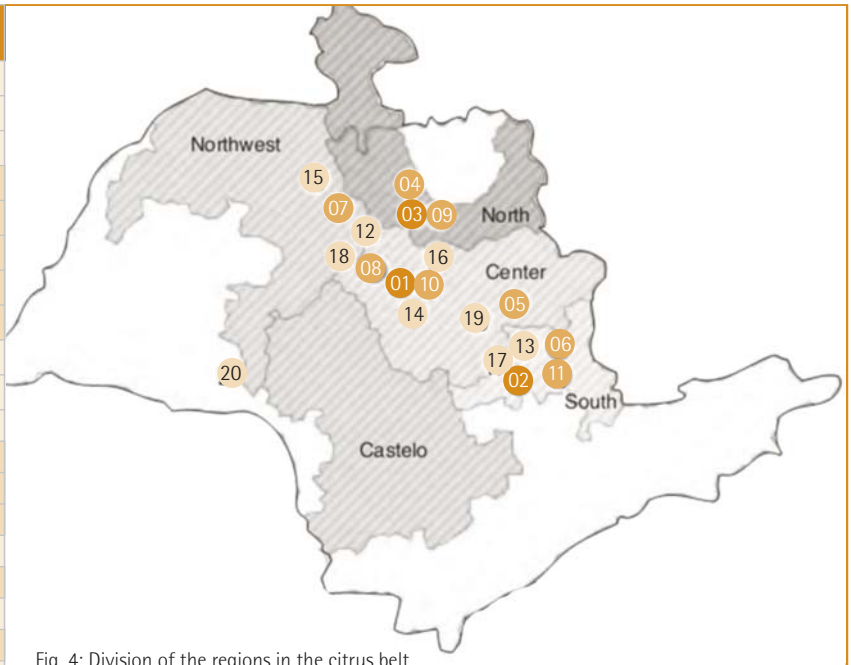



Fig. 4: Division of the regions in the citrus belt

© Elaborated by Markestrat with data from CitrusBR.

**TAB. 2: CITRICULTURE PRODUCTION DETAILS WITHIN THE BRAZILIAN CITRUS BELT**

| Harvest | Productive adult trees over 2 years of age (millions) | Productivity (boxes* per tree) | Production (millions of boxes) | Oranges to fresh fruit market (millions of boxes) | Oranges to industry (millions of boxes) | Industrial efficiency (boxe/ton of juice**) | Orange juice production (1,000 of tons) |
|---|---|---|---|---|---|---|---|
| 2005/06 | 159.3 | 1.9 | 303.4 | 38.1 | 265.3 | 228 | 1,164.5 |
| 2006/07 | 158.4 | 2.22 | 351.0 | 34.4 | 316.6 | 231 | 1,369.2 |
| 2007/08 | 159.6 | 2.23 | 356.0 | 38.3 | 317.7 | 233 | 1,362.7 |
| 2008/09 | 160.7 | 2.01 | 323.3 | 35.5 | 287.8 | 254 | 1,132.9 |
| 2009/10 | 164.2 | 1.93 | 317.4 | 43.3 | 274.1 | 257 | 1,064.7 |

* 40.8 kg boxes; ** orange juice at 66o Brix.

© Elaborated by Markestrat with data from CitrusBR and USDA.

last to second place in quantity of trees within the citrus belt. Also, 42 % of the new trees (from zero to two years of age) are concentrated in this region, meaning that its participation and importance in production will increase in the years to come.

The Brazilian citrus belt can also be characterized according to the producer s profile. The data for such characterization was provided by CitrusBR and was based on the producers who delivered oranges to the industry within 2009/10. It enabled the construction of the producer s profile for the first time, according to the industry s records regarding area, number of trees and volume produced.

The results show that 87 % of producers belonging to the citrus belt can be categorized as small (a total of 11,011 producers), with properties that have up to 20 thousand trees, and are responsible for 21 % of all trees. A total of 11 % of producers (a total of 1,496) are categorized as medium sized, with properties having 20 to 199 thousand trees, and contain 32 % of all trees. And only 2 % are categorized as large producers (total of 120), with properties that have over 200 thousand trees, and contain 47 % of all trees (Table 3).

The data also makes it possible to observe the increase, in number of trees, and the increasing participation of large producers. This is explained by the economy of scale obtained in larger properties which allows for gains in competitiveness due to a more efficient use of technology and orchard management. In other words, inefficient producers will be forced out of the activity due to their inability to compete with other players in the market. The producers that remain in citriculture must find the most appropriate path for their profile and determine a strategy to be followed, be it low cost, differentiation or diversification.

### *Citrus varieties*

The diversification of citrus varieties in an orchard is important because it allows producers to sell part of their crop during months with higher prices and also enables the industry to increase the period for fruit processing. It is al-

TAB. 3: BRAZILIAN CITRUS BELT PRODUCER S STRATIFICATION ACCORDING TO THEIR NUMBER OF TREES, FOR 2001, 2006 AND 2009

| Thousands of trees | 2001 | | | 2006 | | | 2009 | | |
|---|---|---|---|---|---|---|---|---|---|
| | Trees (%) | Producers (%) | Number of producers | Trees (%) | Producers (%) | Number of producers | Trees (%) | Producers (%) | Number of producers |
| > 400 | 16.15 | 0.15 | 23 | 33.65 | 0.35 | 46 | 39.25 | 0.40 | 51 |
| > 200 and < 399 | 7.65 | 0.25 | 38 | 8.05 | 0.55 | 73 | 7.35 | 0.55 | 69 |
| > 100 and < 199 | 10.60 | 0.70 | 105 | 8.10 | 1.05 | 139 | 8.95 | 1.30 | 164 |
| > 50 and < 99 | 12.40 | 1.75 | 263 | 11.45 | 2.70 | 356 | 10.75 | 2.95 | 372 |
| > 30 and < 49 | 12.30 | 3.15 | 473 | 7.70 | 3.35 | 442 | 7.00 | 3.50 | 442 |
| > 20 and < 29 | 8.95 | 3.90 | 585 | 5.50 | 3.80 | 502 | 5.30 | 4.10 | 518 |
| > 10 and < 19 | 16.45 | 14.50 | 2,175 | 9.45 | 11.35 | 1,498 | 8.00 | 11.15 | 1,408 |
| < 10 | 15.45 | 75.55 | 11,333 | 16.15 | 76.90 | 10,151 | 13.40 | 76.05 | 9,603 |
| Total | 100 | 100 | 14,995 | 100 | 100 | 13,207 | 100 | 100 | 12,627 |

© Elaborated by Markestrat with data from CitrusBR.

so a way for improving pest and disease management as well as reducing the impacts of adverse climate conditions.

Currently, the orchards located in the state of São Paulo grow 55 % of late season varieties (natal and valencia), 23 % of early season varieties (hamlin, westin, rubi and pineapple) and 22 % of mid season varieties (pera rio) (Figure 5). The preference for the late season varieties is due to their higher productivity. But this created a gap for mid season varieties, which have excellent characteristics for the fresh fruit market, increasing competition for oranges between the industry and the fresh fruit market during September.

It has been observed that in new trees (from ages 0 to 2 years) the percentage of early season varieties has increased to 29 %, indicating that producers are changing their orchard profiles in order to reduce the supply deficit from May to August. But the gap in mid season varieties still remains.

*Financial impacts of diseases in the Brazilian citrus belt*

Undoubtedly, cirtrus disease is one of the most important threats to the Brazilian citriculture. During the last decade, four diseases (citrus canker, CVC, sudden death and greening) alone were responsible for eradicating 39 million trees within the citrus belt. This increased the mortality rate from 4.5 % to 7.3 %, reducing annual production in aproximatly 78 million boxes of 40.8 kg, when considering an average productivity of two boxes per tree. This

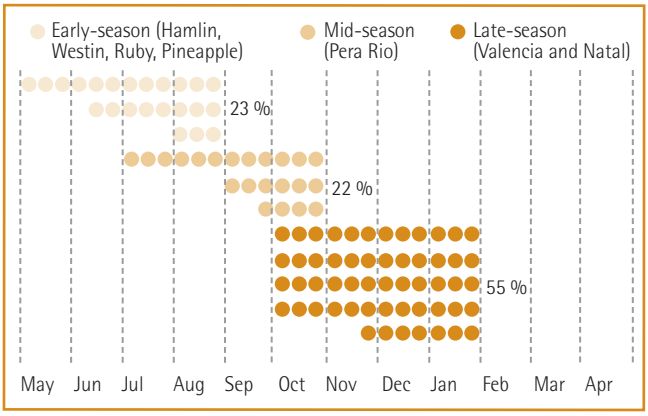



Fig. 5: Harvesting season by citrus variety and participation in production
© Elaborated by Markestrat with data from CitrusBR.

figure represents 25 % of the 2009/10 harvest of 317 million boxes of 40.8 kg (Table 4).

*Post Orchards*

The inputs acquired by packing houses and juice factories for citrus processing totaled US$ 360.9 million, as detailed in Graph 5. Electricity represented 24 % of the total value and BPF oil/bagasse 25 %.

In 2008/09 packing house revenue with fresh fruit was of US$ 1.8 billion, 96 % of which was obtained in the internal market. Fresh fruit wholesales revenue was of US$ 1.7 billion and the retailers obtained US$ 3.8 billion, of which 58 % came from orange sales, 17 % from lemon/lime and 25 % from tangerine.

TAB. 4: NUMBER OF THOUSAND OF TREES ERADICATED WITHIN THE CITRUS BELT DUE TO FOUR DISEASES FROM 2000 TO 2009

| Disease | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Citrus canker | 795 | 191 | 71 | 164 | 177 | 153 | 186 | 151 | 115 | 240 | 2,243 |
| CVC | 678 | 2,406 | 2,38 | 1,023 | 2,887 | 4,043 | 3,32 | 3,299 | 3,276 | 3,07 | 26,382 |
| Greening | - | - | - | - | - | | | 5,33 | | | 5,33 |
| Sudden death | - | - | | | 5,158 | | | - | - | - | 5,158 |

© Elaborated by Markestrat with data from Fundecitrus and CitrusBR.

Juice and sub product sales totaled US$ 2.2 billion, of which 95 % was obtained in the external market and 5 % in the internal market. From the revenue gained from exports, US$ 2.07 billion, 86 % came from juice (Graph 6). This value representing around 3 % of the countries agribusiness exports. Bottling companies, wholesalers and retailers presented the following revenue with orange juice or nectar, respectively, US$ 255.7 million, US$ 33.9 million and US$ 459.1 million.

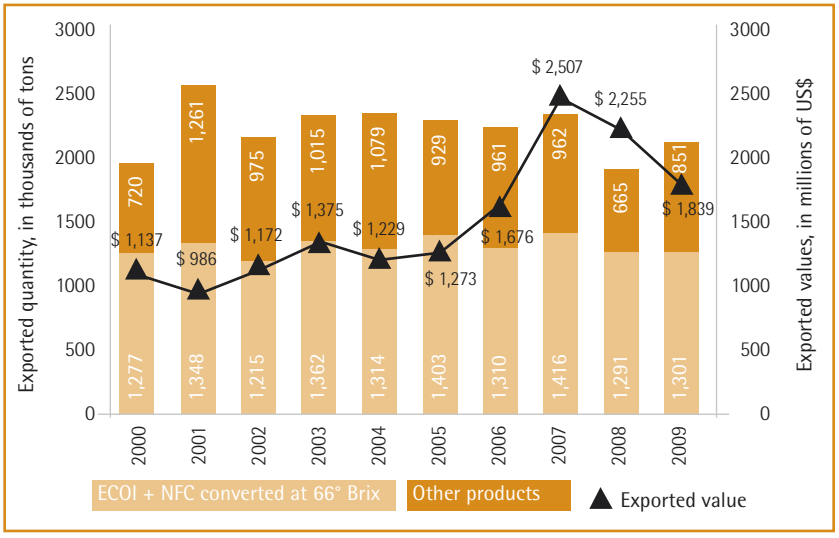
The numbers obtained for the Brazilian citrus industry are impressive. Brazil comprises 53 % of the world s orange juice production and exports 98 % of its production of the commodity. Between the years of 1962 and 2009, citriculture accumulated almost US$ 60 billions in export revenues, bringing an average of US$ 1.3 billion per year in foreign exchange. It is important to note that orange juice production worldwide has decreased by 13 % from the agricultural year 1995/96 to 2009/2010, the equivalent of 308 thousand tons. The State of Florida presented a decrease of 295 thousand tons and the Brazilian citrus belt (composed of the State of São Paulo and the Triângulo Mineiro region) of 31 thousand tons. But these two regions still account for more than 81 % of the world s production.

In 2002, the Brazilian citrus industry took an important step with the beginning of the NFC exports. This showed the industry s capacity to innovate before a change in consumer habits, switching to less processed products with a more natural image. NFC has a more pleasant taste because its flavor is more similar to fresh orange juice and its image is associated with a healthier product.

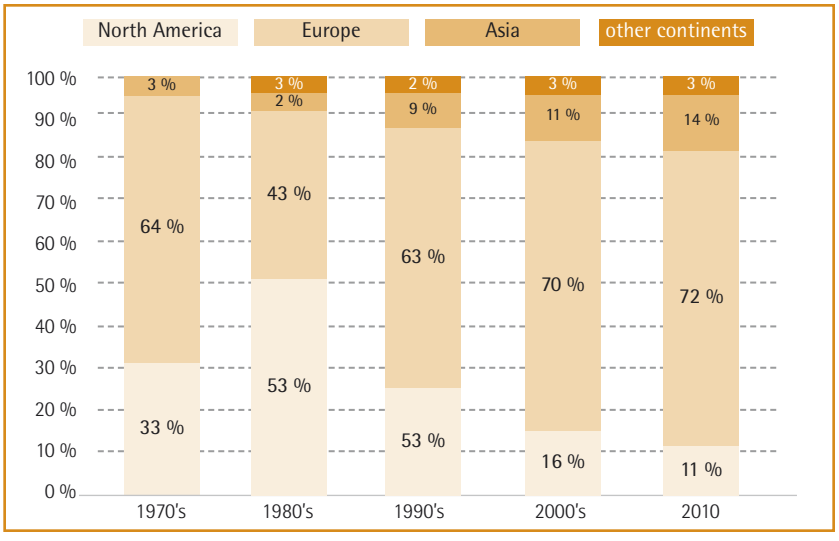
This same capacity innovate was again demonstrated during the past decade with the diversification of the exports destination as a response to the citrus industry s search for new and non saturated markets. Traditionally, Europe and USA imported together over 90 % of Brazil s orange juice exports. Currently, the most promising markets in growth potential are Asia, due to its population, and the Middle East, mainly because of the population s habit of not consuming alcohol. In 2009, Brazil exported orange juice to 70 different countries, of which twelve imported NFC (Graph 7).

| Industrial Inputs (US$ (million) | Gross Amount | Tax | Net amount |
|---|---|---|---|
| Electric power | 85,6 | 29,3 | 56,3 |
| Oil BPF | 76,3 | 18,7 | 57,6 |
| Packaging of Ready-to-Drink Juice | 46,7 | 13,3 | 33,4 |
| Ready-to-Drink Juice Bottling Activity | 37,8 | 0,0 | 37,8 |
| Lease of Extractors | 33,9 | 0,0 | 33,9 |
| Chemicals | 26,9 | 7,6 | 19,2 |
| Drum | 26,1 | 7,4 | 18,7 |
| Sugarcane bagasse | 12,9 | 1,2 | 11,7 |
| Wax | 8,6 | 1,7 | 6,9 |
| Pesticides | 5,3 | 0,0 | 5,3 |
| Plastic Bag | 0,9 | 0,3 | 0,7 |

Graph 5: Sales of the industrial inputs link of the supply chain
© Neves and Trombin from data elaborated by Markestrat (2010).




Graph 6: Brazilian citrus complex exports, from years 2000 to 2009
© Elaborated by Marketstrat with data from Cacex, Banco do Brasil and SECEX/MIDC




Graph 7: Brazilian FOCJ export destinations, by decade and in the year 2010
© Elaborated by Markestrat with data from Cacex, Banco do Brasil, Siscomex and SECEX/MDIC

In addition to the demand for less processed products and the need to search for new non saturated markets, the citrus industry export is also challenged with tax, phytosanitary and technical barriers which reduce its competitiveness in the international market.

With the exception of the USA, where Brazilian orange juice is taxed with a fixed value per ton, in other continents and countries, such as in Europe, Japan, South Korea, China and Australia, the tax value is calculated as a percentage of the financial volume imported. This tends to amplify the effect of a rise in orange juice prices in the international market to the final consumer because once orange juice prices rise, more taxes will be paid for the same quantity of the commodity. In 2009, orange juice exports from Brazil were taxed with US$ 260.4 millions.

Phytosanitary and technical barriers are related to package characteristics, consistency in product quality and punctuality in delivery. In Europe, for example, the main demands are product security (consumer health, contaminant levels, and pesticide residue), quality (sensational appeal and compliance with technical specifications), authenticity (adulteration and compliance with the legislation), traceability (product identification and readiness in identifying the source of any potential problem) and consumer perception (product image and origin).

*Facilitating agents*

The revenue for facilitating agents in the citrus production chain in 2008/09 was US$ 877.5 million. Regarding transportation, on average, over six trucks per hour passed through a tollbooth on their way to the Port of Santos. This made it possible for highway concessionaires to garner revenues of US$ 18.5 million, corresponding to 5 % of all freight expenses paid by the citrus sector, which totaled US$ 396 million. Diesel represented 9% of this total. Freight can be divided into primary, transportation from orchards to packing houses or the processing industry, which showed a total revenue of US$ 171.4 million; and secondary, which refer to transportation from packing houses to wholesalers or retailers, with total revenue of US$ 137 million, or to the port, with total revenue of US$ 2.7 million. Secondary freight can also refer to transportation between processing industry and port, with total revenue of US$ 85 million.

Regarding port costs, it is estimated that in 2008, the Port of Santos earned US$ 71 million storing oranges in warehouses and loading them on ships. It is important to state that 97 % of Brazil s orange juice exports were shipped through the Port of Santos.

Regarding payroll, the agricultural year 2008/09 ended with 132,776 employees in the citrus sector, of which 121,332 were registered in fruit production activities and 11,444 in the juice industry. During this period, over 69,000 workers were hired, contributing to the US$ 352.7 million paid in salaries and benefits.

*Aggregated taxes*

Total tax expenses were calculated by adding the taxes generated in each segment of the production chain, from the sales of agricultural and industrial inputs to the sales of final goods. From this total, taxes generated at the beginning of the production chain (agricultural and industrial inputs) were subtracted to eliminate double counting and to consider the aggregated taxes in the production chain. It was presumed that companies opted for the actual profit tax contribution system.

The results of this estimate indicates that taxes charged to the citrus production chain totaled US$ 339.4 million, of which US$ 150.67 were generated by agricultural and industrial inputs sales. This means that aggregated taxes were estimated at US$ 188.74 million.

## CONCLUSION

This work was able to present a method for both quantification and mapping of productive chains as well as to discuss some findings relevant for its applications in the citrus production chain in Brazil. Brazil has achieved high efficiency in the citrus production chain. This efficiency includes everything from certified plant nurseries and seedlings, to the planting and cultivation of oranges, to the production and international distribution of orange juice through integrated bulk cargo systems that include tanker-trucks, port terminals, and dedicated ocean vessels that ship citrus products to consumers in Europe, North America and Asia, with dozens of different specifications and blends for the most diversified applications and unmatched excellence. All with Brazilian competence and know-how. Brazil produces half of the orange juice on the planet, the exports of which bring in US$ 1.5 - 2.5 billion to Brazil yearly. In roughly 50 years, the supply chain has brought Brazil nearly US$ 60 billion (at today's prices) directly from the world's orange juice consumers.

This wealth is distributed to hundreds of enterprises directly involved in the sector, on thousands of orchards, generating over 200,000 direct and indirect jobs, paying taxes, and serving as a driving force for establishments and many other companies located in nearly 400 municipalities in the state of São Paulo dedicated to growing oranges, accounting for 80 % of Brazil's overall production. In fact, oranges are grown in more than 3,000 municipalities across Brazil.

## REFERENCES


- ANDA, 2010. National Association for Dissemination of Fertilizers. Available at <http://www.anda.org.br>. Acesssed 17 October 2010.
- Batalha, M.O., (org), 2001. Agribusiness Management. 2ª ed., São Paulo: Atlas, 2001. v. 1, 23–63.
- Batalha, M.O., and A.L. Silva, 2001. Agribusiness Management Systems: Current and Methodological Definitions. In: Batalha, M.O. (Coord.). Agribusiness Management. 2ª ed. São Paulo: Atlas, v.1, pp. 23–63.
- CitrusBR, 2010. Brazilian Association of Citrus Exporters. Available at < http://www.citrusbr.com> Accessed 28 October 2010.
- Consoli, M.A., and M.F. Neves, 2006. Strategies for Milk in Brazil. 1st ed., São Paulo: Atlas, 291 pp.
- Goldberg, R.A., 1968. Agribusiness coordination: A system approach to wheat, soybean and Florida orange economies. Division of Research, Graduate School of Business and Administration, Harvard University, 256 pp.
- Hardman, P.A., M.A.G. Darroch, and G.F. Ortmann, 2002. Improving cooperation to make the South African fresh apple export value chain more competitive. Journal on Chain and Network Science, v. 2, n. 1, 61–72.
- Lazzarini, S.G., F.R. Chaddad, and M.L. Cook, 2001. Integrating supply chain and network analyses: The study of net chains. Journal on Chain and Network Science. v. 1, n. 1, 7–22.
- Malhotra, N. K., 2001. Marketing Research: an applied orientation. 3.ed. São Paulo: Bookman.
- Mattar, F. N., 1993. Marketing Research - compact edition. São Paulo: Atlas.
- Morvan, Y., 1985. Filière de Production, in Fondaments d'economie industrielle, Economica, 199–231.
- Neves, M.F., 2007. A Method for Demand Driven Strategic Planning and Management for Food Chains (The ChainPlan Method). In: 17th Annual World Forum and Symposium - Food Culture: Tradition, Innovation and Trust - A Positive Force for Modern Agribusiness, 2007, Parma, Italy: June.
- Neves, M.F., R.M. Rossi, L.T. Castro, F.F. Lopes, and M.K. Marino, 2004. A framework for mapping and quantifying value chains towards collective actions. European Marketing Academy, Murcia. International Food Agribusiness Management Association, Montroeux.
- Neves, M.F., and F.F. Lopes, 2005. Strategies for Orange in Brazil. 1. ed. São Paulo: Atlas, 224 p.
- Neves, M. F.; Trombin, V.G., 2011 (Coord.). The Orange Juice Business: a Brazilian Perspective. Holanda: Wageningen Academic Publishers. 176 p.
- Neves, M.F.; Trombin, V.G.; Consoli, A.M. Mapping and Quantification of the Sugar-Energy Sector in Brazil. In: Proceedings of 2010 IAMA (International Food And Agribusiness Management Association) World Symposium & Forum, 2010, Boston, MA, USA.
- Omta, O., J. Trienekens, and G. Beers, 2001. The knowledge domain of chain and network science. Journal on Chain and Network Science, v. 1, n. 2, 77–85.
- Rossi, R., and M.F. Neves, 2004 . Strategies for Wheat in Brazil. 1. ed. São Paulo: Editora Atlas, 224 pp.
- SECEX/MDIC, 2010. Ministry of Development, Industry and Foreign Trade of Brazil. Available at < http://mdic.gov.br> Accessed 7 October 2010.
- SINDAG, 2010. National Union of Crop Protection Industry. Available at < http://mdic.gov.br> Accessed 7 October 2010.
- SISCOMEX, 2010. Integrated Foreign Trade System. Available at <http://www.receita.fazenda.gov.br> Accessed 09 July 2010.
- Zylbersztajn, D. Neves, M. F. (org.), 2000. Economy & Business Management Agrifood. São Paulo: Pioneira, 2000. 428 p.
- USDA, 2010. United States Department of Agriculture. Accessed < http://www.usda.gov> Accessed 09 July 2010.
- VILELLA, F. et al, "El sistema de Agronegocios de la Soja en Argentina, su cadena y prospectiva al 2020", Bayer, ACSOJa, Programa de Agronegocios y Alimentos, Facultad de Agronomía, Universidad de Buenos Aires, 2009


## ACKNOWLEDGMENTS

This would not have been possible without the support of various governmental and research institutions whose studies have been contributing to Brazil's worldwide leadership in citrus production. In order for the study to be completed, it was also fundamental for data to be made more openly available from the agricultural supply companies, growers, juice exporting industries, smaller-sized orange juice factories, packing houses, bottling plants and distribution channels.

## AUTHORS

Marcos Fava Neves, Vinícius Gustavo Trombin
University of São Paulo; School of Economics, Business and Accounting of Ribeirão Preto

BR–14025-640 Ribeirão Preto - SP – Brazil

**www.usp.br**