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Evaluating Sustainable Competitive Advantages in Brazilian and U.S. Processed Citrus Supply Chains: An Application of Porter's Diamond Framework

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ABSTRACT

The processed citrus industries of Sao Paulo, Brazil and Florida, United States collectively account for over 80 percent of world orange juice production. In recent years, both industries have been confronted with serious plant disease outbreaks. Porter's Diamond framework is used to assess the strengths and weakness of the processed citrus industry in each country to confront the combined challenge of effectively combating these diseases while maintaining market competitiveness. Although Sao Paulo and Florida produce a similar product, the Porter's Diamond framework reveals that there are significant differences in the organizational structure of the two industries. The article concludes with an analysis of how these differences will impact each industry's ability to sustain its global leadership in the international processed citrus market.

Keywords: orange juice, Porter's diamond, competitive advantage

1 Introduction

The states of Sao Paulo, Brazil and Florida, United States collectively dominate the world supply of orange juice. Collectively, these two regions account for over 80 percent of world processed orange juice production. Florida is the prime supplier to the United States and Canada, while Sao Paulo dominates world trade of orange juice and is the primary supplier to the EU market. It is these three markets—the United States, Canada and the European Union—that represent the vast majority of global consumption of processed orange products (Table 1).

The global dominance by these two national industries is being threatened. Both the Florida and Sao Paulo citrus industries are experiencing outbreaks of the same potentially devastating diseases – citrus canker (*Xanthomonas axonopodis pv. citri*) and citrus greening (*Liberibacter asiaticus*). Citrus canker forms lesions on fruit, causing premature fruit drop and rendering the fruit unsuitable for fresh market sales. "In addition to lowering yields, there is likely some increase in tree mortality as canker may open pathways for other diseases... [though] tree mortality is not the major concern with endemic citrus canker (Spreen, et al., 2006, p. 14-5)." On the other hand, citrus greening, as observed in Asia, has had devastating effects on citrus production, leading to high rates of tree mortality. As the presence of greening is relatively new to both Sao Paulo and Florida, the actual magnitude of this threat is still unknown, but most industry observers are openly concerned about the potential for significant losses of citrus trees.

Each of these national industries' capacity to respond to these outbreaks will ultimately determine their relative competitiveness and perhaps even if either will remain viable producers of citrus products in the near future. In this paper, "Porter's Diamond" is used as a framework to compare and contrast the processed orange industries of Sao Paulo and Florida. In particular, we seek to investigate the ability of these two regions (i.e., the respective "networks" or "clusters" of processed-citrus related firms and industry activities) to deal with the challenges brought by outbreaks of these diseases. Thor (2006) provides an example of this type of analysis in his research on the Argentina and Uruguay beef systems. Serra, et al. (2005) provides a similar example of this type of application of Porter's Diamond in their comparative analysis of the Uruguayan and New Zealand beef industries. As Serra, et al. note, Porter's Diamond is not without its critics (e.g., Grant, 1991; Davis, Ellis, 2000), but it "remains a widely used framework for analyzing the resources and constraints that influence industry competitiveness (p. 138)." Even Davis and Ellis acknowledge in their very detailed critique of the *Competitive Advantage of Nations*, Porter's Diamond is, despite its theoretical shortcomings, a "useful taxonomy (p. 1189)".

Porter's Diamond framework has been widely applied to various research settings. For example, a quick search of the ABI/Inform database generates over 170 journal articles and 15 unpublished Ph.D. dissertations that specifically cite Porter's Diamond. Additional examples from the agricultural and food sector include analyses of the Dutch flower industry, the South African beef supply chain, the Belgium pork processing industry, the South African food and fiber complex, and the role of agro-food clusters in the economies of developing countries (van Hermert, 2005; Olivier, 2004; Gellynck, 2002; Esterhuizen et al., 2001; Neven, Droge, 2001, respectively).

2 Porter's Diamond

Michael Porter introduced the concept of Porter's Diamond in 1990. He states that "competitive advantage is created and sustained through a highly localized process." He goes on to note that differences in a country's or a region's economic structures, values, cultures and institutions affect its competitiveness along with the traditional notions of resource endowments and factor prices. The four "pillars" of his diamond are factor conditions, demand conditions, firm structure and strategy, and related and supporting industries. Chance (i.e., invention and entrepreneurship) and the government are auxiliary factors that influence the four pillars of the diamond. He also rejects the traditional notion of "industry policy," arguing that competitiveness (specified as relative productivity) is fostered by location-specific clusters of inter-related firms and activities.

In applying his diamond framework, Porter focuses on an industry's capacity to improve, innovate and grow—all factors related to an industry's potential to expand and capture more global market share. Embedded within Porter's framework is a fundamental assumption that growth and relative productivity will determine an industry's long-term sustainability. Missing from this analysis is any notion of capacity to respond to crisis. Though Porter readily acknowledges that "change is relentless," this change is presented primarily as a positive progression of improvement, innovation and growth. The possibility of a threatening, potentially devastating event tangential to markets and competition is not a type of change explicitly addressed. All industries, but particularly agricultural industries, have exposure to these types of threatening events. In the case of agriculture, this exposure is an inevitable consequence of the biological nature of crop and livestock production—bad weather, disease outbreaks and pest infestations are calamities that happen. This then begs the question, "In international agricultural and food markets, is the long-term competitive advantages of a nation's various agricultural and food industries a function, not only of each industry's capacity to improve, innovate and grow, but also a function of its capacity to respond to a crisis?"

3 Determinants of advantage

Factor Conditions: Historically, the citrus industries of both Florida and Sao Paulo benefited from their national endowments of "basic factors," including an abundance of suitable land and favorable growing conditions. Both industries also evolved in ways that built upon the comparative advantages of these basic factors to create "advanced factors" to sustain their competitive advantages in the market place. In Florida, these included an expertise in consumer-focused marketing of retail, value-added, processed orange juice products. In Sao Paulo, these included expertise in exporting, including the logistics associated with shipping orange juice and the management of international trade and exchange rate risks. Neither region has developed advanced factors for addressing the specific disease outbreaks noted above, but the U.S. land grant university system and its network of research stations and extension programs do represent a type of advanced factor endowment that increases Florida's capacity to respond to general

production-related calamities such as disease outbreaks. Partnerships also exist between the United States Department of Agriculture (USDA) and state-funded University of Florida in terms of research related to citrus tree production and the diseases that affect those trees.

As both industries look forward, both will have their competitive advantages eroded due to threats confronting basic factor conditions. Sao Paulo is, in addition to citrus, the major sugarcane producing region of Brazil. With high crude oil prices, Brazil is seeking to expand its already successful ethanol-from-sugarcane program. As sugarcane is a crop with much less production risk compared to citrus, land is being redirected away from citrus and into sugarcane production (Reuters, 2009). In Florida, the competing “enterprise” has been population growth and increased demand for land for urban use. The market value and price of undeveloped land in Florida rose dramatically in the decade extending from 1997-2007, but the financial crisis of 2008-09 has caused a rapid shift in that trend. Therefore, conversion of agricultural land into urban use was an important factor affecting the price of land for Florida citrus, but that situation was reversed dramatically with the bursting of the real estate bubble in the United States and particularly in Florida. Long-term trends in Florida, however, suggest that urban encroachment will remain a threat to the industry.

Demand Conditions: Historically, Florida has aggressively sought to develop domestic demand for processed orange juice. Starting in the 1950s with the formation of a state marketing order to fund generic advertising that promoted the consumption of orange juice in the United States, the Florida industry has benefited from strong domestic demand. These efforts have generated significant positive returns on investments in advertising (Capps et al., 2003; Ward et al., 2005), and are estimated to have significantly increased demand for processed orange juice. U.S. consumers have evolved into demanding buyers, who are willing to pay premiums for high quality products such as not-from-concentrate (NFC) orange juice. These demand conditions fit Porter’s framework for fostering competitive advantages (i.e., strong domestic demand fosters domestic industries with greater international competitiveness). The opposite is true for Sao Paulo. Virtually none of the processed orange juice made in Sao Paulo is consumed domestically. It is an industry that is completely dependent upon export markets.

Related and Supporting Industries: Though specialized to meet the contrasting needs of the two industries (one domestically focused, one export focused), both the Florida and Sao Paulo industries benefit from extensive networks of related firms and activities (i.e., well developed “clusters” exist in both locations).

In Florida, the growing demand for processed orange juice in the 1950s and 1960s sparked the development of an extensive network of supporting firms and industries that exist to this day. Input suppliers of fertilizer and agricultural chemicals, harvesting and transportation services, specialized containers for both fruit and juice, tree nurseries for new trees, and irrigation and engineering firms for new grove development all came into being. Similarly, networks of growers and processors were linked through an array of institutional arrangements. These include grower associations to collectively process and market orange juice, intra-firm vertical integration to lower transaction costs, multi-year delivery contracts to assure price and supply stability, and forward pricing arrangements for current year harvests to effectively manage price risk.

In Sao Paulo, the specific context of the development of the industry allowed for a greater focus on economies of scale within participating firms, which in turn allowed for more reliance on vertical integration and less reliance on external networks of input suppliers and downstream industries. The founding of the processed orange industry in Sao Paulo was initiated in 1962 when a major winter freeze in Florida destroyed much of that state’s harvest and killed a significant number of the citrus trees in Florida. In response to these losses, a major grower-processor based in Florida established a joint venture with a Brazilian firm. This push by the Florida firm to reduce its exposure to weather-related production risk was almost exclusively focused on finding an alternative production zone with the same basic factor conditions as Florida. Sao Paulo fit that need, yet this new industry grew slowly at first. Only in the 1980s, when Florida was struck with a series of severe freezes over several years did the Brazilian industry see significant growth as other firms began to invest in Sao Paulo citrus production and processing. By this time, advances in processing technologies, particularly with aseptic bulk storage, fostered the development of an extensive network of Sao Paulo-based firms capable of large-scale storage and transport of orange juice. Today, this includes a fleet of aseptic transport ships, some large enough to transport over a million gallons of orange juice, that delivers to importing countries around the globe. This fleet is served by modern, state-of-the-art port facilities built specifically to serve the Brazilian processed orange juice industry.

Firm structure and strategies: Two clear differences exist. One major difference is in the degree of vertical integration. In Sao Paulo, all of the large citrus processors have backward vertically integrated, owning large holdings of citrus groves. In Florida, processors do not own orange groves, with the only exceptions

being cases of farmers acting collectively (either through a cooperative or through private joint ventures) to forward vertically integrate into processing.¹ In Florida, a large portion of citrus production is in absentee ownership. Investors from outside the industry commit capital to purchase groves, but grove care is provided by custom caretaking companies. Generally, the expertise of the custom caretaking operations is quite high. In many cases, these service providers are farmers who have expanded horizontally to offer grove management services to absentee owners. The high capital requirements associated with citrus groves means that economies of scale can be realized even with a diffused ownership structure. In Sao Paulo, the ownership structure is quite different. As noted above, there are large processor-owned farms with high levels of expertise. There are also other large farms that do not own processing assets; they typically have long-term contracts with processors at fixed prices. There are also a significant number of smaller land holdings, but there are virtually no custom caretaking services available. Therefore, smaller land holdings represent small, independent farmers who must do their own grove maintenance.

Government: Active government partnerships with industry and other forms of support are almost completely absent in Sao Paulo's citrus industry. The industry self-finances an entity called FUNDECITRUS, which conducts the majority of research related to orange tree production. Unlike Florida, the government does not oversee the transaction between grower and processor. Statistics related to production, price, cost of production, and utilization are generally not publicly available in Sao Paulo. The United States Department of Agriculture (USDA) *Citrus Report* on Sao Paulo is probably the more reliable source of accurate information on orange production, orange tree numbers and other production statistics. The Brazilian government does enforce labor laws and requires significant non-wage costs for citrus workers. There are also laws related to the environment that restrict the percentage of land that can be used for citrus production.

In stark contrast to the situation in Brazil, the government plays an active role in Florida, especially in monitoring grower-processor transactions, data gathering, and research and development. The state government of Florida is responsible for weighing and inspecting fruit at delivery to the processing plant. Since payment is made based upon juice content, the government samples each load delivered and estimates juice content. Government also conducts bi-annual surveys to establish tree numbers; it publishes annual reports on production, price, and utilization. The USDA and the University of Florida are primary sources of research and development related to tree production, harvesting technology and irrigation. This publicly-funded university also annually publishes reports on costs of production. There also is the Florida Department of Citrus, which is a state government entity that administers the generic advertising program to promote orange juice consumption.

The role of government and culture-related land use policy is another dichotomy between the two industries. Sao Paulo is characterized by large vertical cities. Compared to the United States, there is little urban sprawl in Sao Paulo. This pattern of living likely stems from a policy of expensive energy and automobiles, and strict regulation of conversion of farmland to urban use. On the other hand, the United States, in general, and Florida, in particular, have long pursued policies of cheap energy through low consumption taxes and little restriction on the conversion of land from agriculture to urban use. These two factors have combined to encourage urban sprawl, with single family, detached homes being the predominate form of housing in Florida.

4 Implications for sustaining advantages

These differences across Porter's "determinants of competitive advantage" suggest that each industry is vulnerable to the disease outbreaks, but Florida appears better positioned to sustain its competitive advantages in citrus processing. This conclusion is based on the following analysis of the information in the preceding section of the paper.

As noted in the preceding discussion, the major dichotomies between the citrus industries of Florida and Sao Paulo can be categorized in four major areas: (1) government involvement, (2) ownership structure, (3) markets served (export versus domestic), and (4) urban sprawl. Each of these factors is discussed in reverse order.

4.1 Urban Sprawl (and subsequent changes in factor conditions)

Although not the explicit topic of this paper, urban sprawl is providing a powerful effect on competitive advantage in Florida through its effect on factor prices. While land prices are more directly affected by

¹ There is one exception to this observation in Florida. A large agribusiness company owns both citrus groves and citrus processing facilities. Its share of processed orange capacity in Florida, however, is less than 15 percent.

urban sprawl, this phenomenon also affects labor costs by drawing labor away from agricultural markets into non-agricultural markets (e.g., construction, landscaping, and food-service). There is also increasing public pressure to increase the minimum wage for all workers in the United States and to tighten immigration laws. Immigrant labor is the primary source of harvest labor for a wide range of crops in the United States including citrus. With Sao Paulo's apparent willingness to live in vertical cities and a low wage policy towards agriculture, it is clear that in terms of factor prices, Sao Paulo will gain an increasing competitive advantage in its set of basic factor conditions.²

4.2 Markets served

Although consumer demand has stagnated in the United States and Canada, the North American orange juice market remains the largest in the world. Per capita consumption growth in much of Western Europe has also slowed, but new markets are emerging in former Eastern European countries and in Russia and China (Table 1). Given its wide advantage in logistics, the industry of Sao Paulo is better positioned to serve these new markets compared to its Florida counterpart.

A question emerges, however: How will consumers react across all markets if supply is limited by the impact of new diseases, which very likely will lead to price increases for consumers? Florida continues to invest in market development through its generic advertising program while the citrus industry of Sao Paulo has shown no interest in generic promotion activities. With limited supplies, will the industry in Florida be able to sustain demand in face of price increases as the industry internalizes the cost of dealing with new disease threats? Will U.S. consumers continue to support orange juice produced in Florida over imported products? Given its historic competitive advantage in the U.S. market, will Florida continue to make the necessary investments to retain this advantage in the North American market? An affirmative answer to one or all of these questions suggests that a large domestic market can still be exploited by a Florida-based processed orange industry. This should give Florida a growing competitive advantage in relative demand conditions.

4.3 Ownership structure and related industries

The citrus industry of Sao Paulo is highly vertically integrated, with all of the major processors being among the largest growers. Given the capital available to these companies, it is likely that they will develop the capability of dealing with citrus canker and citrus greening. They not only can fund internal research, but also can access research results from other citrus producing countries including the United States. Other large growers in Sao Paulo with sufficient capital reserves will also likely survive as new management strategies evolve that deal directly with the disease threat. The group at risk, however, is small growers (less than 200 hectares) who likely represent about 20 percent of the citrus produced in Sao Paulo.³ With the lack of publicly available research related to citrus production, lower financial reserves and a lack of know-how for managing disease outbreaks, this group may find it difficult, if not impossible, to survive in an environment with substantial higher costs of production and more intensive management. These observations suggest a smaller, more concentrated citrus industry in Sao Paulo emerging as the full impact of diseases is realized.

The ownership structure in Florida is more diffused, with a high degree of absentee owners. There is little structured vertical coordination between citrus growing and citrus processing. At first glance, this type of structure would seem to leave the Florida industry relatively more vulnerable to the challenges currently emerging from the disease threats. The widespread existence of citrus management companies, however, mitigates this apparent disadvantage. Growers of any size can access citrus grove management practices as these practices are developed and given their general level of education and training, management companies will be able to quickly develop a high level of expertise in new practices. And with widespread publicly available information regarding new production practices, these companies will quickly adapt as new information becomes available regarding strategies to combat new diseases. Our conclusion is that the Florida industry has the resilience to withstand the impact of new diseases assuming that management tactics can be successfully developed that control effects of the diseases. It is likely, however, that some contraction of production will occur, accompanied by higher U.S. retail prices for orange juice and higher input costs for growers.

The implication, therefore, is mixed. Sao Paulo's large-scale, vertically integrated industry structure will likely provide "deep pockets" and rapid adoption of management strategies for dealing with the diseases. Florida's diffused ownership and more broadly diffused production expertise and production-related

² As shown recently by Boteon (2009), however, Sao Paulo has seen rapid land price increases over the past 10 years. She argues that this is likely explained by the expansion of Brazil's sugarcane industry and its concomitant expanded production of ethanol.

³ Reliable data on the distribution of size of grower in Sao Paulo is not available. This estimate is an "intelligent guess" made by the authors based upon recent visits to Sao Paulo and conversation with growers/experts there.

support industries will likely provide the flexibility and adaptability needed for combating and overcoming the disease outbreaks. Hence, both industries are likely to find the means for sustaining their competitiveness within their own, albeit different, industry structures.

4.4 Government involvement

Government involvement marks one of the greatest distinctions between the citrus industries of Florida and Sao Paulo. From oversight of grower-processor transactions to funding of research and development, the government of Sao Paulo and the federal government of Brazil are virtually absent in citrus. Therefore, the resources of the government are not readily available to fund new research to understand the biology of these new diseases and develop tactics to offset their impact on citrus production. It is likely that long-term solutions to citrus canker and greening in the form of disease-resistant varieties, pesticides to attack the vector that spreads citrus greening and other management strategies will be developed in Florida. Florida growers will have first access to these discoveries. Our conclusion is that the collaborative networks that have long existed between the Florida citrus industry and state and federal governments will serve the Florida industry well in this time of stress, and will have a very positive effect on Florida's ability to sustain its competitive advantages in the world processed citrus market.

We recognize that "knowledge" is a high exclusion cost good. And as such, the Sao Paulo industry will be able to observe and import solutions to these disease outbreaks as they are made available in Florida. As Cartwright (1993) notes, this is a useful strategy for export-dependent industries, which follow a "double-diamond" approach to creating their international competitive advantages. This ability, however, is tempered some by the biological nature of the problem at hand. Production conditions in Sao Paulo are similar to those in Florida, but not identical, and the transferability of disease-fighting management practices may not be costless or comparatively as effective.

5 Stages of industrial development

A second set of assertions found in Porter's *Competitive Advantages of Nations* builds upon his Diamond Analysis. In particular, he asserts that countries evolve through a series of industrial development stages, and for each stage, the relative importance of each corner of the diamond alters as does the origin of a given industry's competitiveness. The four stages, in order of development, are the factor-driven stage, the investment-driven stage, the innovation-driven stage, and finally, the wealth-driven phase. According to Porter, it is only in the innovation-driven stage that the full impact of the four pillars of the diamond can be realized and truly sustained competitive advantage reached. As with the Diamond itself, these assertions are not without critics (e.g. Reich, 1990, as cited by Davies, Ellis, 2000), but the assertion that industrial development can evolve over time and that this evolution can impact an industry's international competitiveness is a useful guide for further analysis of the case at hand.

In terms of the Brazilian and U.S. processed orange juice industries, there are differences in the two industries' stages of development, and these differences may impact each industry's ability to remain competitive as each attempts to manage their responses to the disease outbreaks noted earlier. By the authors' own assessment, the Sao Paulo industry has been moving, during the past 15 years from the investment-driven stage to the innovation-driven stage. The assessment is based on the following observations – first, Sao Paulo became a global supplier of processed orange juice because of its very significant investments in technologies and firm structures that created and sustained economies of scale and global price competitiveness. This was the basis of the industry's evolution from a factor-driven to an investment-driven industry. Second, the Sao Paulo industry, in more recent times, has spent considerable effort in creating innovative technological advances, particularly in large-scale aseptic storage and transport. Their innovations have extended the benefits of economies of scale to high-end niche marketing of not-from-concentrate (NFC) orange juice. Hence, through innovation, the Sao Paulo orange juice processing industry has been able to sustain its global competitive advantage.

Florida's processed orange juice industry has a long history of innovation, not only in processing technologies, but also in institutional arrangements within its supply chain as well as in consumer marketing. These numerous innovations have sustained the industry's competitive advantages for decades, and provide an industry "culture" and set of relationships that spur and support innovation. That said, the authors believe that the Florida industry has been migrating to the wealth-driven stage of industry development, particularly with both the threats of urbanization (i.e., land owners "cashing in" by selling orange groves to developers) and the emergence over the past three decades of the diffused ownership structure noted earlier. With much of Florida's production acreage now owned by absentee owners who have invested in the industry as a means of wealth generation, the assertion that the industry is evolving to Porter's fourth stage of industry development appears valid.

The implications of these differences in industrial development are not straightforward, though the authors believe the orange processing industry that is better suited to foster innovation will be more likely to address the threats of the disease outbreaks, and hence maintain its international competitiveness. Sao Paulo's adoption of innovative technologies suggest that it is developing the capacity to be innovative, though to date, these innovations have been narrowly focused on technologies that create efficiencies in logistics and supply chain management, and much less so in grove production or new product development. Florida's long history of innovation throughout the supply chain will likely prove a better environment for effectively responding to the diseases. Yet, this assertion is not without the caveat that the Florida industry will need to reinvest in innovations to maintain its market share and not look to "harvest" wealth from the industry, which would ultimately lead to the industry's demise.

6 Summary and conclusions

In this paper, Michael Porter's "Diamond" and related ideas are used as a conceptual framework to compare the competing processed orange industries of Sao Paulo, Brazil and Florida, United States. We have extended Porter's original model to include an industry's ability to react to negative change forces that threaten an industry's competitive advantage. Specifically, our analysis has focused on a given industry's ability to respond to disease outbreaks, a type of non-market based threat particularly relevant for agricultural and food industries.

Disease outbreaks will force both industries to seek new and creative ways to manage basic factor endowments, leverage these basic factors into new and innovative advanced factor endowments, and evaluate both current firm strategies and existing government policies. The likelihood that either industry will completely abandon its historic market shares is unlikely, as neither industry appears prepared to divest completely from past investments, and both industries are supported by extensive networks of related industries. Consequently, both citrus processing industries are likely to seek strategies to preserve their market dominance. As noted in the analysis section of this paper, the current state of affairs in the two regions favors Florida's ability to more effectively respond to the disease outbreaks. This observation, however, must be guarded, as Porter himself notes that competitive advantages can be fleeting, and any of the determinants of competitive advantage can change (and/or be changed).

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