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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 production (Spreen, et al). 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 EU—that represent the vast majority of global consumption of processed orange products (Spreen).

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., p. 14-5).” On the other hand, citrus greening, as observed in Asia, has had devastating effects on citrus production, leading to very high rates of tree mortality. As greening is quite 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, the “Porter 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. Serra, et al. provide an example of this type of application of Porter’s Diamond in their comparative analysis of the Uruguayan and New Zealand beef industries. As these authors note, Porter’s Diamond is not without its critics (e.g., Grant, Davis and Ellis), but it “remains a widely used framework for analyzing the resources and constraints that influence industry competitiveness (p. 138).” 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; Olivier; Gellynck; Esterhuizen, et al; Neven and Droge, respectively).

Porter's Diamond

Michael Porter introduced the concept of Porter's Diamond in 1990. He states "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, firm structure and strategy, demand conditions, 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 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?"

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 competitive advantages of these basic factors to create "advanced factors" to sustain their 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 an 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 like the disease outbreaks. Partnerships also exist between the United States Department of Agriculture (USDA) and the 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, increasingly land is being attracted away from citrus and

into sugarcane production. In Florida, the competing “enterprise” is population growth and increased demand for land for urban use. The market value and price of undeveloped land in Florida has risen dramatically over the past decade limiting its use in agriculture, including citrus.

Demand Conditions: Historically, Florida has aggressively sought to develop domestic demand for processed orange juice. Starting in the 1950s with the formation of a marketing order to fund generic advertising that promoted the consumption of orange juice in the U.S., the Florida industry has benefited from strong domestic demand. And, U.S. consumers have evolved into very 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. 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, from vertical integration to multi-year delivery contracts to forward pricing for current year harvests.

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 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’s groves. In response to these losses, a major grower-processor 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 million gallons of orange juice to importing countries around the globe.

Firm structure and strategies: Two clear differences exist. One major difference is in the degree of vertical integration. In Sao Paulo, large processors with significant market share, 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 processing¹. Second, 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 diffuse 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 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. On the other hand, the government plays an active role in Florida, especially in monitoring grower-processor transactions, data gathering, and research and development. State government 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 cost 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. 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 still being the predominate form of housing in Florida.

1. There are two exceptions to this observation in Florida. Two large agribusiness companies own both citrus groves and citrus processing facilities. Their collective share of processed orange capacity in Florida, however, is less than 20 percent.

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.

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 urban sprawl, this phenomenon is also affecting 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. Immigration labor is the primary source of harvest labor in the United States. 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.

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, China and India. 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 and inevitable price increases? 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 product? Given its historic competitive advantage in the U.S. market, will Florida 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.

Ownership Structure and Related Industries

The citrus industry of Sao Paulo is highly vertically integrated with all of the major processors being 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 access research know-how 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 400 hectares) who likely represent about 30 percent of the citrus produced in Sao Paulo. With the lack of publicly available research related to citrus production, lower financial reserves, and a lack of know-how for ma-

naging 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. On the surface, 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 they are developed and given their general level of education and training, they 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 management companies will quickly adapt as new information becomes available regarding strategies to combat new diseases. Our conclusion is that Florida industry has the resilience to withstand the impact of new diseases assuming that management tactics can be successfully developed that control the disease effects. It is likely, however, that some contraction of production will occur, accompanied by higher retail prices and input costs. The implication, then, 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 support industries will likely provide flexibility and adaptability needed for combating and overcoming the disease outbreaks. Hence, both industries are likely to find means for sustaining their competitiveness within their own, albeit different, industry structures.

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 is 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-run 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 government 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. This ability, however, is tempered some by the biological nature of 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 nor comparatively as effective.

Summary and Conclusions

Within the context of Michael Porter's "Diamond Framework," the historic competitive advantages of the two global leaders in citrus processing – Florida and Sao Paulo – are readily understood. Yet, the sustainability of these advantages currently hinges on change factors outside of Porter's original framework – the potentially catastrophic outbreaks of plant diseases and the industries' ability to respond to these diseases. These 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 their 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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