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Imperfect Competition, Trade Policies, and Technological Changes in the Orange Juice Market

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Orange juice processors in Florida face stiff competition from São Paulo processors. The United States imposes a specific import tariff to protect domestic processors. São Paulo processors also export to the European Union, which imposes an *ad valorem* tariff on orange juice. Under oligopolistic competition with endogenous firm entry and exit, this paper analyzes how the changes in tariff policy and productivity impact the market structure in Florida and São Paulo; prices; quantities; and welfare in the United States, Brazil, and the European Union. Free trade and an increase in São Paulo productivity benefit U.S. and EU consumers and São Paulo processors. In contrast, U.S. tariff reduction adversely impacts Florida processors.

Key words: European Union, Florida, orange juice, productivity, São Paulo, trade policies, United States

Introduction

Since the 1980s, world orange juice production and consumption has steadily increased at an average annual growth rate of 2.29% and 2.76%, respectively (Food and Agricultural Organization, 2014). The production growth is propelled by increased productivity and better supply chain management practices. The leading orange juice producers are the United States and Brazil, accounting for 88% of total world orange juice production (USDA-FAS). In the United States, Florida accounts for about 90% of total orange juice production, and the United States also exports to other countries such as Canada (U.S. Census Bureau; USDA-NASS). In Brazil, São Paulo is the largest producer of orange juice and exports more than 90% of its juice production, with 77% going to the United States and the European Union (Food and Agricultural Organization, 2014).

The expanding orange juice market over the last forty years is also a result of rising income and a shift in consumers' preferences.[1] The leading consumers of orange juice, both in terms of total quantity and per capita consumption, are the United States and the European Union (EU). Due to very limited domestic orange juice production, EU consumption is primarily met through imports, accounting for 58% of total world orange juice imports during 2007–2011 (Food and Agricultural Organization, 2014).

The orange juice market is predominantly controlled with a high degree of concentration by Florida and São Paulo processors (seventeen in Florida and three in São Paulo) (USITC). Past studies have shown that this concentration of firms has led to oligopolistic competition and orange juice

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[1] However, growth in consumption has stagnated in recent years due to health concerns (Allen, 2014).

processors exert control over sales and prices. Wang, Xiang, and Reardon (2006) found that in the United States, Florida processors exercise market power, which declines following a weather shock. More recently, Luckstead, Devadoss, and Mittelhammer (2015) presented evidence that Florida and São Paulo processors exert market power in the U.S. and EU orange juice markets. Their estimates of the Lerner Index showed that Florida and São Paulo processors mark up orange juice prices in the U.S. market by 45% and 42% over their respective marginal costs.

Both the United States and the European Union impose tariffs on orange juice imports. Florida processors had been protected from import competition with a tariff of $0.3501 per single-strength equivalent (SSE) gallon since 1947 (Zekri, 2003). This tariff remained unchanged until the 1994 Uruguay Round agreement, which mandated a reduction of 15%, to $0.2971 per SSE gallon by 2000. Until 1994, the European Union also instituted an *ad valorem* tariff of 19% on orange juice imports as a part of the agricultural import restrictions imposed on non-colonial countries. This tariff was reduced to 15.20% by 2000 under the Uruguay Round agreement.

Beginning in the 1970s, new trade theory has shown that countries with similar resource endowments, technology, and preferences engage in trade because of increasing returns to scale, imperfect competition, and differentiated goods. Krugman (1979) found that returns to scale alter the pattern of comparative advantage. Later studies incorporated imperfect competition (oligopolistic competition and monopolistic competition) into trade models to analyze strategic trade policy, reciprocal dumping, and intra-industry trade. Markusen (1981) found that trade under Cournot-Nash competition would result in bilateral welfare gain for identical countries; however, when countries differ in size, the large country may incur a welfare loss though the world welfare increase. Horstmann and Markusen (1986) extended Markusen (1981) by including free entry to show that import tariffs and export subsidies lead to entry of inefficient firms, resulting in a higher average production cost, price increase, and welfare decline in the domestic country. More recent studies proved that productivity differences among firms also lead to trade. For example, Melitz (2003) illustrated that, under the assumption of firm-heterogeneity and monopolistic competition, firms with higher productivity are more active in trade. Melitz also concluded that trade barriers protect less productive firms and that removing such barriers will lead to a gain in welfare.

Past studies have empirically examined different industries in the manufacturing sector and corroborated the results of new trade theory. For example, Pavcnik (2002) empirically analyzed the impact of trade liberalization on plant productivity in the Chilean industrial sector and found that import-competing sectors improved their productivity owing to competition from freer trade. Such productivity improvements occur due to reallocation of resources and production from inefficient to more efficient manufacturers. Bernard et al. (2003) examined the effect of free trade and dollar appreciation on productivity, entry and exit of firms, and employment in the U.S. manufacturing industry. Their simulation results illustrated that lower trade barriers tend to expel low-productivity plants while incentivizing highly productive firms to sell more abroad.

However, with the exception of a few studies, such strategic trade policies have not been extensively applied to agricultural commodities and processed food markets because most studies assume perfect competition. For example, Yerger (1996) analyzed the U.S. wood pulp industry by estimating market power in both the domestic and export markets. Lavoie (2005) examined vertical price discrimination by the Canadian Wheat Board and showed that product differentiation led to market power across export markets. Luckstead, Devadoss, and Mittelhammer (2014) analyzed export competition between U.S. and Chinese oligopoly firms in the Association of South East Asian Nations' markets. Their results showed empirical evidence of market power exercised by U.S. and Chinese firms as well as rent shifting (i.e., government subsidies benefit home firms at the expense of foreign firms). Luckstead, Devadoss, and Dhamodharan (2015) studied the strategic interaction between U.S. and Chinese apple juice processors in the U.S. market and found that an import tariff reduction by the United States benefits U.S. consumers, harms U.S. processors, and favors Chinese processors.

Spreen, Brewster, and Brown (2003) constructed a spatial equilibrium model for the world processed orange juice market under perfect competition to estimate the impact of U.S. import tariff elimination on U.S. orange juice production, producer prices, and imports. They found that U.S. import tariff elimination reduces Florida processors' price by $0.22 per SSE gallon. Luckstead, Devadoss, and Mittelhammer (2015) developed a strategic trade model of oligopolistic competition between Florida and São Paulo orange juice processors and analyzed the effects of U.S. and EU tariff reduction on U.S., Brazil, and EU orange juice markets. Their results showed a 50% reduction in the U.S. tariff causes São Paulo exports to increase by about 5% and Florida market share to decline by about 5% in the United States. A 50% EU tariff cut causes São Paulo to divert its exports from the United States to the European Union, which augments Florida's market share by about 4% in the United States.

Under imperfect competition, changes in trade policies and productivity will impact firm profits, which can lead to changes in the number of firms, market concentration, and market shares. These changes will thus affect the market structure and, ultimately, welfare. Therefore, trade policy analysis under imperfect competition calls for endogenous determination of number of firms in these orange juice markets. The current study advances the literature by building on Luckstead, Devadoss, and Mittelhammer (2015) in four key aspects: endogenizing firm entry and exit, examining the impacts of productivity changes due to technological advancements, modeling U.S. orange juice exports, and presenting welfare analysis of trade liberalization and productivity improvements.

Interestingly, modeling the industry with the more realistic assumption of free entry and exit generates results contrary to conventional wisdom (see also Venables, 1985; Horstmann and Markusen, 1986). For example, unilateral trade liberalization by the European Union makes it profitable for more firms in São Paulo to enter the industry, which augments São Paulo's total orange juice supply, leading to higher exports, not only to the European Union but also the United States. Consequently, U.S. consumption expands and U.S. welfare increases, even though the U.S. tariff remains the same. However, if firm numbers are not endogenized, then EU trade liberalization will cause São Paulo firms to divert exports from the United State to the European Union and will reduce U.S. welfare.

Theoretical Model and Analysis

To capture the market structure described in the introduction, we construct a strategic trade model based on new trade theory for the U.S., São Paulo, and EU orange juice markets. Orange juice produced by Florida processors is consumed domestically and exported, whereas São Paulo processors export orange juice to both U.S. and EU markets. We do not model domestic consumption for São Paulo, since more than 90% of their processed oranges are exported. São Paulo has a comparative advantage in orange juice production over Florida due to more conducive weather and lower input prices and labor costs.

The Florida firm-level profit function is

$$\pi^f = p^u\left(Q^{fd} + Q^{su}\right)q^{fd} + p^r\left(Q^{fr}\right)q^{fr} - C^f\left(q^{fd} + q^{fr};\theta^f\right) - t^r q^{fr} - f^f, \qquad (1)$$

where p^u is the price of orange juice in the U.S. market, $p^u\left(Q^{fd} + Q^{su}\right)$ is the U.S. inverse demand function, Q^{fd} is the quantity of orange juice sold by all Florida processors in the United States, Q^{su} is the quantity of orange juice sold by all São Paulo processors in the United States, q^{fd} is the firm-level sales in United States, p^r is the export price of Florida orange juice, $p^r\left(Q^{fr}\right)$ is the export demand of the rest of the world (ROW), Q^{fr} is the total orange juice exports by the United States to ROW, q^{fr} is the firm-level exports by Florida firms, $C^f\left(q^{fd} + q^{fr};\theta^f\right)$ is the variable cost function, θ^f is the firm-level productivity parameter, t^r is the transport cost of U.S. exports, and f^f is the firm-level fixed cost. Thus, the firm-level profit in equation (1) is the sum of revenues from domestic and foreign markets minus cost of production, transport cost, and fixed cost.

The São Paulo firm-level profit function is

$$\pi^s = \left(p^u\left(Q^{fd} + Q^{su}\right) - \tau^u\right)q^{su} + \frac{p^e\left(Q^{se}\right)}{(1+\tau^e)}q^{se} - C^s\left(q^{su} + q^{se}; \theta^s\right) - t^u q^{su} - t^e q^{se} - f^s, \tag{2}$$

where q^{su} is the firm-level output sold in the United States, τ^u is the specific tariff imposed by the United States, p^e is the price of orange juice in the European Union, $p^e\left(Q^{se}\right)$ is the EU inverse demand function, Q^{se} is the quantity of orange juice sold in the European Union by all São Paulo processors, q^{se} is the firm-level output sold in the European Union, τ^e is the *ad valorem* tariff imposed by the European Union, $C^s\left(q^{su} + q^{se}; \theta^s\right)$ is the variable cost function, θ^s is the firm-level productivity parameter of São Paulo processors, t^u is the transport cost of exports from São Paulo to the United States, t^e is the transport cost from São Paulo to the European Union, and f^s is the firm-level fixed cost. Thus, the firm-level profit in equation (2) is the sum of revenues (net of tariffs) from the U.S. and EU markets minus cost of production, transport cost, and fixed cost.

We differentiate the profit functions (1) and (2) with respect to q^{fd}, q^{fr}, q^{su}, and q^{se} to obtain the first-order conditions and incorporate conjectural elasticities and demand flexibilities to obtain the following reaction functions:

$$\pi^f_{q^{fd}} = p^u - \frac{\partial C^f\left(q^{fd} + q^{fr}; \theta^f\right)}{\partial q^{fd}} - \psi^{fd}\xi^u p^u = 0 \tag{3}$$

$$\pi^f_{q^{fr}} = p^r - \frac{\partial C^f\left(q^{fd} + q^{fr}; \theta^f\right)}{\partial q^{fr}} - \psi^{fr}\xi^r p^r - t^r = 0 \tag{4}$$

$$\pi^s_{q^{su}} = p^u - \frac{\partial C^s\left(q^{su} + q^{se}; \theta^s\right)}{\partial q^{su}} - t^u - \psi^{su}\xi^u p^u - \tau^u = 0 \tag{5}$$

$$\pi^s_{q^{se}} = p^e - (1+\tau^e)\left(\frac{\partial C^s\left(q^{su} + q^{se}; \theta^s\right)}{\partial q^{se}} + t^e\right) - \left(\psi^{se}\right)\left(\xi^e\right)p^e, \tag{6}$$

where $\psi^{fd} = \frac{\partial\left(Q^{fd}+Q^{su}\right)}{\partial q^{fd}}\frac{q^{fd}}{\left(Q^{fd}+Q^{su}\right)}$ is the firm-level conjectural elasticity for Florida processors' domestic sales, $\xi^u = -\frac{\partial p^u\left(Q^{fd}+Q^{su}\right)}{\partial\left(Q^{fd}+Q^{su}\right)}\frac{\left(Q^{fd}+Q^{su}\right)}{p^u\left(Q^{fd}+Q^{su}\right)}$ is the flexibility of demand in the U.S. market, $\psi^{fr} = \frac{\partial Q^{fr}}{\partial q^{fr}}\frac{q^{fr}}{Q^{fr}}$ is the firm-level conjectural elasticity for Florida processors' exports, $\xi^r = -\frac{\partial p^r\left(Q^{fr}\right)}{\partial\left(Q^{fr}\right)}\frac{Q^{fr}}{p^r\left(Q^{fr}\right)}$ is the flexibility of demand in the rest of the world for Florida orange juice, $\psi^{su} = \frac{\partial\left(Q^{fd}+Q^{su}\right)}{\partial q^{su}}\frac{q^{su}}{\left(Q^{fd}+Q^{su}\right)}$ is the firm-level conjectural elasticity for São Paulo firms exporting to the United States, $\psi^{se} = \frac{\partial Q^{se}}{\partial q^{se}}\frac{q^{se}}{Q^{se}}$ is the firm-level conjectural elasticity for São Paulo firms exporting to the European Union, and $\xi^e = -\frac{\partial p^e(Q^{se})}{\partial Q^{se}}\frac{Q^{se}}{p^e(Q^{se})}$ is the flexibility of demand in the EU market.

To allow for free entry and exit, which endogenizes the market structure, zero-profit conditions (ZPCs) are specified. In the ZPCs, aggregate quantities are expressed as the product of the number of firms and firm-level output ($Q^{fd} = N^f q^{fd}$, $Q^{su} = N^s q^{su}$, $Q^{fr} = N^f q^{fr}$, and $Q^{se} = N^s q^{se}$), where N^f and N^s are the number of firms in Florida and São Paulo, respectively. The zero-profit conditions are given by

$$\text{(7)} \quad \pi^{of} = p^u\left(N^f q^{fd} + N^s q^{su}\right) q^{fd} + p^r\left(N^f q^{fr}\right) q^{fr} - C^f\left(q^{fd} + q^{fr}; \theta^f\right) - t^r q^{fr} - f^f = 0$$

$$\text{(8)} \quad \pi^{os} = \left(p^u\left(N^f q^{fd} + N^s q^{su}\right) - \tau^u\right) q^{su} + \frac{p^e\left(N^s q^{se}\right)}{(1+\tau^e)} q^{se} - C^s\left(q^{su} + q^{se}; \theta^s\right) - t^u q^{su} - t^e q^{se} - f^s = 0.$$

Since we consider general functional forms for the demand and cost functions, we totally differentiate equations (3)–(8) to analyze the impact of a change in the U.S. and EU tariffs (τ^u and τ^e) and productivity parameters (θ^f and θ^s) on q^{fd}, q^{fr}, q^{su}, q^{se}, N^f, and N^s. This differentiation yields a system of six equations and six unknowns. However, the general functional forms do not lend themselves to obtaining unambiguous analytical solutions from the comparative static analysis. Consequently, we utilize linear demand and cost functions to derive qualitative results.[2] Below we interpret the comparative static results.

Reducing the U.S. tariff will lead to an increase in orange juice imports from São Paulo, $\frac{\partial q^{su}}{\partial \tau^u} < 0$, resulting in a lower U.S. price and decline in profits of Florida processors. As a result, Florida firm-level output will decline but exports will increase, $\frac{\partial q^{fr}}{\partial \tau^u} < 0$. As the decline in firm-level output exceeds the increase in exports, Florida firm-level sales will decrease, $\frac{\partial q^{fd}}{\partial \tau^u} + \frac{\partial q^{fr}}{\partial \tau^u} > 0$. With lower firm-level sales and prices, firms will experience losses and exit the industry, $\frac{\partial N^f}{\partial \tau^u} > 0$.

In contrast, a lower U.S. tariff will increase the demand for São Paulo orange juice and prices received by São Paulo processors will rise. This will augment profits of São Paulo firms and attract entry, $\frac{\partial N^s}{\partial \tau^u} < 0$. As São Paulo processors find it more profitable to export to the United States, exports will be diverted from the European Union, $\frac{\partial q^{se}}{\partial \tau^u} > 0$, to the United States. Comparative static results and interpretations for a reduction in EU tariff can be carried out similarly.

An increase in São Paulo productivity will lead to more exports to both the United States, $\frac{\partial q^{su}}{\partial \theta^s} > 0$, and the European Union, $\frac{\partial q^{se}}{\partial \theta^s} > 0$, resulting in a lower U.S. price and hence lower profits for orange juice processors in Florida and a lower price in the European Union. With cheaper imports from São Paulo, Florida processors tend to lose their domestic sales, $\frac{\partial q^{fd}}{\partial \theta^s} < 0$, but increase exports, $\frac{\partial q^{fr}}{\partial \theta^s} > 0$. Lower sales and hence negative profits will force firms to exit the industry, $\frac{\partial N^f}{\partial \theta^s} < 0$. However, due to higher profits from increased exports, more firms will enter the São Paulo orange juice industry, $\frac{\partial N^s}{\partial \theta^s} > 0$.

Welfare Analysis

Next, we analyze the impacts of U.S. and EU trade liberalization and productivity shocks on welfare in the United States, the European Union, and São Paulo. For the United States, welfare is

$$\text{(9)} \quad W^u = \left\{\int p^u\left(Q^u\right) dQ^u - p^u\left(Q^u\right) Q^u\right\} + N^f f^f + \tau^u Q^{su},$$

where $Q^u = Q^{fd} + Q^{su}$. The first term on the right-hand side is consumer surplus, the second term is producer surplus, and the last term is the tariff revenue accrued to the U.S. government. Consumer surplus is the area under the demand curve minus expenditure. Firm-level producer surplus is total revenue minus total variable cost. Under free entry and exit condition, since profits inclusive of fixed

[2] These solutions are too long to report in the paper but are available from the authors upon request.

cost is zero as in equation (8), firm-level producer surplus is equal to fixed cost. Therefore, industry-level producer surplus is equal to the number of firms times fixed cost, $N^f f^f$. The tariff revenue is equal to the per unit tariff times the quantity of imports from São Paulo.

São Paulo welfare comprises only producer surplus:

$$W^s = N^s f^s. \tag{10}$$

EU welfare consists of consumer surplus and tariff revenues (producer surplus is zero because the European Union does not produce orange juice):

$$W^e = \left\{ \int p^e \left(Q^{se}\right) dQ^{se} - p^e \left(Q^{se}\right) Q^{se} \right\} + p^e \left(Q^{se}\right) \tau^e Q^{se}, \tag{11}$$

where the first term is consumer surplus and the second term is tariff revenue.

To determine the effects of a reduction in the U.S. tariff on U.S. welfare, we totally differentiate equation (9) with respect to τ^u:

$$\frac{dW^u}{d\tau^u} = \underbrace{-\frac{\partial p^u}{\partial Q^u}\frac{\partial Q^u}{\partial \tau^u} Q^u}_{\text{CS } (-)} + \underbrace{f^f \frac{\partial N^f}{\partial \tau^u}}_{\text{PS } (+)} + \underbrace{\left(\frac{\partial Q^{su}}{\partial p^u}\frac{\tau^u}{Q^{su}} + 1 \right) Q^{su}}_{\text{TR } (?)}. \tag{12}$$

U.S. trade liberalization leads to more imports from São Paulo, resulting in a decrease in the U.S. orange juice price, higher consumption, and consumer surplus (CS) gain. This lower price adversely impacts the profitability of Florida processors, resulting in firm exits and producer surplus (PS) loss. In response to tariff reduction, the change in tariff revenues (TR) could be positive (negative) if the elasticity of demand, $\frac{\partial Q^{su}}{\partial p^u}\frac{\tau^u}{Q^{su}}$, is inelastic (elastic). Since the United States is an importing country, the gain in consumer surplus is likely to be more than the loss in producer surplus and any decline in tariff revenues, resulting in a positive net welfare.

We examine the effect of a reduction in the U.S. tariff on São Paulo welfare by totally differentiating (10) to obtain

$$\frac{dW^s}{d\tau^u} = \underbrace{f^s \frac{\partial N^s}{\partial \tau^u}}_{\text{PS } (-)}. \tag{13}$$

Because of U.S. liberalization, São Paulo increases its exports to the United States, leading more firms to enter the São Paulo orange juice industry and generating a gain in producer surplus.

To analyze the impacts of a reduction in the U.S. tariff on EU welfare, we totally differentiate (11) with respect to τ^u:

$$\frac{dW^e}{d\tau^u} = \underbrace{-Q^{se}\frac{\partial p^e}{\partial Q^{se}}\frac{\partial Q^{se}}{\partial \tau^u}}_{\text{CS } (+)} + \underbrace{\left(\frac{Q^{se}}{p^e}\frac{\partial p^e}{\partial Q^{se}} + 1 \right) \tau^e p^e \frac{\partial Q^{se}}{\partial \tau^u}}_{\text{TR } (?)}. \tag{14}$$

U.S. trade liberalization increases the price received by São Paulo orange juice processors in the United States relative to the price received in the European Union, which causes São Paulo to divert its exports from the European Union to the United States. The decline in exports to the European Union leads to a higher price, which lowers the consumption and reduces consumer surplus. With less imports and τ^e unchanged, tariff revenue will decrease (increase) if the import demand $\left(\frac{Q^{se}}{p^e}\frac{\partial p^e}{\partial Q^{se}}\right)$ is inelastic (elastic). Because the European Union is an importing region, consumer surplus loss is likely to outweigh any tariff revenue increases, resulting in EU net welfare loss.

To analyze the effect of a change in the European tariff on EU welfare, we totally differentiate (11) with respect to τ^e:

$$\text{(15)} \qquad \frac{dW^e}{d\tau^e} = \underbrace{-Q^{se}\frac{\partial p^e}{\partial Q^{se}}\frac{\partial Q^{se}}{\partial \tau^e}}_{\text{CS }(-)} + \underbrace{\left(\frac{Q^{se}}{p^e}\frac{\partial p^e}{\partial Q^{se}}+1\right)\tau^e p^e\frac{\partial Q^{se}}{\partial \tau^e} + p^e Q^{se}}_{\text{TR }(?)}.$$

With EU trade liberalization, São Paulo processors expand their exports to the European Union and reduce exports to the United States. Higher exports to the European Union lowers the EU price, leading to an increase in consumption and consumer surplus. Tariff revenue will decrease (increase) if the import demand $\left(\frac{Q^{se}}{p^e}\frac{\partial p^e}{\partial Q^{se}}\right)$ is elastic (inelastic). However, since the European Union is an importing region, gain in consumer surplus will most likely outweigh any loss in tariff revenues, resulting in positive EU net welfare.

Change in São Paulo welfare due to EU tariff reduction is derived by totally differentiating (10) with respect to τ^e:

$$\text{(16)} \qquad \frac{dW^s}{d\tau^e} = \underbrace{f^s\frac{\partial N^s}{\partial \tau^e}}_{\text{PS }(-)}.$$

As EU trade liberalization expands São Paulo's exports to the European Union, São Paulo processors' profits rise and attract more firms to enter the orange juice industry, which augments producer surplus.

To obtain the impact of a reduction in the EU tariff τ^e on U.S. welfare, we totally differentiate (9) with respect to τ^e:

$$\text{(17)} \qquad \frac{dW^u}{d\tau^e} = \underbrace{-Q^u\frac{\partial p^u}{\partial Q^u}\frac{\partial Q^u}{\partial \tau^e}}_{\text{CS }(+)} + \underbrace{f^f\frac{\partial N^f}{\partial \tau^e}}_{\text{PS }(-)} + \underbrace{\tau^u\frac{\partial Q^{su}}{\partial \tau^e}}_{\text{TR }(+)}.$$

EU trade liberalization will will lead to reallocation São Paulo's exports from the United States to the European Union, which will increase the price and lower consumption in the United States, leading to a reduction in consumer surplus. However, due to decreased exports by São Paulo, Florida processors will expand their production and profits, resulting in more firms entering the industry and a gain in producer surplus. With lower imports and the U.S. tariff τ^u unchanged, tariff revenues decline. The combined loss in consumer surplus and tariff revenues will likely be higher than the gain in producer surplus, and, consequently, the United States will experience a welfare loss.

Due to technological progress, São Paulo producers use inputs efficiently, reduce their production costs, and expand output. We analyze how an increase in São Paulo's productivity relative to that of Florida affects welfare in the United States, São Paulo, and the European Union.

We obtain the change in U.S. welfare by totally differentiating equation (9) with respect to θ^s:

$$\text{(18)} \qquad \frac{dW^u}{d\theta^s} = \underbrace{-\frac{\partial p^u}{\partial Q^u}\frac{\partial Q^u}{\partial \theta^s}Q^u}_{\text{CS }(+)} + \underbrace{\frac{\partial N^f}{\partial \theta^s}f^f}_{\text{PS }(-)} + \underbrace{\tau^u\frac{\partial Q^{su}}{\partial \theta^s}}_{\text{TR }(+)}.$$

The increase in São Paulo's productivity leads to an expansion of production and exports by São Paulo processors. Higher exports to the United States decreases the U.S. orange juice price, which leads to more consumption and a gain in consumer surplus. However, cheaper imports from São Paulo affect the Florida processors, leading to a decline in their profitability and exit of firms. With the U.S. tariff unchanged, tariff revenues rise because of higher imports from São Paulo. The gain in consumer surplus and tariff revenues will likely offset the loss in producer surplus, resulting in a net welfare gain for the United States.

The change in São Paulo welfare is analyzed by differentiating equation (10) with respect to θ^s:

$$\text{(19)} \qquad \frac{dW^s}{d\theta^s} = \underbrace{\frac{\partial N^f}{\partial \theta^s} f^f}_{\text{PS }(+)}.$$

Due to an increase in productivity, total orange juice production for São Paulo will increase, resulting in more exports to both the United States and the European Union. This leads to a gain in profits and entry of firms, causing welfare to rise.

We obtain the change in EU welfare by totally differentiating (11) with respect to θ^s:

$$\text{(20)} \qquad \frac{dW^e}{d\theta^s} = \underbrace{-Q^{se}\frac{\partial p^e}{\partial Q^{se}}\frac{\partial Q^{se}}{\partial \theta^s}}_{\text{CS }(+)} + \underbrace{\left(\frac{Q^{se}}{p^e}\frac{\partial p^e}{\partial Q^{se}} + 1\right) p^e \tau^e \frac{\partial Q^{se}}{\partial \theta^s}}_{\text{TR }(?)}.$$

As a result of higher productivity, São Paulo exports more to the European Union, which lowers the EU orange juice price, increases consumption, and augments consumer surplus. Though the EU tariff remains unchanged, EU tariff revenues depend on the elasticity of import demand. Consequently, the net change in EU welfare is ambiguous.

Empirical Analysis

This section presents the system of equations for the simulation analysis, describes data and calibration of the model, and discusses the results.

Empirical Model

To carry out the empirical analysis, we must consider specific functional forms for the cost and demand functions. The firm-level total cost functions for Florida (tc^f) and São Paulo (tc^s) processors are defined as

$$\text{(21)} \qquad tc^f = \gamma_0^f \frac{\left(q^{fd} + q^{fr}\right)}{\theta^f} + \frac{\gamma_1^f}{2}\left(\frac{q^{fd} + q^{fr}}{\theta^f}\right)^2 + f^f,$$

$$\text{(22)} \qquad tc^s = \gamma_0^s \frac{\left(q^{su} + q^{se}\right)}{\theta^s} + \frac{\gamma_1^s}{2}\left(\frac{q^{su} + q^{se}}{\theta^s}\right)^2 + f^s,$$

where γ_j^i $(i = f, s,\ j = 0, 1)$ are intercept and slope parameters. The U.S., ROW, and EU demand functions are defined as

$$\text{(23)} \qquad p^u = \delta_0^u - \delta_1^u\left(N^f q^{fd} + N^s q^{su}\right),$$

$$\text{(24)} \qquad p^r = \delta_0^r - \delta_1^r N^f q^{fr},$$

$$\text{(25)} \qquad p^e = \delta_0^e - \delta_1^e N^s q^{se},$$

where δ_j^i $(i = u, r, e;\ j = 0, 1)$ represent the intercept and slope parameters of the demand functions.

From the first-order conditions (3)–(6), marginal cost functions obtained from (21) and (22), and the demand functions from (23)–(25), we derive the supply relations:

$$p^u = \frac{\gamma_0^f}{\theta^f} + \frac{\gamma_1^f q^{fd}}{(\theta^f)^2} + \frac{\gamma_1^f q^{fr}}{(\theta^f)^2} + \delta_1^u q^{fd} \tag{26}$$

$$p^r = \frac{\gamma_0^f}{\theta^f} + \frac{\gamma_1^f q^{fd}}{(\theta^f)^2} + \frac{\gamma_1^f q^{fr}}{(\theta^f)^2} + \delta_1^r q^{fr} + t^r \tag{27}$$

$$p^u = \frac{\gamma_0^s}{\theta^s} + \frac{\gamma_1^s q^{su}}{(\theta^s)^2} + \frac{\gamma_1^s q^{se}}{(\theta^s)^2} + \delta_1^u q^{su} + \tau^u + t^u \tag{28}$$

$$p^e = (1+\tau^e)\left(\frac{\gamma_0^s}{\theta^s} + \frac{\gamma_1^s q^{su}}{(\theta^s)^2} + \frac{\gamma_1^s q^{se}}{(\theta^s)^2} + t^e\right) + \delta_1^e q^{se}. \tag{29}$$

We also redefine the zero-profit equations (7) and (8) by including specific demand functions (23)–(25) and total cost functions (21) and (22):

$$\pi^{of} = \left(\delta_0^u - \delta_1^u\left(N^f q^{fd} + N^s q^{su}\right)\right) q^{fd} + \left(\delta_0^r - \delta_1^r N^f q^{fr}\right) q^{fr} - \gamma_0^f \frac{(q^{fd}+q^{fr})}{\theta^f} - \frac{\gamma_1^f}{2}\left(\frac{(q^{fd}+q^{fr})}{\theta^f}\right)^2 - t^r q^{fr} - f^f = 0 \tag{30}$$

$$\pi^{os} = \left(\delta_0^u - \delta_1^u\left(N^f q^{fd} + N^s q^{su}\right) - \tau^u\right) q^{su} + \frac{\delta_0^e - \delta_1^e (N^s q^{se})}{(1+\tau^e)} q^{se} - \gamma_0^s \frac{(q^{su}+q^{se})}{\theta^s} - \frac{\gamma_1^s}{2}\left(\frac{q^{su}+q^{se}}{\theta^s}\right)^2 - t^u q^{su} - t^e q^{se} - f^s = 0 \tag{31}$$

Equations (26)–(31) represent the system of six simultaneous equations with six endogenous variables—q^{fd}, q^{su}, q^{fr}, q^{se}, N^f, and N^s—used for the simulation analysis.

Calibration and Data

We parameterize the supply relations and demand functions using data on prices, quantities, tariffs, and average transport costs for 2007–2011 as well as supply and demand elasticities.

Data for prices, quantities, tariffs, and transport costs are collected from various sources. Total U.S. consumption, Florida supply, U.S. exports, and São Paulo export quantities and values are obtained from Food and Agricultural Organization (2014). The U.S. orange juice price is collected from the Florida Department of Citrus (2014). The EU price is calculated by dividing the value of imports by the quantity of imports from São Paulo. The U.S. and EU import tariffs are obtained from the World Trade Organization. Transportation cost data are calculated as difference between Cost, Insurance, and Freight (CIF) and Freight On Board (FOB) values.

We assume Cournot competition at the industry-level, which implies that $\frac{\partial(Q^{UD}+Q^{CU})}{\partial Q^i} = 1$, and thus the conjectural elasticities are given by market shares $\psi^i = \frac{Q^i}{Q^{UD}+Q^{CU}}$. The supply flexibilities of Florida supply and exports and São Paulo exports to the United States and the European Union are assumed at 0.1. Using these elasticity estimates as a basis and incorporating price and quantity data, the intercept and slope parameters for the supply relation are calibrated at 17.98 and 0.37 for Florida firms and 14.64 and 0.12 for São Paulo firms, respectively.

Brown, Spreen, and Lee (2004) estimated the U.S. and EU demand elasticities for frozen concentrated orange juice at −0.70 and −0.41, respectively. Brown reported the EU demand elasticity for orange juice at −0.46 using Ordinary Least Squares and −0.60 using Instrumental Variable estimation methods. Luckstead, Devadoss, and Mittelhammer (2015) estimated the U.S. price elasticity of demand at −0.70 (flexibility at −1.44) and the EU price elasticity of demand for orange juice at −0.88 (flexibility as −1.73). We utilize these elasticity estimates as a basis to calibrate the intercept and slope parameters of the U.S. demand function at 4.33 and −0.002, U.S. export demand function at 4.42 and −0.01, and EU demand function at 3.48 and −0.001, respectively. Both the Florida and São Paulo productivity parameters are normalized to 1 for the calibration process.

Simulation and Results

With the potential completion of the Doha Round, U.S. and EU import tariffs will likely be reduced. Therefore, it is worth analyzing the impacts of U.S. and EU trade liberalization on prices, quantities, market structure, and welfare. Also, São Paulo producers have been improving their processing technology to compete effectively with Florida producers. These technological advancements intensify competition and have implications for survivability of firms, supply, market structure, and prices. Consequently, it is worth examining the effects of productivity shocks on the orange juice markets.

For the simulation analysis, we numerically solve the system of six equations (26)–(31) with six endogenous variables (q^{fd}, q^{fr}, q^{su}, q^{se}, N^f, and N^s). We run the baseline scenario and three counterfactual scenarios. The baseline scenario maintains the current U.S. tariff ($0.2971 per SSE gallon) and EU tariff (15.20%). The three counterfactuals are 1) a 50% reduction of the U.S. tariff, 2) a 50% reduction of the EU tariff, and 3) an exogenous increase in São Paulo processors' productivity by 10% relative to Florida processors' productivity. The values of endogenous variables under the counterfactual scenarios are compared to those of the baseline values to quantify the impacts. Table 1 summarizes the simulation results of the impacts of U.S. and EU import tariff reductions. Table 2 presents the results of an increase in São Paulo processors' productivity.

Scenario 1

A 50% reduction of the U.S. tariff causes São Paulo firm-level and aggregate exports to the United States to expand. Higher exports augment the profits of São Paulo orange juice processing firms, which attracts more firms into the industry. Consequently, the number of São Paulo firms increases by 61.94%.[3] Luckstead, Devadoss, and Mittelhammer (2015) found a 50% U.S. tariff reduction expands aggregate São Paulo exports by 38.65% under exogenous firm numbers. In contrast, our results show that aggregate São Paulo exports increase considerably more (233.99%) because of additional firms operating in the São Paulo orange juice industry.

In response to U.S. trade liberalization, per firm and aggregate output supply in São Paulo rise. As more exports come into the United States, the U.S. orange juice price declines by 3.33%. Consequently, Florida processors' firm-level and aggregate output decrease by 31.98% and 54.12%, respectively. Lower price and output reduce Florida processors' profits, which causes 32.55% of firms to exit. Because of the greater competition in the United States from the São Paulo exporters, Florida processors divert their sales from the domestic market to the foreign markets. As a result, Florida processors' firm-level exports increase by 48.01%; however, aggregate exports are lower because of the decline in the number of firms.

Because of the tariff reduction by the United States, São Paulo firms find it more profitable to export to the United States than to the European Union. Consequently, São Paulo firms reallocate

[3] Since the simulation results for changes in the number of firms are in fractions, we report these changes in terms of percentages.

Table 1. Impacts of Tariff Reduction on Prices, Quantities, Market Structure, and Welfare

	Tariff reduction by	
Variables	**United States**	**European Union**
Florida firm-level U.S. sales (% change)	−31.98	−2.23
Florida firm-level exports (% change)	48.01	3.87
São Paulo firm-level exports to U.S. (% change)	106.24	−1.93
São Paulo firm-level exports to EU (% change)	−33.64	−1.40
Number of Florida processors (% change)	−32.55	−3.78
Number of São Paulo processors (% change)	61.94	27.36
Florida aggregate domestic sales (% change)	−54.12	−5.93
Florida aggregate exports (% change)	−0.17	−0.05
São Paulo aggregate exports to U.S. (% change)	233.99	24.90
São Paulo aggregate exports to EU (% change)	7.47	25.57
US price (% change)	−3.33	−0.22
EU price (% change)	−1.88	−6.45
Welfare		
Change in U.S. total welfare ($ millions)	62.25	13.33
Change in U.S. consumer surplus ($ millions)	83.17	5.61
Change in U.S. producer surplus ($ millions)	−60.66	−7.04
Change in tariff revenue ($ millions)	39.74	14.77
Change in SP producer surplus ($ millions)	119.27	52.69
Change in EU total welfare ($ millions)	51.86	3.56
Change in EU consumer surplus ($ millions)	36.05	123.42
Change in tariff revenue ($ millions)	15.81	−119.86

their exports from the European Union to the United States, leading firm-level exports to the European Union to decline by 33.64%. However, aggregate exports to the European Union increase by 7.47% due to more firms entering the São Paulo orange juice industry, which causes the EU price to decline by 1.88%. It is worth emphasizing that under the assumption of fixed or exogenous firm numbers, total exports from São Paulo to the European Union would not increase given that firm-level exports fall. In fact, Luckstead, Devadoss, and Mittelhammer (2015) estimated that São Paulo's aggregate exports to the European Union would decrease by 4.44%. However, our results show that total São Paulo exports to the European Union would increase under endogenous firm entry and exit as more firms enter into the industry in response to U.S. tariff reduction.

The welfare analysis shows that a lower price and higher consumption arising from the reduction of the tariff cause the U.S. consumer surplus to increase by $83.17 million. With lower price and sales, the producer surplus of Florida processors declines by $60.66 million. Despite tariff reduction, tariff revenues accrued to the U.S. government increase by $39.74 as higher imports offset the effect of the lower tariff. Consequently, the net U.S. welfare gain is $62.25 million. With more São Paulo firms entering the market, producer surplus of São Paulo processors increases by $119.27 million. Greater imports from São Paulo lower the price, which expands EU consumption. Hence, consumer surplus increases by $36.05 million. Because the EU tariff remains the same, higher imports lead to higher tariff revenues of $15.81 million. As a result, the European Union experiences a total welfare gain of $51.86 million.

Scenario 2

In response to a 50% tariff reduction by the European Union, São Paulo orange juice processors expand their aggregate exports. As a result, orange juice production in São Paulo becomes more profitable, prompting entry of new firms into the industry by 27.36%. This increases the competition and the market share of each firm declines. Consequently, firm-level exports to the European Union decrease, but aggregate exports increase by 25.57% because of the increase in the number of firms. Higher imports from São Paulo lead to a 6.45% drop in the EU orange juice price.

It is worth noting that São Paulo aggregate exports to the United States also increase. However, without free entry, we would expect São Paulo aggregate exports to the United States to fall in response to EU tariff reduction. For instance, Luckstead, Devadoss, and Mittelhammer (2015) found that São Paulo exports to the United States decline by 36.42% for a 50% reduction in the EU tariff. However, our results show that São Paulo exports to the United States rise by 24.90%, which is attributed to the entry of more firms under free entry and exit condition. More imports from São Paulo lower the U.S. price and displaces the total domestic sales of Florida processors by 5.93%. Consequently, profitability of Florida firms is affected, leading 3.78% of firms to exit the industry. Due to greater competition from São Paulo processors, Florida processors reallocate their sales from the domestic market to foreign markets. As a result, firm-level exports increase by 3.87%.

In the European Union, consumer surplus increases by $123.42 million with greater imports, lower prices, and higher consumption. With tariff reduction, EU tariff revenues go down by $119.86 million. Consequently, the European Union experiences a net welfare gain of $3.56 million. Increase in exports to both the European Union and the United States causes the São Paulo producer surplus to go up by $52.69 million. In the United States, as Florida firms' expensive orange juice is replaced by cheaper imports from São Paulo, consumption increases and the price declines, leading to a $5.61 million gain in consumer surplus. Due to the decline in their total sales, producer surplus of Florida firms goes down by $7.04 million. Since the U.S. tariff does not change, higher imports lead to a gain in tariff revenue by $14.77 million. As a result, net U.S. welfare increases by $13.33 million.

Scenario 3

Due to technological advancements in processing, São Paulo processors augment their production and export more to both the United States and the European Union. As a consequence of this productivity shock (Table 2), new firms are attracted to the industry, leading to a 77.89% increase in the number of São Paulo firms. Because of greater competition, Florida firms are adversely impacted. As a result, firm-level sales of Florida processors decrease by 37.91%. In contrast, the firm-level exports increase by 55.23% because these firms divert their sales from the domestic market to the foreign market. However, the total firm-level sales (i.e., sum of domestic plus export sales) decline by 23.11%. Consequently, the profitability of Florida processors is affected, leading 35.62% of firms to exit the industry. Reduction in number of firms coupled with less firm-level sales leads to a fall in aggregate U.S. sales of Florida processors by 60.03%. Although firm-level exports rise, offset by the decline in the number of firms, aggregate exports experience only a very small change. Because U.S. imports are higher than the loss in domestic sales, total orange juice sales in the United States increase by 4.27%, leading to a 3.97% decline in the U.S. price. In the European Union, aggregate exports of São Paulo firms rise by 32.07%, resulting in a 8.09% decline in the EU price.

The increased sales and lower prices in the United States result in a consumer surplus gain of $99.26 million. Because of lower prices and reduced sales, Florida processors incur a producer surplus loss of $66.38 million. With an increase in imports and unchanged tariff, U.S. government tariff revenues increase by $12.64 million. As a result, U.S. total welfare increases by $45.52 million. Expansion of production and exports by São Paulo firms results in producer surplus gain of $149.98 million. Lower prices and higher consumption in the European Union augment consumer surplus by $154.74 million and tariff revenues by $69.62 million, which increases EU total welfare by $224.37 million.

Table 2. Impacts of an Increase in São Paulo Processors' Productivity

Variables	Productivity increase in São Paulo
Florida firm-level U.S. sales (% change)	−37.91
Florida firm-level exports (% change)	55.23
São Paulo firm-level exports to U.S. (% change)	102.94
São Paulo firm-level exports to EU (% change)	−25.76
Number of Florida processors (% change)	−35.62
Number of São Paulo processors (% change)	77.89
Florida aggregate domestic sales (% change)	−60.03
Florida aggregate exports (% change)	−0.07
São Paulo aggregate exports to U.S. (% change)	261.04
São Paulo aggregate exports to EU (% change)	32.07
US price (% change)	−3.97
EU price (% change)	−8.09
Welfare	
Change in U.S. total welfare ($ millions)	45.52
Change in U.S. consumer surplus ($ millions)	99.26
Change in U.S. producer surplus ($ millions)	−66.38
Change in tariff revenue ($ millions)	12.64
Change in São Paulo producer surplus($ millions)	149.98
Change in EU total welfare ($ millions)	224.37
Change in EU consumer surplus ($ millions)	154.74
Change in tariff revenue ($ millions)	69.62

Conclusion

Based on new trade theory, we develop a strategic trade model of U.S., EU, and São Paulo orange juice markets. We endogenize firm entry and exit by incorporating zero-profit conditions for Florida and São Paulo processors. We theoretically analyze the effects of changes in U.S. and EU tariffs and of a productivity shock on the orange juice market. For the empirical analysis, we specify a system of simultaneous equations based on the theoretical model. We calibrate the model to the data and conduct simulation analyses of U.S. and EU tariff reductions and São Paulo orange juice processors' productivity increases.

The results show that reducing the U.S. tariff leads to more U.S. imports from São Paulo, resulting in a decrease in the U.S. price and an increase in U.S. net welfare. U.S. tariff reduction causes some Florida firms to exit, whereas new firms enter the São Paulo orange juice industry. Even though we would expect São Paulo total exports to the European Union to decline in response to U.S. trade liberalization, our results show that São Paulo expands its exports to the European Union, augmenting EU welfare. This result is attributable to endogenizing the firm numbers, corroborating the findings of Venables (1985) and Horstmann and Markusen (1986). As a result of reducing the EU tariff, EU imports increase and the price decreases, which leads to consumer surplus gain and tariff revenue loss. In response to EU trade liberalization, more São Paulo firms enter the industry, which leads to more exports to the United States as well.

Free trade and technological advancement in orange juice processing in São Paulo lead to increased efficiency and production. As a result, São Paulo processors export more to the United States, reducing domestic juice production by Florida processors. They also increase their exports to the European Union. Consequently, their market shares in both the United States and European Union increase. Thus, Florida processors face stiff competition and lose market share to São Paulo processors. However, due to increased competition, the orange juice price decreases and

U.S. consumer surplus increases. Also, EU consumers gain from increased exports by São Paulo processors. Thus, higher São Paulo productivity augments welfare in all three regions.

If the Doha Round trade liberalization materializes, it is imperative that Florida processors increase their efficiency if they are to maintain their competitive status. To be competitive, Florida processors should also invest in cost-cutting technology in juice production. Similarly, Florida orange growers should also enhance their productivity to increase orange production since São Paulo has a comparative advantage in orange production. Otherwise, Florida orange juice processors will find it difficult to compete because oranges are the single most important intermediate input in juice production.

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References

Allen, G. "The 'Greening' of Florida Citrus Means Less Green in Growers' Pockets." 2014. National Public Radio, Morning Edition. Available online at http://www.npr.org/blogs/thesalt/2014/08/26/343211968/the-greening-of-florida-citrus-means-less-green-in-growers-pockets.

Bernard, A. B., J. Eaton, J. B. Jenson, and S. Kortum. "Plants and Productivity in International Trade." *The American Economic Review* 93(2003):1268–1290. doi: 10.1257/000282803769206296.

Brown, M. G. "European Demand for Orange Juice." Research Paper 5, Florida Department of Citrus, Lakeland, FL.

Brown, M. G., T. H. Spreen, and J.-Y. Lee. "Impacts on U.S. Prices of Reducing Orange Juice Tariffs in Major World Markets." *Journal of Food Distribution Research* 35(2004):26–33.

Florida Department of Citrus. "Economic Research." 2014. Lakeland, FL: Florida Department of Citrus. Available online at http://fdocgrower.com/florida-department-of-citrus/.

Food and Agricultural Organization. "FAOSTAT." 2014. Rome: FAO. Available online at http://faostat.fao.org/default.aspx.

Horstmann, I. J., and J. R. Markusen. "Up the Average Cost Curve: Inefficient Entry and the New Protectionism." *Journal of International Economics* 20(1986):225–247. doi: 10.1016/0022-1996(86)90020-6.

Krugman, P. R. "Increasing Returns, Monopolistic Competition, and International Trade." *Journal of International Economics* 9(1979):469–479. doi: 10.1016/0022-1996(79)90017-5.

Lavoie, N. "Price Discrimination in the Context of Vertical Differentiation: An Application to Canadian Wheat Exports." *American Journal of Agricultural Economics* 87(2005):835–854. doi: 10.1111/j.1467-8276.2005.00773.x.

Luckstead, J., S. Devadoss, and M. Dhamodharan. "Strategic Trade Analysis of U.S. and Chinese Apple Juice Market." *Journal of Agricultural and Applied Economics* 47(2015):175–191. doi: 10.1017/aae.2015.4.

Luckstead, J., S. Devadoss, and R. Mittelhammer. "Imperfect Competition between Florida and Sao Paulo (Brazil) Orange Juice Producers in the US and European Markets." *Journal of Agricultural and Resource Economics* 40(2015):164–178.

Luckstead, J., S. Devadoss, and R. C. Mittelhammer. "U.S. and Chinese Strategic Trade Policies and Product Differentiation in the ASEAN Apple Market." *International Economic Journal* 28(2014):613–637. doi: 10.1080/10168737.2014.920894.

Markusen, J. R. "Trade and Gains from Trade with Imperfect Competition." *Journal of International Economics* 11(1981):531–551. doi: 10.1016/0022-1996(81)90033-7.

Melitz, M. J. "The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity." *Econometrica* 71(2003):1695–1725. doi: 10.1111/1468-0262.00467.

Pavcnik, N. "Trade Liberalization, Exit, and Productivity Improvements: Evidence from Chilean Plants." *Review of Economic Studies* 69(2002):245–276. doi: 10.1111/1467-937X.00205.

Spreen, T. H., C. Brewster, and M. G. Brown. "The Free Trade Area of the Americas and the Market for Processed Oange Products." *Journal of Agricultural and Applied Economics* 35(2003):107–126. doi: 10.1017/S1074070800005976.

U.S. Census Bureau. "Foreign Trade Division." 2014. Washington, DC: U.S. Census Bureau. Available online at http://www.census.gov/foreign-trade.

USDA-FAS. "Data and Analysis." 2014. Washington, DC: USDA Foreign Agricultural Service, Available online at http://www.fas.usda.gov/data.

USDA-NASS. "Quick Stats." 2014. Washington, DC: USDA National Agricultural Statistics Service. Available online at http://www.nass.usda.gov.

USITC. "DataWeb." 2014. Washington, DC: U.S. International Trade Commission. Available online at http://dataweb.usitc.gov/.

Venables, A. J. "Trade and Trade Policy with Imperfect Competition: The Case of Identical Products and Free Entry." *Journal of International Economics* 19(1985):1–19. doi: 10.1016/0022-1996(85)90016-9.

Wang, H., Q. Xiang, and T. Reardon. "Market Power and Supply Shocks: Evidence from the Orange Juice Market." Staff Paper 2006-02, Michigan State University, Department of Agricultural, Food, and Resource Economics, 2006.

World Trade Organization. "Tariff Analysis Online." 2014. Available online at https://tariffanalysis.wto.org.

Yerger, D. B. "Testing for Market Power in Multi-Product Industries across Multiple Export Markets." *Southern Economic Journal* 62(1996):938–956. doi: 10.2307/1060939.

Zekri, M. "Orange Juice Tariff Necessary for Good of Florida's Economy." *Ft. Myers News-Press* (2003). Available online at http://www.ussugar.com/news/trade/archives_trade/2003/tariff_necessary.html.