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International commodity trade, transport costs, and product differentiation

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ABSTRACT

Transport costs and product quality have received increased attention in the international trade literature. Product quality is a particularly important factor in international trade of high-valued commodities. We observe that significant transport costs for a relatively high quality product represent a natural trade barrier. In this case, transport costs may introduce product differentiation, protecting home-country production of the higher quality product and constraining the foreign exporter to shipping a lower quality substitute. With differential transport costs between a higher and a lower quality product, firms in both countries may gain by implicitly coordinating in an increasingly segmented market and choosing a high-price strategy for both products. Home-country producers clearly gain. Through product differentiation in an oligopolistic market, the foreign producers may also gain when the home producers exploit the transport cost advantage. The international orange juice market, with significant trade volumes in both lower quality frozen-concentrated juice and higher quality not-from-concentrate juice, provides compelling evidence supporting this model.

1. Introduction

The recent trade literature highlights the importance of both transportation costs and product differentiation (e.g. [22,3,15]). In addition, the connection between product quality and trade has been modeled [16,8,19]. This literature generally confirms the *Alchian–Allen theorem* which states that, in an international trade context, importers' purchases will switch toward relatively higher quality products, in response to a rise in transportation costs. Such an effect has been confirmed in markets such as grapes [1] and textiles [23], and is often stated colloquially as “shipping the good apples out” [4]. In these papers, it is typical to assume that transport costs remain relatively constant between different levels of quality. However, Hummels and Skiba [22] mention that if transport costs rise faster than goods prices, a reverse Alchian–Allen effect is possible.

This paper proposes a model in which the high-quality good cannot be profitably shipped out to an export market with domestic production. For certain goods, there are some levels of quality that are prohibitively expensive to ship, making the high-quality product noncompetitive in certain markets. Indeed, this is the case with Brazilian orange juice exported to the U.S. market. Orange juice can be shipped in lower-quality concentrated form (i.e., with the water removed) or in higher

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Table 1
Concentration in the orange juice processing industry in 2010.
Source: Compiled by authors through industry interviews.

Firm	Capacity[a]	Market share[b] (%)
Processing firms based in U.S.		
Tropicana	40	25
Cutrale	25–30	16
Peace River Citrus	20–30	14
Citrosuco	20	11
Louis Dreyfus	20	11
Southern Gardens/Florida's Natural	20	11
Citrus World	20	11
Other	3	2
Total	175	100
HHI		1499
Processing firms based in Brazil		
Cutrale	135–150	47.5
Citrosuco/Citrovita[c]	105–120	37.5
Louis Dreyfus	37.5–52.5	15
Total	300	100
HHI		3888

[a] Units in millions of 90 lb. boxes.
[b] Shares are calculated from midpoint of ranges.
[c] Citrosuco and Citrovita agreed to merge on a 50–50 basis on May 14, 2010.

quality, *fresh juice* form. Fresh juice exports from Brazil are not competitive in the U.S. market (where there is domestic juice production) due to the high cost of transport, compared to concentrated juice. This means that the exporter ships out the lower quality products, which then compete in a differentiated market against higher quality goods in the importing country. The relatively high cost of transporting high quality goods therefore leads to more differentiated consumption in the importing country, as in Echazu [13].

It has been widely acknowledged that asymmetries in cost and production characteristics can hinder collusion among firms (e.g. [33]). In particular, Gross and Holahan [18] found that increases in transportation costs tend to destabilize collusive agreements. However, whether product differentiation by quality hinders or facilitates collusion appears to be ambiguous [31,25,29]. This study introduces a new dimension to this literature, demonstrating that transportation costs can introduce product differentiation and a collusive outcome.

Before proceeding to the theoretical and simulation models in greater detail and depth, the next section describes the international market for orange juice and elaborates upon the motivation and the main findings of this paper.

2. The orange juice market

World trade in orange juice is a classic oligopolistic market. The U.S. and Brazil are the world's largest producers of orange juice, accounting respectively for 30% and 60% of global production. Behind the EU, the U.S. is the second largest market for Brazilian exports. But unlike in the EU, a significant share of U.S. consumption is domestically produced [6].

Table 1 demonstrates the fact that orange juice processing and trade are highly concentrated. The trade protection efforts by the Florida industry have been acknowledged to result in a highly concentrated industry [5,20].

The Herfindahl–Hirschman Index (HHI) indicates that the market shares of processing firms in the U.S. and Brazil would be considered *moderately concentrated* and *concentrated*, respectively, according to the Horizontal Merger Guidelines issued by the U.S. Department of Justice and the Federal Trade Commission.[1]

In recent years, the U.S. orange juice market has experienced a dramatic shift in both consumption and production patterns, from the once-dominant Frozen Concentrated Orange Juice (FCOJ) to Not From Concentrate (NFC) fresh juice. Consumers generally view NFC as a higher quality product than FCOJ. Despite selling for a premium, NFC accounted for 53% of consumption in 2011, rising from 34% in 1997. Meanwhile, the share of NFC in total U.S. production of orange juice increased from 29% in 1997 to 59% in 2011. Fig. 1 reflects the dramatic increase in the relative importance of NFC, with an apparent structural change around 2004–2005.

[1] Markets in which the HHI is between 1000 and 1800 points are considered to be moderately concentrated, and those in which the HHI is in excess of 1800 points are considered to be concentrated. Transactions that increase the HHI by more than 100 points in concentrated markets presumptively raise antitrust concerns, under the Horizontal Merger Guidelines issued by the U.S. Department of Justice and the Federal Trade Commission. See Merger Guidelines 1.51 (http://www.justice.gov/atr/public/testimony/hhi.htm).