

Layers of Commerce: Modelling the Onion Trade of Dubai

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Abstract—This paper utilizes a comparative case study design to examine a regional onion market. The particular case of onion markets is used to understand perishable product supply chains. The site for the study is Dubai, United Arab Emirates. Results from a six-month field study are outlined. In particular, the findings suggest that firms should examine adding additional destinations to their supply chain. Further, we argue that utilizing Dubai as a supply chain hub is in certain cases counterproductive. Implications for food supply chains and regional trade are discussed.

Keywords—Supply chains, Food markets, Onion trade, Field study

I. INTRODUCTION

THE international trade in fruits and vegetables has a history, as long as civilization itself. However, in recent decades this trade has assumed a distinctive configuration. Surprisingly, nations such as China and India, which lead global production in fruits and vegetables are not the largest exporters [1]. In contrast, nations such as the Netherlands and Spain have emerged as key global food exporters. Hub nations such as the United Arab Emirates possess the potential to significantly affect such dynamics, as they provide a bridge between the global north and south [2]. Yet, extant research has paid little empirical attention to trade in the region. In the current paper we take on this task. We conducted a field study based in Dubai which examines the constraints and opportunities that affect the decision making of traders. Additionally, we argue that much of the food supply chain literature deals with macro-level trends and data [3], [4]. Left understudied are the micro-level decisions that face traders in the region, for instance, “*Should we source onions from India or Pakistan?*” In the current study, we utilize field data from Dubai to examine such supply chain choices and their consequences.

Modern food supply chains are essentially transportation puzzles [5]. The linear programming literature, and in particular the work of G.B. Dantzig provided innovative means of modelling such transportation problems [6], [7]. Dantzig’s simplex method to solve the traveling salesman problem heralded a burgeoning literature on the topic. The advent of microprocessors and computing applications allowed for the growth of sub-literatures on topics such as meta-heuristics, genetic algorithms, and neural networks [8]–[11]. While sophistication in modelling techniques continues to grow, we

argue that the singular focus on generalizable patterns has led to the neglect of market particularities. As a reaction to this trend, we conducted a field study which remains grounded in the world of produce trading.

Onions provide an interesting focal object to conduct a market study. The pricing of onions depends on factors such as annual onion yields, weather patterns, quality of seeds, fertilizers [12]. Further, exogenous events can dramatically affect production outcomes. For instance, the El Nino weather phenomenon caused significant monsoon delays and crop losses in 2014. Such production delays and drops lead to price and export volatilities. In the context of climate change, and predictions of more frequent extreme weather events, traders and governments need to be more deliberate in their sourcing decisions. Our hope is that this study can provide a small step towards better understanding trading contexts and practices.

II. BACKGROUND

Initially, the focal organization for this study was a Dubai-based fruit and vegetable firm (pseudonymized as OniOne). Later, the study scope was extended to another company (labelled in this paper as OnionCorp) in the same market category. OniOne has been based in Al Aweer fruit and vegetable market since 2002. In the beginning, the company focused on local purchase and sales, but gradually adopted import and export business. The switchover to exports was explained by the management as being driven by profitability and reliability concerns. Vegetables (and in particular onions) constitute the main product line for OniOne. The firm additionally focuses on vegetables like potatoes, coconuts, garlic, and fruits like oranges and watermelons. OniOne imports onions from three primary exporters situated in India, Pakistan and Iran. Additionally, secondary exporters from Yemen, China, and Oman are utilized in cases of supply shortfalls and price fluctuations. OnionCorp trades in similar products and faces the same sourcing decisions as OniOne. Due to space limitations we use OnionCorp only for quantitative comparisons. The two chosen organizations consider themselves as market peers, and we argue are suitable peers for a comparative case study.

III. ONION TRANSPORTATION PROCESS

In this section, we outline the particulars of the onion transportation process. The transport of onions across ports is dependent on the use of specially built containers. The containers may employ air-conditioning depending on seasonal conditions at ports. Typically, an air-conditioned container is only selected if the goods are dispatched from a

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port with low atmospheric temperature and humidity. Such measures are necessary as sudden changes in atmospheric temperature can result in the rapid decay of produce. The transport of onions, like other food products, is strictly regulated by Dubai Port & Customs. Port rules allow a standard container to accommodate approximately 12.5 tonnes of produce. Two types of containers (20 feet or 40 feet) are used for transportation. Firm representatives suggest that the cost of transporting one ton of onions can range from USD 400 to USD 800. Once the goods arrive at Dubai port, an extra handling, inspection and transportation fee is applied. Under normal conditions, a consignment of produce takes on average five to seven days to travel from India or Pakistan to Dubai.

A. Expected Profits & Losses

As with other markets, the key variable of interest to traders is the expected profit or loss from a container of onions. Irrespective of the purchase cost, all the transported goods have to be assessed based on a fixed market rate. This market rate fluctuates on a daily basis and during peak seasons the rate can even change twice a day. Hence, the profit and loss of a consignment completely depends on market variations and on the luck of individual traders. Typically, the profit rate for onion varies from 1 to 2 Cents/kg. Expectedly, the produce business has to plan for product spoilage issues. In the case of onions, on average approximately 3-4% of produce is lost due to the absorption of the atmospheric water content. The specific rate of loss depends on the humidity and the environmental conditions in transit. Thus, every supplier or agent tries to sell all the goods as early as possible so as to retrieve the maximum profit possible.

B. Transportation and Transaction Costs

OniOne is involved in both the direct purchase of goods from suppliers, and additionally engages in commission-based transactions i.e. deals not involving the original supplier. As a consequence, the firm may or may not be liable for the cost of transportation. For instance, when a consignment of goods is purchased directly from the supplier, the supplier sends the consignment to Dubai port on the basis of the Cost and Freight (C&F) price. The C&F price is the sum of the total cost of products and transportation charges from end-to-end. In such cases, the OniOne is obligated to pay the C&F price to the supplier and an additional cost of nearly USD 400 to the transportation company for clearing and transporting the goods from Dubai sea port to the fruits and vegetable market. In contrast, in the commission-scenario, all costs (such as port clearance, transportation charges from port to market, delay costs, fines, etc.) become the liability of the supplier. OniOne deducts these costs from the supplier's net profit at the time of payment.

Additionally, other transaction particulars often determine the liabilities of the parties involved. Generally, when goods are transported from Dubai to another country, the transportation cost becomes the responsibility of the customer. In such cases, the customer either arranges his own transportation means, or alternatively, an additional charge is

added to the customers' bill. Alternatively, when goods are sold within the Dubai market, OniOne assumes responsibility of transportation arrangements and costs, and coordinates delivery to the customer.

IV. DATA COLLECTION

In total, data collection for this project was conducted over a period of six months. In the current paper, we present analysis of data obtained from the firms' accounting information system. At OniOne, all accounts and transaction data is stored in a computerized database which is updated on a daily basis. The accounting system is designed, customized, and supported by a leading local software company. The accounting system logs all consignment-based information. Importantly, the firm itself makes strategic decisions based on this archival accounting data, and based on graphs and reports generated from the system.

V. ANALYSIS (ONIONE)

During the observation period, OniOne had engaged in imports, exports, and local sales. We observed that the company had seven primary sourcing destinations, namely-India, Pakistan, Iran, Egypt, China, Yemen and Dubai (local purchase). Exports were limited to Dubai, and sales were primarily intended for Dubai's local market. Table I provides a tabulation of the source, destination and selling price (inclusive of transportation cost). Costs are expressed in Dirhams (AED; 1 AED≈~0.27 USD) per tonne, and demand and supply are detailed in tonnes [5].

TABLE I
 MATRIX FOR ONIONE

Countries of Import	Transportation cost (to Dubai) per tonne in AED	Onions Transported in tonnes
India	1938	328.25
Pakistan	1871	345.55
Dubai	1561	606.65
Iran	1335	463.75
Egypt	1870	231.55
China	1616	185.45
Yemen	2523	160.55
Destination of exports from Dubai	Transportation cost (from Dubai) per tonne in AED	Demand of onions in Oman (in tonnes)
Oman	1255	500

We utilized a managerial analytics tool (Excel Solver) to analyze and optimize the supply chain decisions of OniOne. Solver [6] provides a means of locating optimal decision values within the constraints of particular scenarios. The choice of Solver was motivated by two factors. First, our dataset is valuable for its real-world provenance, as opposed to its inherent complexity. Second, we illustrate that a simple tool can solve the relatively complex problems of managers, and we hope to encourage the use of such analytics in 'traditional' industrial sectors.

Our preliminary analysis suggests that the ideal parameters for sales maximization involve a slight divergence from

OniOne's current allocation scheme. We find that our suggested changes would increase OniOne's selling price from AED 3.2 million to AED 3.8 million. Further, our results indicate that ideally OniOne should distribute its total supply of 606.65 tonnes in the following way, (1) 500.00 tonnes should be exported to Muscat, Oman and (2) the remaining 106.65 should be sold in the local Dubai market. Currently, OniOne only supplies 75.52 tonnes to Oman, and sells the rest in the Dubai market. As would be obvious, these suggested allocation parameters would be contingent on market needs, for instance, the demand for onions in Oman. However, our analysis suggests that OniOne should consider a fundamental re-evaluation of its business plan, moving from its primary role (as a supplier to the Dubai market) towards an export-based identity. However, generalizing from a single case-study can be less than ideal, so in the next section we compare OniOne's results with those of another similar firm-OnionCorp.

VI. COMPARISON OF ONIONE WITH ONIONCORP

This section outlines our analysis of data collected from OnionCorp. The data set from OnionCorp covers one month of transactions. While the two cases differ in their data collection durations, we argue that this transaction log sufficiently surmises the trading patterns of our secondary case.

Table II details the trading particulars of OnionCorp. We find that OnionCorp transports onions from seven source locations, and supplies to six destinations. Apart from Dubai and Oman, OnionCorp additionally supplies to other nations, such as Qatar, Bahrain, Kuwait & Afghanistan. As before, costs are expressed in Dirhams per tonne, and demand and supply are measured in tonnes.

TABLE II
 MATRIX FOR ONIONCORP

	DUBAI	MUSCAT	BAHRAIN	QATAR	KUWAIT	AFGHANISTAN	SUPPLY
INDIA	1929	0	0	2258	2317	1401	45.98
PAKISTAN	1900	0	0	0	0	1201	29
DUBAI	1502	1298	1809	1792	2379	0	158.61
SOURCE IRAN	1395	0	1702	1949	0	0	15.7
EGYPT	1870	0	2228	2156	2019	0	18.1
CHINA	1671	0	0	0	0	1798	11.98
TURKEY	2525	0	0	0	0	2591	11.11
DEMAND	24.55	4.9	45.22	51.01	76.5	88.3	

A. Comparative Analysis

The results of our comparative analysis suggest that the two firms under consideration occupy similar geographic and product niches, but utilize fundamentally different allocation strategies. While OniOne has acquired a significant market share in Dubai (i.e. local sales), it has neglected to grow export sales. For example, OniOne's only major export destination is Muscat. OnionCorp in contrast, exports only 4.9 tonnes to Muscat, as compared to OniOne's substantial figure of 75 tonnes. Yet, the figures from Oman can be a bit misleading, as OnionCorp devotes considerable resources to markets in Bahrain, Qatar, Kuwait & Afghanistan. Out of these four countries, Afghanistan is the biggest export destination. Considering that these alternative market opportunities present themselves to OniOne as well, how do we account for variations in export strategies, and supply chains?

Our field research suggests several potential explanations for differences between OniOne and OnionCorp. First, OnionCorp has a larger supply chain as compared to OniOne. Second, OnionCorp is dependent on contract based arrangements with Indian suppliers, which necessitates the maintenance of a large inventory. Third, we find that Pakistan is an under-utilized sourcing option. In total, OnionCorp imported 29 tonnes from Pakistan during the observation period in comparison to OniOne's figure of 18.1 tonnes. Interviews with representatives of both firms suggest a

pragmatic reason for the neglect of Pakistani imports. Our respondents suggested that they viewed imports from Pakistan as being risky propositions due to the fickle nature of local government regulations, and decision making. Shipments have to deal with Pakistan's inconsistent border and customs regimes which can lead to significant delays in delivery. A delay is consequential as it affects the importer in several ways, for instance, losing customers and orders (as orders are taken prior to dispatch of goods), greater damages etc. Fourth, OnionCorp deals with the products from China and Turkey at relatively low levels (of 11.98 and 11.11 tonnes, respectively); whereas the same suppliers are more prominent in OniOne's roster (15.98 and 18.85 tonnes, respectively). The neglect of these nations is particularly puzzling, as our interviewees suggest that China and Turkey provide high quality produce. For example, Chinese onions are meticulously packed, and well maintained during transit. As a consequence, produce from these nations typically has a low perish rate for each consignment. While we were unable to explicate the exact cause of this curious supply choice, our conjecture is that these differences stem from cultural differences. Traders at OnionCorp and OniOne are typically of South-Asian descent, and perhaps these antecedents lead to a disinclination towards more 'foreign' suppliers. However, the lack of specific evidence to this effect limits us to speculation on this point.

1. Comparison Results

Based on the data provided by these two firms, and our analysis of their supply chain as a transportation problem, we are able to summarize their present performance, and hypothesize about their future prospects. Specifically, OniOne has achieved a total turnover of amount AED: 345,804, and the equivalent amount for OnionCorp is AED: 550,217. The total turnover of OnionCorp is significantly higher than OniOne because of its greater global reach in terms of purchase and sales. Even though one might imagine that the distribution of products to far-flung parts of the world would necessitate a prohibitively large additional investment of resources, our results re-emphasize the importance of a greater global presence. As per our analysis, OniOne can achieve at least an additional turnover of AED: 150,000 each month through an expanded reach. In terms of actionable steps, OniOne should expand its destination markets. Additionally, the firm should focus on facilitating the export of onions directly from sources like India, Iran, etc. to final destinations without the intermediate step of shipping to Dubai. Reducing Dubai's physical role in this supply chain could help the company reduce unwanted costs and losses, as it has the potential to reduce transportation times.

VII. MARKET SURVEY

Customer base expansion is a key objective for any firm. However, when the management at OniOne considers the specifics of how to achieve such goals, decision paralysis confronts them, i.e. *where to buy from and who to sell to?* There are many potential ways through which this objective could be achieved, yet committing to an unwise choice has unremediable consequences. In the context of such complexity, a market survey can help illuminate competitor dynamics. In this section, we present preliminary evidence from a brief market survey.

We selected three firms in the onion trade for the survey. Firm representatives were then interviewed on a variety of issues- (1) the type of markets they target and attendant rationales, (2) nature of problems they face in each market, the nature of their investments, (3) types of cash transfers they deal with, and (4) the advantages and disadvantages they face due to the two-sided nature of their markets (i.e. targeting both suppliers and customers). Once responses were obtained from all three firms, we conducted an inductive analysis to isolate similarities amongst firms. We subsequently used these

generated insights as a means of examining the feasibility of OniOne's various options. In the interest of brevity, we limit our discussion to the most salient elements from our analysis.

All three companies were found to be dependent on the export of onions to countries like Qatar, Kuwait, Saudi Arabia, and Bahrain. Exports to these countries can be carried out either directly from the source, or through Dubai (as a hub). This choice is an important one, since skipping Dubai in-transit can potentially help the company minimize extra costs, reduce transit times, and reduce the chances of goods getting damaged. Another big risk for firms in this sector is the issue of customer payments. These may be delayed, the customer may often maintain a huge credit line, or at times even abscond post-delivery without payment. Unlike other businesses, a prior signed contract from the customer is not applicable in the onion trade, as almost 80% of the deals are done verbally (over the phone). Moreover, making a customer sign a payment liability contract for each consignment could result in losses, as customers prefer the ease of a verbal contract. Further, the Dubai onion market hosts many small trading firms which are more amenable to such contractual compromises. We used the information from the market survey as a source for testing different supply chain options for OniOne. We conducted a transportation problem analysis to understand the means of maximizing turnover. We focus on two main scenarios, shipping with Dubai as a hub, and alternatively, a direct shipping scenario. The details of this analysis are presented in subsequent sub-sections.

A. Adding New Destinations with Dubai as a Hub

We created a transportation matrix based on data collected in our market survey. New destinations such as Qatar, Kuwait, Bahrain and Saudi Arabia were added to OniOne's existing roster. The anticipated demand values for the new destinations (41.25, 33, 30, and 50 tonnes, respectively) were approximate estimates. The cost per ton of procuring onions across these new transit routes were obtained from OnionCorp. All other OniOne rates and market figures were left unchanged. Demand figures for Dubai, and the anticipated demand of new destinations were added to the extant field data. With the addition of the new destinations, our optimization analysis suggests that the total turnover for OniOne will be AED 655,824, which is approximately twice the amount obtained earlier. A similar pattern is observed when we compare these modelled results with OnionCorp's turnover for the same month (an increment of AED: 105,607).

TABLE III
 NEW DESTINATIONS ADDED TO ONIONE

	DUBAI	MUSCAT	QATAR	BAHRAIN	SAUDI	KUWAIT	SUPPLY
INDIA	1925	0	0	0	0	0	15.06
PAKISTAN	1885	0	0	0	0	0	18.1
DUBAI	1561	1255	1792	1809	1900	2379	260.27
IRAN	1390	0	0	0	0	0	40.36
EGYPT	1870	0	0	0	0	0	5.86
CHINA	1623	0	0	0	0	0	15.98
YEMEN	2534	0	0	0	0	0	18.85
DEMAND	144.71	75.52	41.25	33	30	50	

B. When Dubai Is Not Used as a Hub

One respondent in our market survey argued that, in the case of Indian onions, removing Dubai as a hub would lead to a considerable increase in turnover. As mentioned earlier, Indian onions constitute a big portion of produce transported from Dubai. Consistent with the views of our respondent, the analysis in Table III suggests that while transporting goods from Dubai to other GCC countries is a convenient option, transporting directly yields a minor increase in turnover. Direct transportation costs AED 652,129, which is a slight improvement on the extant figures of AED: 655,824. While not a significant improvement, this analysis suggests that the role of Dubai as a hub is not a given, and may be reconsidered in certain cases.

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VIII. DISCUSSION & CONCLUSION

Our quantitative analysis and market survey collectively suggest three insights for trade in conventional market sectors, such as onion trading. First, trading firms limit themselves to conventional modes of operation (such as avoiding new trading destinations, and supply chain arrangements) due to the inherent risk and uncertainty involved in changing these elements. Second, local markets involve many intrinsic aspects, which in some instances can be modelled (propensity of customers to not pay etc.) and in other instances cannot (preference for verbal contracts). Hence, local knowledge of traders remains important to supply chain decisions. Third, the role of hub cities in perishable product supply chains is not a given, and instead should be examined empirically by firms. It is our hope that simple analyses, as illustrated in the current paper, can allow firms to better navigate the complex issues of the onion trade.

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