

PROCUREMENT MODELS IN THE AGRICULTURAL SUPPLY CHAIN: A CASE STUDY OF ONLINE COFFEE AUCTIONS IN INDIA

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Abstract

During the past few years, several innovative IT based applications have emerged around the world that promise to bridge the proverbial digital divide by linking growers directly to domestic and international markets through the internet. Online commodity auctions are an example of such initiatives and have the potential to impact the livelihood of millions around the world. However, an important factor that affects the benefits obtained by growers is the supply chain structure that results from the introduction of the online platform. In this paper, we provide a case study of an online coffee auction established in India for selling various grades of coffee beans. The focus of the case study is on the supply chain structure that is likely to evolve under various product and supplier characteristics. We argue that the online direct selling of commodities by growers is likely to evolve only under a certain set of conditions. We also argue that governments and platform providers can facilitate online direct selling by growers through initiatives that increase the bargaining power of the growers and increase the confidence of the buyer to directly procure from lesser known growers.

Keywords and Phrases: Auction, digital divide, agricultural auction, procurement model, commodity auction

Acknowledgements: The authors would like to gratefully acknowledge ITC (India) Limited and Mr. Rajasekhar (CIO) for valuable discussions regarding the analysis presented here. We would also like to thank three anonymous referees and the Associate Editor for valuable comments on an earlier version of the paper. Authors are listed alphabetically and contributed equally to the project.

1.0 INTRODUCTION

In many parts of the developing world, the proverbial “digital divide” is of grave concern to governments, developmental agencies, economists and others concerned with the growing income inequality between the rural poor and the urban rich in these nations. There is accumulating evidence in the trade literature of a global divide between the developed and the developing world, as well as a social divide between the rich and poor within the same society [37]. It is often argued that ubiquitous information technology (IT), the Internet and globalization has led to significant income increases for the urban rich, while the vast majority of the rural population in developing countries remains mired in abject poverty [6].

At the same time, the Internet is often viewed as the means to reduce income disparities between the urban and rural populations in the developing world [5, 42]. Consequently, numerous innovative information technology (IT) based applications have emerged around the world that promise to bridge the digital divide. Such applications include the e-choupal project in India that is used by farmers to sell wheat and soybean directly to commodity exporters through internet kiosks placed in several thousand villages [49], online cooperatives of artisans in Latin America to sell products to end consumers around the world [3], and online coffee auctions in Brazil [45]. The purpose of these initiatives is to transform the agricultural supply chain by linking the rural communities to the internet, providing producers with access to the international markets, reducing unfair trading practices and eliminating intermediaries who often absorb a significant portion of the producers’ margins.

Auctions to buy and sell agricultural commodities are an important part of the agricultural supply chain in many regions of the world [13, 23, 33]. In recent years, agricultural auctions have been experimenting with online formats, where the physical auction environment is imitated in an online setting. The projected benefits of the online environment include lower transaction costs for buyers and sellers, daily operations, better price and product information, less collusion among buyers, fewer intermediaries, and a more streamlined agricultural supply chain.

While online commodity auctions and other internet enabled commodity procurement methods have the potential to affect the lives of millions of people who live on the other side of the proverbial “digital divide,” many are skeptical that the benefits actually reach the rural communities [6]. A series of recent articles in the *The Economist* that analyze the impact of the digital divide argues that access to mobile phones and basic infrastructure is more important than access to the Internet [4, 7]. On the other hand, others have argued that access to the Internet can lead to the integration of global labor markets, provide farmers with direct access to international markets, and reduce income disparities [42]. An important factor that affects the benefits obtained by farmers from the online platform is the commodity supply chain structure that results from the introduction of internet enabled commodity procurement methods. Intuitively, direct procurement from farmers through the online platform results in the elimination of intermediaries and consequently, higher prices for producers [3, 49]. However, it is not entirely clear whether direct procurement is the dominant procurement model that will result from the online platform.

In this paper, we provide a case study of a recently setup online auction in India for trading various grades of coffee. The focus of the case study is on the alternative supply chain structures that result from the introduction of the online auction. The electronic auction is operated by the International Business Division of ITC Limited (ITC-IBD), a large conglomerate in India with annual revenue of approximately \$ 2 Billion. ITC-IBD procures agricultural commodities from the commodity markets in India and sells to several international customers. The online coffee auction described here is part of a major initiative (popularly known as e-choupals) by ITC Limited to transform the agricultural supply chain in India and reach the rural masses through computer kiosks located in several thousand villages [49]. The e-chaupal initiative was originally focused on wheat and soybean farmers and the online coffee auction is part of its new growth phase.

The online coffee auction mimics an existing physical auction held weekly by the Indian Coffee Traders Association (ICTA) in the southern city of Bangalore in India. Buyers, who are typically commodity exporters that sell coffee in bulk to the international trading houses, have several alternatives in procuring coffee from the planters, such as through intermediaries, at the physical ICTA auction, or through the online coffee trading platform described here. We describe these procurement models later in the paper.

The case study presented here is focused on three important but related research questions that arise in the context of online commodity supply chains. First, it is well recognized in the IS literature that the introduction of an electronic trading platform influences the industry structure, the supply chain, and the participants in ways that are

often unpredictable [36, 41]. We identify and analyze four different procurement models for commodity exporters that result from the introduction of the online auction platform. Each of these models has its advantages and disadvantages and some include the services of intermediaries. Using the Process-Stakeholder approach to analyzing exchange transactions [32], we describe the benefits to buyers and sellers under each procurement model. Second, we identify the conditions under which each procurement model is likely to evolve as the preferred model for commodity exporters. We focus on characteristics of the commodity that affect the choice of the preferred model. By doing so, we provide insights on the types of commodities that are likely to be procured using each of the four models. Third, we focus on the role of governmental agencies and platform providers in “bridging the digital divide” and ensuring that the benefits actually reach the producers.

The case study approach provides several benefits in studying the emerging online commodity procurement platforms. The findings from the case study can be used to form the basis for more sophisticated models and empirical analysis. Further, the flexibility of the case study approach is particularly well suited to emerging areas of research where well-established theories and a-priori hypotheses do not exist. It allows us to analyze what we observe, draw conclusions and develop frameworks that emerge from the data and observations.

The rest of the paper is organized as follows. In section 1.1, we provide a brief literature review and a summary of the contributions of this research. In section 2, we describe the research process we follow in conducting the case study. In section 3, we describe the coffee supply chain in India and the market conditions prevailing at the time of the case study. In section 4, we describe the online and physical ICTA auction formats.

We also describe the four procurement models that result from the introduction of the online format. We also summarize the results of an earlier empirical analysis that compares the price of coffee sold through the online and physical auction formats [14]. In section 5, we discuss the benefits of the four procurement models to buyers and sellers and then utilize this comparison to predict the dominant procurement model that is likely to evolve under different product and seller characteristics. Section 6 concludes the paper, discusses the role of governmental agencies, and outlines areas of future research.

1.1 Literature Review

The information systems (IS) literature has extensively examined analytical models of online auctions in the consumer-to-consumer (C2C) and business-to-consumer (B2C) contexts (see [40] for a recent survey). Typical research issues that are important in the C2C and B2C contexts include trust building [25, 29], reputation mechanism design [24], and optimal design of online auction mechanisms [15]. Empirical research on B2C online auctions have focused on price differences [34], consumer surplus and product variety [18], trust building [8, 38] and the frictional costs of submitting new bids [28].

In the business-to-business (B2B) context, recent research in the IS area has examined the optimal design of combinatorial and multiunit auctions [39]. Typical issues addressed in this research include algorithms for winner determination [43] and real time bidder support strategies [1]. Several analytical models have also been proposed in the IS literature on the use of online auctions to support integrated supply chains [12, 27]. Empirical research on B2B online auctions has been relatively sparse, perhaps due to the difficulty in obtaining data. An exception is presented in [46] that empirically evaluates the procurement of IT services by U.S. businesses through online auctions.

We contribute to the literature on B2B online auctions in several ways. First, the nascent electronic auctions that trade in agricultural commodities provide an excellent and unique opportunity to study the differences between the electronic and physical trading formats. By providing a case study of such auctions, we lay the groundwork for subsequent modeling, empirical analysis and the development of theory related to online agricultural commodity auctions. Second, we analyze the different procurement models that are likely to co-exist in this environment and the benefits of each model under different conditions. The ideas presented in this section of the paper can be used as the basis for more formal, game-theoretic models of the procurement process. Finally, we also contribute to the growing literature that focuses on the use of IT in the global context [31, 48, 52]. Most of this research stream has focused on the use of IT by multinational firms. In contrast, we provide a fresh perspective by examining the role of IT based initiatives in global commodity supply chains. We also examine the role of governmental agencies and platform providers in ensuring that the benefits of the online platform reach the rural population.

2.0 THE RESEARCH PROCESS

According to [51, page 59], the distinguishing characteristic of a case study is that it attempts to examine “a contemporary phenomenon in its real-life context, especially when the boundaries between phenomenon and context are not clearly evident.” To fully understand the interplay between the phenomenon and its context, evidence can come from observations, verbal reports, archival records, quantitative data, or any combination of these. Often, the researcher has to rely on multiple data sources that are determined by

the phenomenon being studied. Further, to integrate the evidence collected from diverse sources, the narrative description of the case study is often organized around specific propositions or questions, with the flexibility to modify these topics as the research progresses [51].

Consistent with this approach, we conduct the case study described in this article by collecting data about the various procurement models for commodities that result from the introduction of an online trading format through interviews, website reviews, trade and newspaper articles, and an analysis of transaction data from the online auction. We also examined transaction summary data from the physical ICTA auctions. The data collected by us is organized using the process-stakeholder framework of exchange transactions (described later in the paper) to understand the benefits of each procurement model for the various stakeholders. Figure 1 provides a summary of the research process. The figure shows the steps in the process, the type of data analyzed, and the outcome of each step. It also shows the section of the paper where each step is described in more detail.

INSERT FIGURE 1 ABOUT HERE

In order to understand the coffee supply chain and its participants, major legislation related to commodity trading, industry organizations and their role, coffee grading schemes, and international commodity markets, we conducted an extensive and informal review of the websites of commodity traders and exporters, prominent coffee plantations, coffee boards, the Indian Coffee Traders Association, and online commodity auction

platforms. We also did a review of the trade literature and newspaper articles to better understand the market trends. A summary is provided in section 3.

We also interviewed multiple times (face-to-face and on the phone) 5 experts from ITC-IBD (the online auction platform provider and a prominent commodity exporter) and spent significant time with the Chief Information Officer of ITC-IBD to better understand the procurement models used by commodity exporters, their motivation behind initiating the online auction format, and the mechanics of the online and the physical ICTA auctions. After completion of an analysis of the transaction data from the online auction, we provided them with a written summary of our findings and explanations, and obtained feedback on our interpretations. Details of the procurement models and the auction platforms can be found in section 4.

We also obtained transaction data from the ICTA physical auction from the State Coffee Board that manages the auction. We compared the closing prices at the online auction of various grades of coffee with the corresponding prices at the physical ICTA auctions. This analysis helped us to identify the factors that affect the difference in price between the two formats. The detailed analysis can be found in [14] and is summarized in section 4.

We then used the process-stakeholder approach described in [32] to organize the information collected and compare the procurement models that result from the introduction of the online auction format. Based on this comparison, we developed a simple 2x2 model that predicts the preferred procurement model under different product and supplier characteristics. This analysis can be found in section 5.

3. COFFEE SUPPLY CHAIN, PARTICIPANTS AND AUCTIONS

3.1 The Coffee Supply Chain in India

The coffee supply chain in India consists of four major players: (a) *planters* who are the coffee growers and plantation owners, (b) *exporters* who contract with international trading houses and international roasters, (c) *domestic roasters* who produce coffee for the domestic market, and (d) *intermediaries* such as agents, brokers and traders who perform several roles such as searching for buyers and sellers and negotiating deals on behalf of other participants. Planters sell the coffee through intermediaries or they sell directly through the weekly coffee auctions organized by various industry organizations such as the Indian Coffee Traders Association. Likewise, exporters and domestic roasters buy coffee through intermediaries or directly from the planters at the weekly coffee auctions. Intermediaries, such as agents and brokers, also participate in the weekly coffee auctions.

India produces about 275,000 metric tons of coffee per year. Indian coffee represents 4.7% of the total global production, and Indian exporters are price takers in the global market. About 65% of the area under coffee cultivation in India is held by small farmers with an average of 1.4 hectares. Large holdings represent 35% of the area under cultivation, with an average holding size of about 34 hectares. Domestic consumption accounts for only 58,000 tons, with the rest (78%) exported. Coffee planters are significantly richer, educated and more sophisticated than typical Indian farmers.

3.2 Coffee Grades

The berries of the coffee plant, both the Arabica and Robusta varieties, are subjected to on-farm processing to extract the bean in its raw form. Based on the type of on-farm

processing, four types of raw coffee beans are traded in the market: (a) Washed Arabica or *Arabica Parchment*, (b) Unwashed Arabica or *Arabica Cherry*, (c) Washed Robusta or *Robusta Parchment*, and (d) Unwashed Robusta or *Robusta Cherry*. Each of these four types of coffee beans is further graded using international standards into several sub-grades (PB, AA, A, B, C and BBB), based on the bean size (measured through standard sieves), and the percentage and type of imperfections present¹. Coffee prices at the auctions are quoted for specific sub-grades.

3.3 Regulations and Market Trends

Like other commodities in various parts of the world, the trading of coffee in India was highly regulated by the government to protect the interests of the producers and reduce unfair trading practices. The Coffee Board, constituted under the Coffee Act of 1942, had monopolistic control over the marketing of coffee in India until 1995. Buyers, such as exporters and domestic roasters, procured coffee through public auctions monitored by the Coffee Board. With liberalization of the coffee industry since 1995, the marketing of coffee is strictly a private sector activity, with buyers contacting and negotiating with planters directly or through intermediaries. The Coffee Board now serves as an advisory and research organization that promotes the Indian coffee industry. Similar liberalization movements have also occurred in other commodities around the world. The online trading platform by ITC-IBD is a result of this liberalization.

The New York and London futures markets exert a strong influence on coffee prices. The prices at these markets are known to be volatile on a weekly or even daily basis based on projected supply and demand. However, the price variance is consistently

¹ See the website of the Indian Coffee Board (<http://www.indiacoffee.org>) for more details on the grading scheme

higher at the international markets than in the Indian markets. Coffee prices in the Indian coffee auctions averaged between INR² 24.60 and INR 59.80 during the one year period of the study (2002-2003), depending on the coffee grade. International yearly price variances at the New York (Arabica) and London (Robusta) coffee exchanges were INR 49.70/Kg and INR 35.94/Kg, respectively. The corresponding yearly price variance at the Indian coffee auctions ranged between INR 12.24/Kg and INR 29.64/Kg. The market at the International level is highly competitive. Although Indian coffee exports have increased over the years, lower commodity prices have led to significant decreases in profit margins for many planters during certain years. For example, the price of Arabica A, which was INR 97/ kg in January 1999, dropped to INR 53/ kg in January 2002 (the year for which we obtained transaction data from the online auction format), and had since climbed back to INR 100 / Kg in January 2005.

4.0 COFFEE AUCTIONS AND PROCUREMENT MODELS

4.1 ICTA and Online Auctions

The Indian Coffee Traders Association (ICTA), a cooperative of coffee planters and traders, holds a coffee auction every Thursday in Bangalore. The auction, which was earlier monitored by the Coffee Board, now represents an independent but important element of the coffee supply chain. It is the major weekly coffee auction held in India, but other auctions are also held in various coffee growing regions of the country. Planters, brokers and agents carry a sample of the coffee to the auction where the lots are sold through oral, ascending bid, English auctions in the presence of all the buyers. Each weekly ICTA auction has approximately 600 tons of coffee offered for sale, representing

² INR is Indian Rupees. \$ 1 = 45 INR approximately

approximately 300 lots per week. On a yearly basis, this accounts for approximately 11% of the total coffee production in India.

Unlike the ICTA auction, the online auction is open for business 5 days a week. Between 9 and 11 am every day, sellers submit information about the lots for sale on that day, such as the coffee type and grade, lot size, reservation price and details of the seller. Beginning at 11 am, lots are auctioned sequentially through an ascending-bid English auction. Each bid submitted is open for 3 minutes after which the lot is sold to the highest bidder. The auction concludes when all the lots have been processed, although some lots may remain unsold because no acceptable bids were received. Lots that remain unsold may be offered again on the following days or sold through other channels. The online auction is identical to the ICTA auction in all respects, except for the four dimensions described below.

4.2 Online Auction Differences and Supply Chain Impact

Table I highlights the differences between the online and physical ICTA auctions and discusses the impact of the difference on the supply chain structure. The online format differs from the physical ICTA auction along four major dimensions. First, it is well known that transaction costs are lower in the electronic format for several reasons [10, 40]. The participants do not have to travel to the auction site and do not incur the travel related costs associated with the physical ICTA auction. Further, since the electronic auction concludes fairly rapidly, the time commitment is lower for the participants. Second, the electronic auction operates daily, unlike the physical ICTA auction that is held once a week. Third, the electronic auction tends to attract more sophisticated sellers such as intermediaries and larger planters. The buyers, who are typically large

corporations and commodity traders, participate in both auctions. Fourth, one of the drawbacks of the electronic format is the inability to physically verify quality. This refers to both the touch-and-feel associated with the physical ICTA auction format, as well as the ability to interact with the sellers face-to-face.

INSERT TABLE I ABOUT HERE

Lower transaction cost in the electronic auction creates a market for less liquid commodities (traded less frequently). The higher transaction cost of the physical ICTA auction format increases the risk of the seller who may incur the transaction cost of the ICTA auction and not be able to find a buyer. Often, such commodities are sold through intermediaries who interface between buyers and sellers and have detailed local information on the availability of the commodity. The low transaction cost of the electronic auction allows the seller of less liquid commodities to participate directly and reduces the search cost of the buyer for such commodities.

For several reasons, the benefit of daily operations is more prominent for buyers than for sellers. As mentioned before, the price variance is consistently higher at the international markets than in the ICTA auctions. Since buyers typically sell at the international markets, they are under a greater pressure than sellers to complete a transaction at the daily electronic auction to take advantage of any changes in international coffee prices. On the other hand, the relatively long shelf life of coffee also increases the seller's ability to wait if they are not satisfied with the price. Buyers pay a higher price for the convenience of the daily format to avoid the price risk associated

with waiting. Commodities that have stable prices and that are widely available are also more likely to be traded at the physical ICTA auction because the benefit of daily operations is of less consequence to such commodities.

There is evidence in the IS literature of user heterogeneity in different auction formats [16]. In the context of coffee auctions, it is reasonable to expect that sophisticated intermediaries and larger planters are more likely to participate, at least initially, in the electronic auction format. Such planters and intermediaries are more aware of the online platform and have the necessary education and access required for participation. Further, the online auction creates a value added market where intermediaries buy coffee beans directly from the planters and sell in larger lots at the online auction. Further, the lack of face-to-face interaction with the seller will also reduce buyer trust [8], especially for smaller and unknown sellers. Consequently, more prominent planters and intermediaries will be the primary participants in the online auction market.

The IS literature has also emphasized the emerging role of intermediaries in electronic supply chains [2, 17]. In our context, the lack of face-to-face interaction in the online format will create a new role for intermediaries. Such intermediaries can buy from planters in small lots, verify quality, aggregate the lots and sell at the electronic auction. Larger planters who are more trusted by the buyers can sell directly at the online auction. The intermediaries create a value added market where the buyer is able to procure larger sized lots of known quality from reputable vendors. Smaller planters who want to sell directly will face a deflated price at the electronic auction and are more likely to participate in the physical ICTA auction.

4.3 Empirical Evidence from Price Comparisons

In an earlier analysis, we compared the price of various coffee grades in the electronic and physical ICTA auctions. The results are summarized here and more details about the models, statistical analysis and conclusions can be found in [14].

We found that the price of the same grade of coffee is approximately 4% higher in the electronic auction and the price difference is statistically significant at the 5% level based on a 2-tailed t-test of means. Further, we analyzed the factors that impact this price difference and found that coffee grades that have higher price volatility or that are traded less frequently have a higher price difference between the two formats. We also found that premium coffee grades that require a higher level of touch-and-feel to verify quality fetch a lower price at the electronic auction. Coffee is also traded in larger lot sizes in the electronic auction. The average lot size at the electronic auction is 9 metric tons, while the average lot size at the physical ICTA auction is 2 metric tons, and the difference is statistically significant at the 1% level based on a t-test of means. Conversations with ITC personnel indicated that the majority of participants in the electronic auction are intermediaries and large planters.

4.4 Alternative Procurement Models for Commodities

Interviews with ITC-IBD personnel revealed four different models that commodity exporters can use to procure coffee from the planters. These four models are shown in Figure 2. In the first model (Physical Mediated), the buyer procures coffee beans from the planters through intermediaries who find the planters with the right coffee beans and facilitate the transaction. The intermediary plays a critical role in bringing the buyers and planters together and creating the market. The intermediary operates with significant

local knowledge, such as the type and location of beans available, the quality of the beans, and the prevailing local price. Often, the intermediary acts on behalf of a single buyer, although it is possible for them to serve multiple buyers.

INSERT FIGURE 2 ABOUT HERE

In the second model (Online Direct), the planter sells the coffee beans directly through the online auction. There are no intermediaries in this model. The transaction is completed between the buyer and the planter and the logistics arranged bilaterally. The planter and the buyer incur low transaction costs because there is no travel required to the auction site, dialup internet access is fairly widely available in India, and the time commitment to participate in the online auction is low.

In the third model (Online Mediated), intermediaries buy the coffee from the planters, usually in smaller lots, aggregate the lots and sell through the online auction. Unlike the first model (Physical Mediated), the intermediary does not work on behalf of a single buyer and sells to multiple buyers through the online auction platform. In this model, the intermediary (who is known to the buyer), visually inspects the lots procured from the planters and implicitly certifies the quality.

In the fourth model (Physical Direct), the planter sells the coffee through the ICTA weekly auctions to the buyers directly. There are no intermediaries in this model. The buyer can evaluate the credentials of the seller and physically examine the coffee samples at the physical auction. The transaction cost for the buyer and planter are higher because of the travel and other related costs of the physical auction.

The four models shown above are somewhat simplistic and two variations are common that do not affect the subsequent analysis here. First, the buyers can sell excess coffee through the online auction. Second, intermediaries can also procure coffee through the ICTA auction on behalf of buyers or sell the coffee procured through the ICTA auction through the online auction.

5.0 ANALYSIS OF PROCUREMENT MODELS

5.1 A Process-Stakeholder Perspective of the Procurement Models

An useful model that appears in [32] for analyzing exchange transactions in the context of the Dutch flower auctions can be used to summarize the results of the case study described here. The process-stakeholder approach described in [32] identifies ten distinct processes within an exchange transaction. Table II summarizes the ten dimensions. It also describes how each of these dimensions is achieved in the four procurement models in the previous section. In describing each procurement model, we have chosen to include possible future extensions of each platform, rather than focusing on what is exactly provided at the current time. The online platform is in its infancy. Thus, including future extensions in the description will better enable us to predict the type of procurement model that is likely to emerge.

INSERT TABLE II ABOUT HERE

While it is not required for our purpose and somewhat tedious to explain the entire table in the narrative, a few points need to be highlighted. In the Physical Mediated model, the intermediary plays a very important role in searching for planters with a specific grade of coffee, negotiating prices on behalf of the buyers, arranging transportation and payment, and visually inspecting the product. The planters also enjoy a relatively easy selling process with the intricacies handled by the intermediary. The prominent role of the intermediary results in lower margins for the buyers and planters.

In the Physical Direct Model, buyers procure directly from the planters at the ICTA auction with the intermediary playing no role in the process. Search and price discovery is through the auction mechanism. Several aspects of the transaction are arranged bilaterally through face-to-face interaction. The product can be inspected visually and the ICTA auction rules and regulations are used to execute the transaction. Without intermediaries, the margins are higher for the buyer and planter, but they incur higher transaction costs associated with traveling to the ICTA auction. The auction is also once-a-week and the buyer cannot easily take advantage of price fluctuations in the international markets.

In the online mediated model, buyers buy from intermediaries who procure from the planters, consolidate lots, and sell through the online auction platform. The search and price discovery is through a combination of the online auction and through the intermediary. Since the buyer cannot physically verify quality, product details are communicated through product grade and sub-grade specifications. Since the buyer is procuring from known intermediaries in most cases, trust plays a role in mitigating the risks associated with product quality. Authentication and dispute resolution is through the

rules of the online auction. The presence of the intermediary lowers margins for the buyer and seller.

In the online direct model, the buyer procures directly from the planter through the online auction. Search and price discovery, as well as authentication and dispute resolution are through the rules of the online auction. However, the disadvantage to the buyer results from their inability to physically verify quality or rely on trusted intermediaries. Consequently, buyers are more likely to use this model for procuring from better known and larger planters, relying on their need to protect their own reputation. The advantages and disadvantages of each model that result from the discussion above are shown in Table III.

INSERT TABLE III ABOUT HERE

5.2 The Uncertainty-Verifiability Framework

The results of the empirical analysis presented in [14], as well as the advantages and disadvantages of each procurement model summarized in Table III, point to the impact of (a) price volatility, (b) product availability, and (c) the need for physical product verification on the relative advantages of each procurement model. The value of the daily format of the electronic auction is most pronounced for commodities that have higher price volatility as buyers can take advantage of price fluctuations in the international markets. Further, for products that are less liquid (traded less frequently), the low transaction cost of the electronic auction creates a market by allowing sellers to participate without the risk of incurring a high transaction cost and not finding a buyer.

On the other hand, the electronic auction makes it difficult to verify quality of the product and the lack of face-to-face interaction works against lesser known sellers.

Literature on transaction cost economics (TCE) suggests that firms choose governance structures that minimize transaction costs [50]. In our context, transaction costs for the buyer and planter must also include the uncertainty that arises from the degree of price volatility, product unavailability and the inability to visually verify quality. These three components of transaction cost vary based on the product characteristics and the chosen procurement model. The procurement model that minimizes this total transaction cost for a specified set of product characteristics, will emerge as the dominant model for that situation [35].

We use the framework presented in [35] to organize these three dimensions into a 2x2 framework that predicts the dominant procurement model. In [35], uncertainty is defined as the cost associated with unexpected outcomes and information asymmetry. The article defines two dimensions of uncertainty – product and process uncertainty. Product uncertainty refers to the possibility that the product may not meet the expectations of the buyer at the time of purchase. In our context, the *need for physical verification* of quality is associated with this dimension of uncertainty. Higher grades of coffee have a higher need for physical verification than the lower grades of coffee. Indeed, our empirical evidence suggests that such grades are associated with lower prices on the online auction format. Further, process uncertainty is defined as the uncertainty associated with the transaction process, such as product availability, price uncertainty and on-time delivery [35]. In our context, both price volatility and availability are associated with this dimension of uncertainty. We term this dimension *Process Uncertainty*.

Figure 3 shows how these two dimensions (*Process Uncertainty* and the *Need for Physical Verification*) affect the choice of the procurement model. The *online mediated* model is preferred when process uncertainty is high and there is a need to physically verify quality. Trusted and well-known intermediaries procure the commodity from planters and sell in larger lots at the online auction. Buyers benefit from the daily format of the online auction and rely on trusted intermediaries to verify the quality of the product. The reputation of the intermediary plays an important role in reducing the risk for the buyer while preserving the benefits of the daily format. The buyer pays a premium for the reduced risk and the higher liquidity associated with the daily format. We also expect intermediaries to specialize in this procurement model, where they focus on specific coffee grades or regions of the country to develop and exploit local knowledge.

INSERT FIGURE 3 ABOUT HERE

When process uncertainty is high and the need for physical verification is low, such as for commodities where price is the only differentiator, the *online direct* model emerges. The high process uncertainty places a premium on the daily format of the online auction. Further, buyers are willing to buy directly from smaller and lesser known planters (without intermediaries) when they have a lesser need to verify quality. The role of trusted intermediaries is reduced in this situation.

When process uncertainty is low, the value of the daily format of the online auction is reduced. Further, when the need for physical verification of quality is high, the buyer procures through trusted intermediaries and the *physical mediated* model emerges as the

choice. The buyer relies on these intermediaries to verify quality. In this model, the intermediaries contract with specific buyers and procure on their behalf. The buyer sees little benefit in the daily format of the online auction and prefers stable, long term relationships with preferred intermediaries.

With low process uncertainty and a lesser need for physical verification of quality, the *physical direct* model emerges as the choice. The buyer is willing to wait for the weekly physical ICTA auction and can procure directly from smaller and lesser known planters. The role of intermediaries is reduced in this model. This model is suited for true commodities with stable prices and availability, and where product specifications are clear and quality variations are minimal.

It is important to understand that the four models described above are “pure” models and a combination of the above approaches may be used by buyers. The purpose of the above discussion was to analyze the type of supply chain model that is likely to evolve under varying combinations of product uncertainty and need for physical verification. In reality, commodities may not be classified into one of the four categories in Figure 2, and will fall somewhere in a continuum between the four extremes. For example, some commodities may have high price volatility but may be widely available. In that case, process uncertainty may be classified as medium. However, the analysis above provides insights on the dominant (not exclusive) supply chain model that is likely to emerge in each situation.

5.3 The Role of the Intermediary

An interesting question that arises in this context is the role of the intermediary in the redefined supply chain. Intuitive reasoning suggests that the introduction of an online

platform should lead to disintermediation by directly connecting buyers and planters. It is interesting to note, however, that in two of the four procurement models in Figure 3, the intermediary plays a prominent role.

This is consistent with recent research in IS that points to a new and redefined role of the intermediary in electronic supply chains [20]. The well known “move to the middle hypothesis” posits that firms will enter into a set of stable relationships with few suppliers [21]. This is consistent with the physical and online mediated models in Figure 3 where the buyers procure from a smaller set of intermediaries rather than directly from more numerous planters. Several authors have also argued that electronic markets lead to specialization and new roles for intermediaries [9, 22, 44]. In our context, one can envision several new and specialized roles for intermediaries. Intermediaries already play an important role in consolidating lots from multiple buyers in the online mediated model. They also often arrange for transportation and manage logistics for buyers and planters in the other procurement models. There is also a need for intermediaries to provide storage facilities, grading and certification services, and financing for planters.

5.4 A Comparison with Dutch Flower Auctions

Dutch Flower auctions are examples of agricultural commodity auctions that have been well studied in the literature (see [32] for a summary). It is interesting to compare the differences between Dutch flower auctions and the Indian coffee auctions examined in this paper. The primary differences can be summarized along three dimensions:

- (a) *Product Shelf Life*: Flowers have a shelf life of a few days, while coffee beans have a long shelf life of several months. This difference in the two products has two implications. First, coffee planters are willing to wait a longer time for an acceptable

price and often withdraw lots that are offered for sale at the auction if the price is too low. Second, the daily format is more valuable for Dutch flower auctions, while a weekly format is often adequate for the coffee auctions to balance speed and the transaction costs incurred to participate on a daily basis.

- (b) *Grading and Quality Specifications:* Coffee as a commodity has a well defined grading scheme based on internationally accepted standards, while the grading schemes available for flowers in the Dutch auctions are more rudimentary and ill-defined. Thus, coffee is better suited for remote trading, such as through an online auction, since the need for visual inspection is lower than that for flowers. Video based remote trading schemes in the Dutch Flower auctions has met with limited success because buyers considered it as an inadequate means of judging quality [32].
- (c) *Buyer Fragmentation:* More than 5000 wholesalers and retailers participate as buyers in the Dutch flower auctions. In contrast, the Coffee Board of India website lists fewer than 200 commodity exporters, and only a handful of these are major commodity exporters such as ITC-IBD. Since the market is less fragmented, the physical mediated model serves as a useful alternative to the online and ICTA auction mechanisms for coffee procurement.

While we provide a preliminary analysis of these differences, we envision that future research will further explore these issues to determine the types of commodities that are most suited to the online auction format.

6. SUMMARY AND CONCLUSIONS

6.1 Revisiting the Digital Divide

Does the introduction of an online commodity auction format reduce the digital divide and bring the benefits of the Internet to the rural communities? We argue in this paper that the online direct model, which connects smaller and lesser known planters directly to buyers, emerges as the dominant model only under certain situations. In two of the other supply chain models, intermediaries play an important role in the supply chain and are likely to appropriate significant economic rents for the value they provide. An important issue that arises in this context focuses on the role of governments and platform providers in ensuring that the benefits of online platforms are disseminated to the smaller and lesser known planters in the supply chain. We outline four initiatives that can further such an objective.

First, the development of a quality verification scheme for commodities should precede the establishment of the online auction. While the grading scheme is well specified, quality certification by the government or trusted intermediaries will ensure that the coffee is indeed of a certain quality. This will reduce the need for physical verification of quality and increase the confidence of buyers participating in the online auction and procuring directly from lesser known planters. Governments can provide the infrastructure for quality certification, although such an infrastructure can also be created by the platform providers and intermediaries.

The marketing literature on two party channel negotiations between manufacturers and retailers provides insight on how the surplus created by the online auction will be shared between buyers and sellers [11, 26, 30, 47]. The basic premise of this literature is

that bargaining power is an important determinant of the outcome of price negotiations [30]. Two factors increase the bargaining power of the seller – the ability to wait to complete the transaction and the availability of information on buyer valuations of the product [19]. Thus, governments and platform providers can create an infrastructure of adequate storage facilities that increase shelf life of the commodity. This will allow planters to sell the product when it is most beneficial and will increase their bargaining power. Further, governments can mandate that current prices at the international markets be made available to the seller, so that they have better information on buyer valuations. In addition, another way to increase the bargaining power of the sellers is through planter cooperatives that consolidate smaller planters, provide legitimacy, increase lot sizes, and provide economies of scale in logistics. Governments can support and encourage the emergence of such cooperatives.

In conjunction with the above two initiatives, a third important role of the government will be to provide the IT and Internet infrastructure in the villages so that the planters can directly trade on the online platform. This will assist the smaller planters in two ways. First, it reduces the transaction cost associated with traveling to the physical auction and creates tangible savings for the smaller planters whose small lots can make the transaction cost a heavy burden to bear. Second, it reduces the power of intermediaries, whose primary purpose is often to locate commodity sellers for buyers. This will move more commodities from the physical mediated to the online direct models of procurement.

Collusion in agricultural commodity markets in India and elsewhere in the developing world is a well known phenomenon [13]. Buyers collude by rotating bids among

themselves to avoid bidding against each other. This drives the selling price of the commodity down. To prevent collusion and other related unfair practices, governments have often mandated the sale of commodities only through monitored and approved auctions. With liberalization and the removal of such regulations, many are concerned that collusive behavior among buyers will result in lower commodity prices. We believe that the online platform has the potential to reduce unfair trading practices for a variety of reasons. First, the lack of physical proximity can reduce cooperation among buyers. Second, records of all bids and transactions are retained in online auctions and can be analyzed to detect collusive and unfair practices. An important role of the government is to insist that online auction records be made public and provide periodic audits to track unfair practices.

In summary, the online trading format has the potential to increase the price obtained by planters by allowing them to directly sell the commodity to buyers, and to reduce the transaction cost for the planters. However, merely installing an online trading format will not bridge the proverbial digital divide. Action by governments and platform providers along the three dimensions described above will ensure that more of the benefits of the online platform actually reach the rural communities.

6.1 Future Research

The purpose of a case study is to explore an emerging research area and provide preliminary understanding. We conclude this case study with a call for further research on this important but often ignored area. First, game theoretic and analytical models of the agricultural supply chain can formally analyze the ideas presented here. Second, empirical evidence on the benefits actually obtained by farmers under the various

procurement models will provide insights on the best policies to bridge the digital divide. Finally, further analysis of successful and failed implementations will provide a better understanding of the success factors of such initiatives.

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STEP	DESCRIPTION	OUTCOME	SEC
<div style="border: 1px solid black; padding: 5px; text-align: center;">Analysis of websites and trade articles</div>	<p>Analyzed websites of coffee exporters, traders, coffee boards, research organizations, coffee plantations and online platform providers. Examined trade and newspaper articles related</p>	<p>Coffee supply chain and participants Recent laws and regulations Market conditions and trends</p>	3
<div style="border: 1px solid black; padding: 5px; text-align: center;">Interviews with experts</div>	<p>Numerous face-to-face and phone interviews with ITC personnel to understand the procurement models used by commodity exporters. Written feedback on data analysis and interpretation.</p>	<p>Commodity procurement models used by exporters Online and physical ICTA auction mechanics, benefits and drawbacks</p>	4
<div style="border: 1px solid black; padding: 5px; text-align: center;">Analysis of Transaction Data</div>	<p>Compared prices of various grades of coffee at the online and physical ICTA</p>	<p>Factors that affect the difference in price between the two formats</p>	4
<div style="border: 1px solid black; padding: 5px; text-align: center;">Process Stakeholder Perspective</div>	<p>Organized the information collected using the process-stakeholder perspective</p>	<p>Benefits and drawbacks of each procurement model The Uncertainty-Verifiability framework to predict procurement model choice</p>	5

Figure 1: The Research Process and Organization of the Paper

Table I: Impact of the Online Platform on Market Structure

Electronic Auction Characteristics	Market Structure Impact
Lower Transaction Cost	For commodities that are traded less frequently, the lower transaction cost of the electronic format allows the seller to participate at lower cost and sell directly to the buyer. The seller is less willing to participate in the physical ICTA auction because of the risk of incurring transaction costs and yet not finding a buyer. Often, markets for such commodities are created through intermediaries.
Daily Operations	Commodities that have higher price volatility are more likely to be traded at the electronic auction than at the physical auction. Commodities with stable prices benefit less from the daily operations of the electronic auction format. Further, domestic roasters who do not trade at the international markets and consequently face lower price volatility, are less likely to benefit from the daily format of the online auction and are unwilling to pay the higher price at the online auction.
Experienced Participants	Sellers in the electronic auction tend to be more sophisticated. They are usually intermediaries or larger planters with better resources and access to the Internet. The electronic auction also creates a role for intermediaries who buy directly from planters or from the physical ICTA auction in small lots, aggregate the lots and find buyers through the online auction. They can act as trusted intermediaries for buyers who appreciate the lower quality risk associated with buying from trusted parties in larger lots.
Lack of Face to Face Interaction	Trusted intermediaries and more established planters have an advantage in the electronic auction because the buyers view them as trusted partners. Thus, intermediaries may buy from the planters, verify quality and sell at the electronic auction.

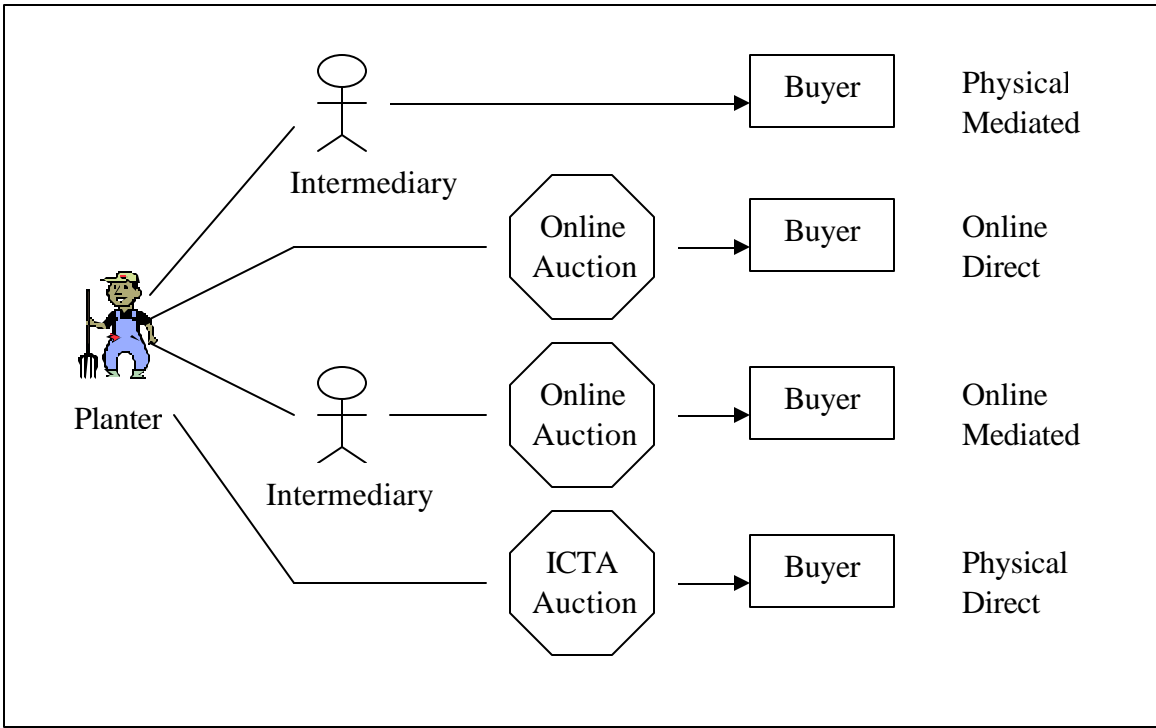


Figure 2: Alternative Supply Chain Models for Commodity Procurement

Table II: Process Based Comparisons of the Four Procurement Models

Dimensions	Physical Mediated	Physical Direct	Online Mediated	Online Direct
Search The information gathering process	The intermediary searches for sellers on behalf of buyers	The buyer finds a seller through the ICTA auction	The intermediary searches for sellers, consolidates lots and sells through the online auction	The buyer finds a seller through the online auction
Valuation Negotiating and discovering a purchase price	Price discovery through intermediary who communicates price to seller	Price discovery through the auction mechanism	Price discovery through a combination of intermediary and auction mechanism	Price discovery through the auction mechanism
Logistics Coordinating the delivery of goods and services	Arranged through the intermediary who can arrange for transportation and payment	Arranged face-to-face between buyer and seller. Future 3PL services through the auction are possible.	Arranged between buyer and intermediary. Future 3PL services through auction are possible	Arranged between buyer and seller. Future 3PL services through auction are possible
Payment Ensuring the settlement of invoices	Arranged through intermediary who pays the seller and collects from buyer	Arranged face-to-face between buyer and seller based on auction rules.	Arranged through the online auction platform based on rules	Arranged through the online auction platform based on rules
Authentication Authenticating parties and monitoring contract compliance	Authentication through trusted intermediary who contacts qualified sellers and buyers	Authentication through face-to-face interaction between buyer and seller.	Authentication through trusted intermediary and through the online auction platform	Authentication through the online auction platform
Communications and Computing Communication and computing	Communication through intermediary	Face-to-face communication between buyer and seller	Limited communication through the online platform	Limited communication through the online platform
Product Representation How product attributes are specified	Visual inspection and coffee type and sub-grade specification	Visual inspection and coffee type and sub-grade specification	Coffee type and sub-grade specification	Coffee type and sub-grade specification
Legitimation Validating the trading agreement and defining the rules.	No formal mechanism	By the physical auction rules and regulations	By the online auction rules and regulations	By the online auction rules and regulations
Influence Structures Enforcing obligations and penalties for non-compliance	No formal mechanism	By the physical auction rules and regulations	By the online auction rules and regulations	By the online auction rules and regulations
Dispute Resolution Resolving disputes and specifying decision rights	No formal mechanism	By the physical auction rules and regulations	By the online auction rules and regulations	By the online auction rules and regulations

Table III: Advantages and Disadvantages of Each Procurement Model

Model	Advantages	Disadvantages
Physical Mediated	<p>For Buyers Intermediary uses local knowledge to find sellers Trusted intermediaries perform visual inspection</p> <p>For Planters Easier selling process without auction participation</p>	<p>For Buyers Lower margins due to intermediary Slow and time consuming process Power of intermediaries</p> <p>For Planters Lower margins due to intermediary</p>
Physical Direct	<p>For Buyers Easier search and price discovery through auction Increased margins due to direct purchase</p> <p>For Planters Increased margins due to direct sale to buyers</p>	<p>For Buyers Smaller lots Higher costs of physical auction Once a week operation</p> <p>For Planters Higher costs of physical auction</p>
Online Mediated	<p>For Buyers Larger lot sizes Buying from trusted parties Daily operations Lower cost of online auction participation</p> <p>For Planters Easier selling process without auction participation</p>	<p>For Buyers Lower margins due to intermediary</p> <p>For Planters Lower margins due to intermediary</p>
Online Direct	<p>For Buyers Easier search and price discovery through auction Increased margins due to direct purchase Lower costs of online auction participation Daily operations</p> <p>For Planters Increased margins due to direct sale to buyers</p>	<p>For Buyers No visual inspection of quality</p> <p>For Planters No intermediaries to assist in the selling process</p>

Need for Physical Verification

		High	Low
Process Uncertainty	High	Online Mediated	Online Direct
	Low	Physical Mediated	Physical Direct

Figure 3: Choice of Procurement Models