Supply Assurance, Relational Contracts and Vertical Integration: Evidence from Costa Rica's Coffee Chain

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Abstract

This paper studies vertical integration between coffee mills and exporters in Costa Rica - a context in which demand and supply assurance considerations are important. Vertical integration is compared against both forward contracts and relational contracts. Detailed data on transactions between and within firms reveal that trade within integrated chains is insulated from market forces and vertical integration achieves better supply assurance. Trade responses to unanticipated shocks to reference prices show that, due to strategic default, both formal and relational contracts are only imperfect substitutes for integration. Integration's benefits, however, come at the cost of worse market access and relationships with independent suppliers. The evidence strongly supports models in which firms boundaries alter temptations to renege on relational contracts. Policy implications for export-oriented agricultural chains in developing countries are discussed.

Keywords: Firm Boundaries, Vertical Integration, Forward Contracts, Relational Contracts, Supply Assurance.

JEL Codes: D23, L14, L22, O12, Q13.

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1 Introduction

Since Coase (1937) seminal contribution, economists have been interested in understanding how resource allocation within firms differs from allocation between firms. This question is of central importance in fields as diverse as industrial organization, international trade, public and corporate finance, and development.[1] Important theoretical contributions recognize contractual imperfections as the keystone upon which the foundations of any theory of the firm must be laid (see, e.g., Gibbons (2005)[2]). In many real-world commercial circumstances, however, contractual parties also rely on repeated transactions – relational contracts – to deal with these very same contractual imperfections.[3] A full understanding of how firm boundaries affect resource allocation, therefore, requires a comparison between integration and relational contracts (see, e.g., Baker, Gibbons and Murphy (2002)).

This paper compares trade within firms against trade between firms in the context of the Costa Rica coffee chain. We focus on the relationships between coffee mills selling coffee to buyers (either domestic roasters or exporters) and argue that in this context demand uncertainty induces supply and demand assurance concerns for buyers and mills respectively. We ask three questions: 1) Does trade within firms look different from trade between firms?; 2) If yes, why can't formal and/or relational contracts replicate the trading patterns achieved by integration?; and, finally, 3) Do the benefits of integration also imply its costs?

On the first question, we show that trade within firms is insulated from market forces: integrated trade doesn't display the timing of contracting and pricing patterns associated with demand uncertainty. On the second question, trade responses to unanticipated shocks to international coffee prices reveal that trade between firms is left exposed to strategic default, while trade within firms isn't. Finally, on the third question, we show that the benefits from integration come at a cost: when trading with independent parties, integrated firms obtain worse terms (i.e., source at higher and sell at lower prices), fail to develop relationships with independent firms, and remain relatively more exposed to strategic default. The evidence strongly supports models in which firms boundaries alter temptations to renege on relational contracts (such as Baker, Gibbons and Murphy (2002)) and uncovers, within a coherent set of facts, both

[1] Roughly one-third of world trade occurs within firm boundaries (Antras (2003)). Census Bureau Data reveals that in the United States transactions that occur *within* firms account for roughly the same share of aggregate value added as transactions *between* firms (Lafontaine and Slade (2007)).

[2] Prominent theoretical contributions include work by Williamson (1971, 1975, 1985); Klein et al. (1978); Grossman and Hart (1986); Holmstrom and Milgrom (1994) and many others.

[3] See, e.g., Macaulay (1963), Klein and Leffler (1981), McLeod (2007).

costs and benefits of integration.

Three challenges must be overcome to test the theory. First, transactions both within and between firms must be observed. Second, the selection of transactions into organizational forms must be confronted. Third, temptations to renege on the relational contract must be examined. While the first two challenges are shared with empirical work testing any theory of the firm, the third one is intrinsic to test a theory that combines the integration decision within a relational contract framework.

The Costa Rica coffee chain provides an environment in which empirical progress can be made along all three dimensions. The analysis focuses on sales of coffee between mills and domestic buyers (either exporters or domestic roasters). A rich variety of organizational forms is observed, including vertical integration and long-term relationships between independent firms. First, due to regulations in the industry, all transactions of coffee between mills and buyers – including those occurring within firms – must be registered with the coffee board. Second, the coffee board specifies extremely detailed standards. In practice, we observe more than three-hundred different types of parchment coffee exchanged.[4] This allows for a comparison of the terms of sales (volumes, prices and timing) of the exact same product across organizational forms. Third, observable unanticipated changes in international coffee prices provide exogenous variation in the temptation to renege across contracts. This allows to study how trade under different organizational forms is affected by those shocks.[5]

To compare vertical integration against relationships between firms, we must first gain an understanding of the concerns those organizational forms are meant to address in the context of study. Numerous conversations with industry practitioners and industry reports suggest that demand and supply assurance considerations are important for mills and buyers respectively.[6] Mills face demand uncertainty, that they try to mitigate through the pervasive use of forward contracts. On their side, buyers need to assure supply to satisfy their uncertain demand, and hence are also interested in signing forward contracts. Besides the frequent use of forward contracts, evidence of significant advance-purchase and end-of-season discounts confirms demand uncertainty as a powerful force in this industry. Vertical integration and relational contracting, then, might help parties overcome supply and demand assurance concerns.

[4] Parchment coffee corresponds to 6-digit HS code 090111 (Coffee, not roasted, not decaffeinated). We observe more than 300 hundred product categories within this single code. As a comparison, the Harmonized Tariff Schedule of the United States (2015)(Rev.2) includes only four 10-digit codes within this 6-digit code, of which only two are relevant (since Costa Rica only exports Arabica coffee).

[5] This strategy is also used in Blouin and Macchiavello (2013) on a different sample of contracts.

[6] See, e.g., reports by I.T.C. (2012), I.C.O. (2014) and World Bank (2015).

The theoretical section begins by discussing a number of testable predictions from the Carlton (1979) model of vertical integration as supply assurance. Demand and supply assurance considerations also provide the foundation for the empirical test of the Baker, Gibbons and Murphy (2002) model. The central insight of the model is that firm boundaries affect temptations to deviate. Under non-integrated ownership, an extreme realization of the supply price creates a large temptation for the upstream supplier to renege on the relational contract. This reneging temptation limits the scope of the best relational contract that can be sustained. Under integrated ownership, however, the reneging temptation is independent of the supply price. While this makes integration a more robust governance structure when prices vary widely, integration comes at a cost. A corollary of the relational contract logic is that better outside options might reduce parties' ability to sustain relational contracting. Vertically integrated buyers have, ceteris paribus, a disadvantage in developing and sustaining relational contracts with independent suppliers precisely because they can rely on the certainty of future internal supply.

The empirical section provides strong support to the predictions of the Carlton (1979) and Baker, Gibbons and Murphy (2002) models. First, we show that trade within firms is insulated from market forces. Integrated buyers buy from the market only if their own integrated supply isn't sufficient and (conversely) sell to market only if internal demand isn't sufficient. Integration substitutes for both forward contracting and spot market adjustment and doesn't display the timing of contracting and pricing patterns associated with demand and supply assurance.

We then turn to the comparison between integration, forward and relational contracts. We consider both strategic default conditional on contracting as well as the terms (prices and timing) of contracting itself. Using unanticipated changes in international coffee prices, we show that – conditional on signing a forward sale contract – buyers are left exposed to mills' opportunism. Unanticipated increases in world prices over the duration of the forward contract significantly increase the chances of default for trade between, but not within, firms. On all three dimensions – default, prices and timing of contracts – long term relationships between non-integrated firms behave qualitatively similarly to integrated trade. Quantitatively, however, only a handful of relationships replicate the magnitude of the effects associated with integration.

Finally, we show how the logic underpinning the benefits of integration also sheds light on its costs. On all three dimensions – default, prices and timing of contracts – integrated buyers fail to develop relationships with independent suppliers, consistent

with the view that those relationships are less valuable precisely because internal supply is available.

In sum, the results support the view that firm boundaries change temptations to renege on relational contracts and, through this channel, matter for resource allocation. Besides their relevance for the empirical study of organizational forms, the findings have policy implications for export oriented agricultural chains in developing countries. Several observers (see, e.g., Talbot (1997), Gibbon and Ponte (2005), Daviron and Ponte (2005), Bair (2009)) have noted how these chains are often dominated by backward integrated buyers, possibly to the detriment of local producers and farmers' welfare. To the extent that supply assurance considerations are a motive for integration in these contexts – a possibility entirely consistent with our evidence – markets tend to generate too much integration relative to the social optimum (see, e.g., Carlton (1979), Bolton and Whinston (1993) and Kranton and Minheart (2000)). Alternative organizational forms, such as networks, alliances and consortia, might be encouraged to promote secure market participation while curbing the negative externalities associated with integration.

Related Literature

This paper contributes to two strands of literature. First, the empirical literature on vertical integration (for a review, see Lafontaine and Slade (2007)). The majority of empirical studies of vertical integration focus on the question "what determines firm boundaries?" (see, e.g., Monteverde and Teece (1982), Masten (1984), Joskow (1985), Gil (2007), Forbes and Lederman (2009), Alfaro et al. (2010), Atalay et al. (2014)). A smaller literature, asks whether "firm boundaries matter?" (see, e.g., Mullhainatan and Sharfstein (2001), Hortacsu and Syverson (2007), Gil (2009), Forbes and Lieberman (2010)). This paper falls within the second strand. To the best of our knowledge, the explicit comparison between integration, forward contracts and relational contracting and the empirical test of the Baker, Gibbons and Murphy (2002) model are distinctive contributions of this paper.

Second, the paper relates to the literature on contracts, relationships and markets in developing countries. Banerjee and Duflo (2000), Banerjee and Munshi (2004), Fafchamps (2000, 2004), Macchiavello (2010), Macchiavello and Morjaria (2015), Mullainatthan and Sukhankar (2014) and McMillan and Woodruff (1999) are examples of empirical studies focusing on the importance of relationships. The question of vertical integration has been much more neglected.[7] Andrabi et al. (2006), provides a rare

[7] But see, for a cross-country, cross-industry approach Acemoglu et al. (2009) and Macchiavello

study of flexible specialization among subcontractors in Pakistan. This paper shares with ours a focus on demand uncertainty to explain vertical contractual arrangements. Fafchamps and Hill (2005, 2008), De Janvry et al. (2015), Dragusano and Nunn (2014), Porto et A. (2011), Blouin and Macchiavello (2013) and Macchiavello and Morjaria (2015) are examples of papers studying the industrial organization of the coffee chain. None focuses on vertical integration.[8]

Roadmap

The rest of the paper is organized as follows. Section 2 presents the context of our analysis. It describes the Costa Rican coffee sector, the role of the coffee board and its regulations and the data used in the analysis. It also provides evidence that demand and supply assurance considerations are important in this market. Based on this evidence, Section 3 discusses theoretical contributions that inform our empirical analysis. We combine insights from theories of vertical integration based on supply assurance considerations with those from models of forward and relational contracting. Section 4 describes the main empirical results. Section 5 discusses policy implications for export-oriented agricultural chains in developing countries. Finally, Section 6 offers few concluding remarks.[9]

2 Industry Background

This section provides background on the industry. After briefly describing the Costa Rica coffee chain, we examine its regulations. Understanding regulations in the sector is important because they generate the data used in the analysis. In addition, the regulations affect market's participants incentives in ways which are taken into account in the empirical analysis. We then describe the data and provide summary statistics on the stages of the value chain that are the object of our analysis. Finally, the section provides evidence for the importance of demand and supply assurance. This evidence guides the focus of the theoretical background section and the design of the subsequent empirical analysis.

(2012).

[8] In concomitant work in progress we match downstream organizational forms (both vertical and forward integration) to the amount and timing of payments to farmers.

[9] An Appendix available upon request provides further details on the data and a description of additional organizational forms in the industry.

2.1 The Coffee Value Chain in Costa Rica

The cultivation of coffee was introduced in the Meseta Central in Costa Rica in the late eighteenth century. Coffee's importance for the Costa Rican economy grew considerably during the nineteenth century. Coffee has played a key role in Costa Rica's political and economic development and has been the main cash export crop for decades. Although recent growth in the manufacturing and service sectors has reduced coffee's prominence as a source of export revenues, Costa Rican still ranks 14th among world's coffee producers.[10] Costa Rica exports the vast majority of its coffee as fully washed and is generally regarded as a "success story" in terms of product quality and differentiation. The production of coffee is distributed across seven coffee producing regions that differ in altitude and climate and, therefore, have different harvest timings. Small farmers account for about 90% of the approximately fifty thousand farmers in the country and for 40% of the total harvest.[11]

Figure 1 describes the coffee value chain in Costa Rica. Coffee cherries are produced by farmers and sold to mills (also known as coffee washing stations or "beneficios"). Farmers harvest coffee cherries from trees. The coffee bean is obtained by removing the pulp from the cherries within hours of harvest. After being washed and dried the bean becomes storable. These stages (depulping, washing and drying) are undertaken by mills. At this stage of the chain the output is called parchment coffee (or "cafe oro").[12]

Mills sell parchment coffee to domestic buyers. Buyers consolidate, mix and mill the coffee before selling to foreign buyers or to domestic roasters. This stage of the chain offers a remarkable variety of organizational forms and is the object of our analysis. There are different types of mills and buyers. Some mills are owned by *backward* vertically integrated buyers. There are also mills that have exporting licenses and are, therefore, *forward* integrated. An additional distinction is between privately owned mills and cooperatives (which are collectively owned by farmers). Some cooperatives form horizontal alliances as part of marketing consortia. Throughout the main analysis, we focus on sales of undifferentiated ("convencional") parchment coffee and compare trade within backward integrated firms with the various forms of trade in the market.

[10] Source: International Coffee Organization

[11] To be precise, small farmers are defined as those producing less than 100 "fanegas" of coffee cherries. The fanega, a spanish measure antecedent the introduction of the metric system, is still used in Costa Rica for coffee. A fanega weights 258 kgs and produces a 46 Kg bag of processed coffee.

[12] In other countries the coffee cherry is directly processed by farmers. This so called "dry method" (in contrast to the "wet method" performed by mills) is extremely uncommon in Costa Rica, where the vast majority of coffee is washed. The washed method generally produces higher and more consistent quality.

For the purpose of our analysis trade of parchment coffee takes four configurations, as illustrated in Figure 1: 1) trade *within* backward integrated firms; and, *between* firms, trade between 2) integrated buyers with non-integrated sellers; 3) integrated sellers with non-integrated buyers; and 4) non-integrated buyers and sellers.[13]

2.2 Industry Regulations

For the purpose of our analysis, it is important to describe how the sector is regulated. Most of the data used in the analysis are available because of these regulations. In addition, regulations shape incentives in ways which are taken into account in the empirical design. The production, processing, marketing and export of coffee in Costa Rica are in the hands of the private sector. The state regulates the sector through the Instituto del Cafe de Costa Rica (ICAFE), a board established by law in 1961.[14] The law established the coffee board, ICAFE, to represent the interests of farmers, processors and exporters. The main objective of the law is "to achieve an equitable system of relationships between producers, processors and exporters of coffee that guarantees a rational and secure participation of each stage in the coffee business".[15]

The key aspect of the regulation is the System of Final Liquidation (i.e., "Sistema de Liquidacion Final"). The main objective of the system is to enforce contracts (between farmers and mills, and between mills and exporters) to thereby minimize exposure to price risk. For the system to be implemented, all transactions of coffee along all stages of the value chain must be registered with the board. The process, illustrated in Figure 2, is as follows:

1. *Advance payment and reception of cherries.* Immediately after harvest, farmers deliver coffee to a mill. Farmers are free to deliver to any mill. At this stage, the mill issues a receipt for the coffee. The law establishes that the receipt has

[13] Forward integration, cooperatives and consortia are described in an Appendix available upon request.

[14] The ICAFE is regulated by the 'Ley 2762 del 21 de junio de 1961'. For more details, see: www.icafe.go.cr. The ICAFE is defined as 'una entidad pública de carácter no estatal que promueve la actividad cafetalera nacional'(a non-governemental public institution that promotes the national coffee activity).

[15] Law N° 2762 "Ley sobre el Régimen de Relaciones entre Productores, Beneficiadores y Exportadores de Café" (Law governing the relationships between mills, farmers and exporters of coffee). Article 1 of the law states "Artículo 1°- Esta ley tiene por finalidad determinar un régimen equitativo de relaciones entre productores, beneficiadores y exportadores de café, que garantice una participación racional y cierta a cada sector en el negocio cafetalero, y por objeto, todas las transacciones con café producido en el territorio nacional." See http://www.icafe.go.cr/icafe/publicaciones/leyes-y-reglamentos/ for the text of the Ley 2762.

the value of a contract. The receipt records the date, type and quantity of coffee and the advance payment paid by the mill, if any.

2. *Contracts between mills and buyers.* Every sale contract between mills and buyers must be approved by the coffee board. A contract is defined by a type and quantity of coffee, a contract and a delivery date, and a price. Without disclosing it to market participants, the board sets minimum prices based on differential prices against prevailing international prices.

3. *Payment to farmers.* Every three months, mills make payments to farmers according to sales up to that point. At the end of the harvest campaign, the mills pay the farmers a final liquidation. The final liquidation is computed according to a formula that detracts from the mill's sales *i*) audited processing costs, *ii*) allowed profit margin, *iii*) any previous advance paid to farmers, *iv*) a contribution to the national coffee fund. The final prices to be paid to farmers must be published in newspapers and the corresponding payments to farmers must be executed within 8 days of publication by the mills.

These regulations are not unique to Costa Rica.[16] The regulations implement a transparent system in which farmers obtain a high share of the final export price and achieve better cash-flow and risk management for farmers and processors.[17]

To compute the final liquidation price, the regulation requires mills to submit all contracts with exporters for approval. This requirement applies to all transactions between mills and exporters, independently of their ownership structure. This implies that terms of the transactions are observed for both trade between and within firms. Vertical integration is allowed and transfer pricing (in which prices are artificially depressed to shift profits downstream) is prevented by rejecting contracts with prices below the undisclosed minimum allowed.[18]

Registering contracts with the board improves enforcement. First, the board enforces standards. The contract must specify type of bean, quality of parchment and

[16] For example, Guatemala, Nicaragua, El Salvador and Burundi have adopted, or tried to adopt, similar regulations. The Kenya and Rwanda tea sectors are currently regulated along the similar lines.

[17] First, the price obtained by farmers depends on international market conditions prevailing throughout the entire season, rather than just at harvest time. Second, the mills have significantly lower working capital requirements since they pay farmers after sales have been realized (and farmers trust mills will pay). Due to poor contract enforcement, both considerations are of paramount importance in coffee chains (see, e.g., Blouin and Macchiavello (2013) and Macchiavello and Morjaria (2014)).

[18] It is not unusual for vertical integration between producers and exporters to be banned altogether in this type of chains (see, e.g., the Ethiopia coffee chain before the creation of the commodity exchange, cocoa in Ghana, cotton in Tanzania).

preparation type. A total of 336 different products are observed in the data.[19] Second, the board protects parties from counterpart risk. As documented below, buyers and sellers often sign forward contracts for future delivery. Sharp changes in (international) market conditions leave parties exposed to strategic default: if prices go up (down), mills (buyers) will want to renege on the deal. The board only allows mills to cancel contracts and only for one of the following reasons: (A) when there is agreement by both sides to substitute the contract for another one with a better price, (B) when the mill does not have enough coffee to honor the contract, (C) when the mill does not have coffee of the quality established in the contract to do the delivery, and (D) for exceptional causes to be evaluated by the coffee board.

2.3 Data and Descriptive Statistics

Data Description

We obtained access to information available at ICAFE. The data include information on 12 harvest seasons (from 2001-2002 to 2012-2013) for a total of 44282 contracts between mills and buyers. Approximately a quarter of all contracts are for the national market while the remaining three quarters are for export-destined coffee. In addition, from the season 2006-2007 onward we have information on which contracts have been canceled and the reasons for the cancellation. Just over 1% of the contracts in the relevant sample are canceled, with significant variation across seasons (from about 2% in 2010-2011 to 0.5% in 2012-2013).

The analysis in this paper complements information about contracts with the following data: 1) the history of operation and mills ownership type during the sample period; 2) location of each mills matched to a vector of geographical characteristics; 3) information on the payments made to farmers (advance payments, trimestral and final liquidations) and mill's reported and audited costs; 4) bi-weekly reports on coffee sourced by mills and on the number and location of farmers supplying each mill in each season.[20]

Descriptive Statistics

Table 1 provides summary statistics for the 2011/12 harvest season. Panel A presents mills' characteristics. Out of 175 mills, approximately 5% are owned by buy-

[19] The contract specifies type of bean (8 categories), quality (7 categories), and preparation (8 categories). Moreover, ICAFE allows mills to register up to three different differentiated product lines of coffee, in addition to an undifferentiated ("convencional") line.

[20] The time coverage of the different data varies.

ers, i.e., are backward vertically integrated. In addition, 14% of mills are cooperatives. The market is highly concentrated with the ten largest mills absorbing 53% of production. Backward integrated mills absorb 30% and cooperatives have a similar market share. Mills have operated on average 6 years under current ownership during the sample period, had an average of 3.35 buyers in a year, sold 12% of their output to backward integrated buyers and exported 76% of their produce. Mills owned by buyers are larger, older, sell to fewer buyers (in fact, sell almost everything to "their" buyer) and export more. They are not different from the rest in terms of unit prices and unit costs.

Panel B presents buyers' characteristics. Of the 162 buyers, 5% are backward integrated. The buyer's side of the market is even more concentrated. The ten largest buyers have a combined 77% market share, while backward integrated buyers absorb 52% of market output. This implies that backward integrated buyers source approximately 60% internally and the rest on the market. Buyers have operated an average of 6.35 years in the market, have about 4 suppliers and export 40% of their purchases (which implies that overall size is strongly positively correlated with share exported). Backward integrated buyers are older, larger, have more suppliers, export more and pay higher prices (possibly as a result of their export activities).

Panel C presents relationships' characteristics. A relationship is here defined as a unique mill-buyer pair that has traded positive amounts. There is a total of 667 such pairs, approximately 30% of which involve an integrated buyer (while only 2% involve an integrated seller). The average relationship was 3.6 years old, exported 60% of its product and traded 1.2 different products. Integrated firms have traded with each other for longer and larger amounts, but are no different along other dimensions.

2.4 Demand and Supply Uncertainty

The international coffee market has a long history of price instability which adds to the uncertainties inherent to local growing conditions. This section provides evidence that demand (and, conversely, supply) assurance are important considerations in this market. Demand assurance concerns arise in markets in which there are idiosyncratic and aggregate demand shocks, once production decisions have been sunk (i.e., we are not concerned with shocks affecting availability of supply). These conditions fit the coffee industry well. From the point of view of a mill, demand uncertainty principally originates from two sources. First, buyers (mostly exporters) are in constant need to manage stocks to deliver coffee to downstream roasters that face uncertain demand in

the retail market. Second, after harvest is completed, the vagaries of weather and harvest conditions in competing locations worldwide induce fluctuations in the (expected) demand and price. Since parchment coffee is storable up to at most the following harvest, inventories can only partially help to navigate demand shocks and potentially significant costs of holding unsold stocks of coffee arise.

As a result, physical markets for coffee often involve future delivery (forward contracts).[21] Figure 3 illustrates the point. For each contract in the sample we compute its duration as the difference in weeks between the delivery date specified in the contract and the date in which the contract is signed. The Figure reports the distribution contract duration. Less than 40% of contract are "spot", i.e., the delivery occurs within a week of the signing date. Contracts are signed with significance advance: less than 50% of contracts are signed within a month of delivery date, and the average contract is signed approximately 3 months in advance.

Table 2 shows that forward contracts tend to fetch lower prices and are signed for smaller amounts of coffee. These correlations hold in the sample of contracts unconditionally (Column 1), and conditionally on a number of controls (Columns 2 to 4). Column 2 controls for detailed product categories and for season fixed effects. Column 3 includes contracts signing dates fixed effects. Finally, Column 4 also includes mills' and buyers' fixed effects. In all specifications, forward contracts are associated with lower prices and smaller volumes.

Theoretical models of markets with demand uncertainty and forward contracting predict advance-purchase discounts. For instance, in the model of Dana (1998) producer sets prices before demand is known and there is both idiosyncratic and aggregate demand uncertainty. Under these assumptions, the model shows that price-taking firms offer forward sales contracts with associated advance-purchase discounts to increase capacity utilization rates. The intuition is remarkably simple: firms carry excess capacity to serve consumers in peak periods; the pricing structure across markets must cover marginal costs and capacity costs; spot prices must then reflect the cost of carrying underutilized capacity.[22]

[21] Physical markets operate alongside futures markets. Futures markets are built on the trade of contracts for future delivery of coffee (rather than coffee itself) and, as such, are principally used for risk management. Contracts in futures markets specify obligations for the delivery of coffee which are, however, very rarely "called" for actual delivery and the majority of future contracts is traded for obligations in other futures contracts. Although very little physical coffee is actually traded on futures markets, the high number of transactions makes them extremely useful price revelation mechanisms. This explains why futures prices provide key reference prices for contracts in physical markets.

[22] In Dana (1998) model producers and buyers take the price in the advance-purchase market as given and decide how much to demand and supply in both the forward and spot markets at each price. Unlike the spot market, the advance-purchase market clears in the traditional sense: there is no

From the Dana (1998) model, an additional prediction follows. Due to uncertain demand and transaction costs in the use of spot markets, mills offer advance-purchase discounts early in the season. Towards the end of the season prices must again be lower due to inventory risk: coffee must be sold before the beginning of the following harvest. Over the course of the harvest campaign, then, price must be an inverted-U shape function of the time at which the contract is signed. Figure 4 describes seasonality patterns in coffee prices per kilo and provides evidence in support of this prediction. The (harvest) campaign is divided into weeks, with week zero representing the first week in which mills start receiving coffee cherries in a given region. Weeks indexed with negative numbers relate to contracts that have been signed before any coffee has been delivered by farmers to mills in that region. For each week in the season (from approximately two months before the beginning of the harvest campaign until approximately one year after) we estimate week dummies on unit prices (logs). We then plot a quadratic and a lowess fit of the estimated coefficients. The regression controls for product fixed effects, for buyer-seller pairs fixed effects and for date of delivery dummies. In addition, the specification controls for time (defined at the week level) fixed effects. These time fixed effects control for common time varying factors, such as world prices and exchange rates movements, that could affect prices but are unrelated to the seasonality pattern we are interested on. The weekly coefficients are then identified out of cross-regional variation in the timing in which the harvest campaign begins.

The Figure shows that mills receive lower prices from contracts signed early in the season. Similarly, mills receive lower prices when selling stock at later stages in the season. The evidence is consistent with demand uncertainty.[23] Given this, and the widespread use of forward contracts, the next Section discusses theoretical contributions relating vertical integration to demand uncertainty.

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rationing or excess supply in that market. The assumption of transaction costs to adjust prices in the spot market doesn't contradict firms ability to adjust prices rapidly in response to changing market conditions. Carlton (1986, 1989) discusses transaction costs of using spot prices and how firms often employ alternative market-clearing mechanisms or simply allow their markets not to clear. Advance purchase discounts emerge in other models with similar features (e.g., Carlton (1978) and Deneckere and Peck (1995) and Cachon (2004) for a discussion).

[23] The estimated effect on unit prices (between -2% and +1%) might appear small. These effects are however of relevant size if compared with average buyers (6%) and mills (9%) profit margins and become even larger if estimated off of time variation (rather than region-specific seasonality patterns). See Table 3.

3 Conceptual Background

This Section discusses theoretical contributions to inform our empirical strategy. The theoretical literature on vertical integration is vast and various excellent summaries are available (see, e.g., Holmstrom and Tirole (1989), Gibbons (2005) and Bresnahan and Levin (2012)). Although the ideas that guide our empirical strategy have been discussed in the theoretical literature, we are not aware of a framework that integrates all of them. The purpose of this section, therefore, is not to provide an exhaustive summary of the literature, but rather to focus on selected contributions that provide sufficient guidance to our empirical exercise.

We begin by reviewing Carlton (1979) model of vertical integration as supply assurance. The model provides a number of intuitive testable predictions which we take to the data. Carlton (1979) model, however, is based on assumptions that lack the microfoundations necessary to distinguish vertical integration from forward sales contracts. We then turn to Baker, Gibbons and Murphy (2002) model of vertical integration and relational contracting. This framework is particularly suitable for our context for a number of reasons. First, the model offers microfoundations necessary to distinguish integration from forward sale contracts. Second, the model is empirically relevant given relational contracting between independent firms coexists alongside vertical integration in our context. Third , key insights of the relational contracting framework can be directly tested using unanticipated shocks to market prices.

Carlton (1979): Vertical Integration and Supply Assurance

Carlton (1979), henceforth **C79**, presents an elegant model of vertical integration and supply assurance. Adapting the terminology to our context, **C79** models a two-tier market in which buyers face demand uncertainty and source from mills. Buyers can decide whether to integrate backward by operating mills. The model is built around three core assumptions:

A1: Production decisions are made before demand is known (demand uncertainty);

A2: Producers sets prices before demand is known ;

A3: Firms cannot sell all they want at prevailing prices.

Assumption A1, demand uncertainty, fits the evidence documented above: endemic use of forward contracts and corresponding seasonal price patterns. Assumption A2 essentially establishes that prices cannot instantaneously adjust to clear markets. Firms

post prices in advance, i.e., ahead of demand shocks realizations, and so part of the adjustment must be realized through quantities and delivery failures. We take this assumption as a fact of real-world commercial life.[24] Finally, Assumption A3 introduces a cost for integrated firms to unload excess production in the market. This assumption is empirically testable.[25]

Under these assumptions, the logic of **C79** is as follows. A downstream firm integrates only to satisfy its high probability, i.e., more certain, demand (A1/A2). Production capacity of non-integrated suppliers satisfies residual demand in the market (A1/A2). These observations have a number of implications. First, even in the absence of technological advantages from integration, there is always an incentive to integrate. Because integrated capacity is allocated to more certain demand, integrated capacity is always utilized. In contrast, non-integrated capacity remains unutilized with some probability. Zero profits, then, requires that output is sold from nonintegrated capacity above (marginal) cost.[26] This implies that there is always a *private* motive for backward integration and that internal sourcing is cheaper than market sourcing. Why don't all firms integrate then? A3 is critical here: an integrated firm with insufficient internal demand cannot sell to the market and is left facing significant inventory risk. We discuss below testable implications of this framework.

Vertical Integration, Contracts and Relationships

Assumptions in **C79** are not microfounded. The lack of microfoundation exposes **C79** to the criticism that there is no distinction between vertical integration and a forward sale contract in which a buyer and a seller agree to transact a certain quantity at a certain price at a future date. Besides the conceptual point, this is problematic given the prevalent use of forward contracting. Aren't integration and forward contracting meant to be different?

In practice forward contracts are unlikely to achieve the same level of supply and demand assurance as integration does. This is for two reasons: opportunism and transaction costs. First, even in the presence of (almost) perfect contract enforcement,

[24] In practice, there might be many reasons why this is the case. Carlton (1986, 1989) provides ample discussion and examples. In our context, a buyer might be unable to secure a forward sale contract despite a willingness to pay above prevailing market prices if suppliers are concerned about reneging on promised delivery to other customers.

[25] The assumption could be microfunded along the lines of incomplete contracts models (see, e.g., Grossman and Hart (1986), Holmstrom and Tirole (1991) and Bolton and Whinston (1993)). For example, relative to the manager of an independent mill, the manager of an integrated mill has less incentives to develop a customer base outside the firm precisely because most of its capacity is allocated to internal trade.

[26] Note that this mechanism is identical to the one in the Dana (1998) model discussed above.

forward contracts leave parties exposed to counterpart risk. If realized spot market prices are much higher than expected, a mill will want to renege on a promised delivery locked in at a lower price. Similarly, if realized spot market prices are much lower than expected, a buyer will possibly have an incentive to pull out of the forward sale fixed price contract. Parties contracting under fixed price in the advance-purchase market, therefore, remain exposed to each other opportunism.

Second, transaction costs might leave market participants facing uncertainty over their ability to secure appropriate forward contracts when needed. In Dana (1998) model the advance purchase market perfectly clears while the spot market is subject to frictions. In practice, however, the distinction between the spot and the advance purchase markets is not as clear-cut, and forward sale contracts are subject to similar transaction costs as contracts in the spot market (e.g., search costs, limited liquidity, etc.)

In sum, even with forward sale contracts, parties might not achieve perfect supply and market assurance: a suitable forward contract might not be available when needed and, conditional on contracting, parties remain exposed to opportunism. Relational contracting is a natural response to achieve mutually beneficial supply and demand assurance and mitigate opportunism.

Baker, Gibbons and Murphy (2002): Relational Contracts and Firms Boundaries

Work by Baker, Gibbons and Murphy (1994, 2002 and 2006) studies the interaction between formal contracting (of which firms boundaries is a special case) and relational contracting. The model in Backer, Gibbons and Murphy (2002) - henceforth **BGM02** - is particularly relevant for our analysis: the model offers microfoundations necessary to distinguish vertical integration from simple forward contracts; it is empirically relevant given relational contracting between independent firms coexists alongside vertical integration in our context; and its key insights can be directly tested in our data.

The central insight in **BGM02** is that firms boundaries are allocated to minimize temptations to deviate. **BGM02** predicts that vertical integration is an efficient response to widely varying supply prices. This happens because integration reduces temptations to renege. Under non-integrated ownership, an extreme realization of the supply price creates a large temptation to renege on a relational contract. This reneging temptation limits the incentive power of the best relational contract that can be implemented under nonintegrated ownership. Under integrated ownership, however, the reneging temptation is independent of the supply price, and this makes integration

the more efficient governance structure when the supply price can vary widely.[27]

A corollary of the observation that contracts and organizational forms are chosen to minimize temptations is that better outside options in net present value might hinder parties ability to sustain relational contracting. This observation has implications for the ability of integrated buyers to develop relational contracts with independent suppliers. In particular, the logic suggests that a vertically integrated buyer that satisfies its certain demand from its own mill will have, ceteris paribus, a disadvantage in developing and sustaining relational contracts with independent suppliers. In a multiparty setting, this introduces an endogenous cost of integration that, to the best of our knowledge, has remained previously unnoticed.

3.1 From Theory to Data

Based on the above discussion, we conclude this Section distilling a number of testable predictions.

T1 *Trade within firms is insulated from market conditions. Specifically:*

1. *Integrated firms source from market only if own supply isn't sufficient and (conversely) sell to market only if internal demand isn't sufficient*;
2. *Lower percentage of integrated trade takes place on spot market and through the use of long forward sale contracting*;
3. *Prices and volumes of trades within integrated firms do not display inverted-U shape patterns associated with uncertain demand.*

The first part of this prediction is a direct implication of **C79**: buyers integrate backward to satisfy their certain demand and always source internally first. Conversely, given costs of selling in the market (see also prediction T2.2 below), integrated mills sell on the market only after exhausting their internal demand. The second and third parts of the prediction come from integrating insights from Dana (1998) and **C79**: in equilibrium, mills within integrated chains are less exposed to uncertain demand. This means they do not need forward contracts nor they need to adjust to realized market demand ex-post.

T2 **C79** *has two additional implications on prices:*

[27] **BGM02** explicitly note that their result explains the puzzle in **C79** that risk-neutral companies pursue vertical integration to ensure supply.

1. *Integrated buyers pay higher prices when sourcing from the market;*

2. *Integrated sellers receive lower prices when selling to the market.*

The first part is a direct prediction of **C79**: integrated capacity is allocated to certain demand and is therefore almost always fully utilized. In contrast, non-integrated capacity remains unutilized with some probability. Non-integrated firms must carry excess capacity to serve uncertain demand during peak periods. Prices must then reflect the cost of carrying underutilized capacity. The second part of the prediction is a direct generalization of Assumption A3 in **C79**.

Following the relational contracting logic, an additional prediction can be derived on the relationship between price shocks and likelihood of default:

T3 *Defaults on Fixed Price Forward Contracts*:

1. *Unanticipated price increases lead to default of forward contracts between firms;*

2. *Relationship's age mitigates the effect of price shocks on default;*

3. *Within firms price shocks have no effect on the likelihood of default;*

4. *Ceteris Paribus, independent suppliers are more likely to default against integrated buyers.*

The first prediction simply comes from the way the board enforces contracts. In the context of study, ICAFE enforces contracts and strategic renegotiation of forward contracts is difficult. In particular, the board doesn't allow contracts to be renegotiated at buyer's request. Quality specifications are verifiable (and, indeed, verified by the board) and cancellation due to lack of funds or downstream demand is not allowed. Mills, however, can claim not to have the necessary quantity/quality available in stock. Hence, strategic renegotiation can be detected only when prices are unexpectedly high.

The second part of the prediction simply captures the idea that relational trade mitigates opportunism. Either through selection or through the accumulation of relational capital, age of the relationship is a commonly used proxy for the quality of the relationship.[28] The third part of the prediction directly follows from **BGM02.** In our context, mills owned by downstream buyers do not have the right to engage

[28] See, for example, Banerjee and Duflo (2002) and Macchiavello and Morjaria (2015). The model in Baker, Gibbons and Murphy (2002) features stationary dynamics. Models of relational contracting with persistent asymmetric information on types or with limited transfers instead imply dynamics in which, conditional on survival, the value of the relationship increases with its age.

in strategic default against their buyers. The fourth part of the testable prediction also comes from the logic in **BGM02**. Because integrated buyers always have access to internal capacity, the value of their relationship with an independent supplier is, all else equal, lower. Consider now the incentives to renege of such a supplier: for the same contract and temptation to deviate, the same supplier will be more likely to strategically default on a contract signed with an integrated buyer.

T4 *Prices and Contracting: Relationships vs. Integration:*

1. *Unit prices decrease with the age of the relationships, but not for integrated buyers*

2. *Length of forward contracts decrease with the age of the relationships, but not for integrated buyers*

The final set of predictions is about "what makes a good relationship". If demand and supply assurance considerations are important, a well-functioning relationship allocates a larger share of the buyer's certain demand to the supplier. Following the logic in Dana (1998) and **C79**, this leads to lower prices. Similarly, since parties trust each other, conditional on delivery date parties can reduce risk and contract at a later date (and, conversely, conditional on the contracting date, parties can agree on later deliveries). Following the logic of the prediction **T3.4**, however, relationships involving an integrated buyer do not display these patterns.

4 Empirical Results

This section reports the main empirical results. The Section closely follows the testable predictions developed in the previous Section. We first provide empirical support for the Carlton (1979) model testing predictions **T1** and **T2**. We then test the predictions of the Baker, Gibbons and Murphy (2002) model and further insights on relational contracting. We first examine strategic default in forward sale contracts (**T3**) and then how vertical integration compares to relational contracting (**T4**).

4.1 Supply Assurance and Vertical Integration: Carlton (1979)

Trade between integrated plants is insulated from market forces

The first set of predictions, **T1.1-4**, compares trade within (backward) integrated chains with trade occurring between independent firms. The first prediction, **T1.1**,

follows straight from Carlton (1979) model. In equilibrium, backward integrated firms use their internal capacity to satisfy the more stable part of their demand. A direct implication, then, is that vertically integrated firms source from the market only if their own supply isn't sufficient to satisfy their demand and, conversely, mills owned by exporters sell to the market only if demand from their downstream buyers has been exhausted. In other words, we shouldn't observe integrated firms selling to *and* buying from the market significant volumes within the course of the same harvest campaign.

Figure 5 reports remarkably strong support for prediction **T1.1**. The Figure reports the shares of coffee bought and sold on the market by vertically integrated firms. An observation is a vertically integrated firm in a given season. The vertical axis is the share of coffee *bought* in the market. The horizontal axis gives the share of coffee *sold* on the market. Carlton's model predicts that if supply assurance considerations are important motives for integration, firms should only be on either the y-axis (they purchase in the market coffee only when their demand exceeds their production capacity) or on the x-axis (they sell in the market production in excess of their demand). As it can be seen, backward integrated firms (blue dots) behave very consistently with supply assurance.

The second set of predictions, **T1.2** and **T1.3**, comes from integrating insights from the Carlton (1979) and Dana (1998) models. Since, in equilibrium, mills belonging to integrated chains serve the certain part of the demand of their downstream buyers, they do not face an uncertain demand. This implies that they do not need advance-purchases nor they need to adjust sales using the spot market. Trade within integrated firms, then, is less likely to rely on spot contracts and long forward sale contracting (**T1.2**) and prices (and volumes) of trade within integrated firms doesn't display the inverted-U shape pattern described in Figure 4 (**T1.3**).

Figure 6 presents evidence supporting prediction **T2.2**. The Figure reports the distribution of the share of contracts classified as spot (i.e., with advance less than 30 days) across four different types of economic relationships: i) vertically integrated chains, ii) long term relationships involving integrated buyers, iii) long term relationships between non-integrated parties, and iv) occasional trades/new relationships between non-integrated parties. Two patterns stand out. First, young relationships between non-integrated parties are much more likely to trade (almost) exclusively based on spot transactions. Second, unlike trade involving long term relationships, trade within integrated chains is less likely to rely exclusively on spot markets or on forward sales contracts. This is consistent with integrated mills facing less demand uncertainty

and integrated chains relying less on the spot market for ex-post adjustments.

Finally, Table 3 provides evidence supporting the prediction that prices and volumes of trades within integrated firms do not display the inverted-U shape pattern described in Figure 3 (**T2.3**). The Table considers three outcomes: whether there is a contract signed at a certain date or not (Columns 1 and 2), conditional on a signed contract, the contracted volume (Columns 3 and 4) and unit price (Column 5 and 6). Consider Column 1 first. Results show that, conditional on detailed product, season and relationships (i.e., mill-buyer pair) fixed effects, parties are less likely to trade before and after than during the harvest campaign. As noted above, parties trade before harvest begins to ensure demand and supply and after to clear unsold stocks. Column 1 shows that trade within integrated firms is even more likely to occur during the harvest campaign by interacting pre-harvest and post-harvest dummies with whether the trade occurs within an integrated firm. Although relationship fixed effects account for buyer and mill unobservable effects, it is possible that the estimated coefficients on the interactions are driven by integrated trade involving buyers and mills that differ along other dimensions (e.g., location, size, etc.). Column 2 includes interactions with these additional controls and confirms the results. Columns 3 and 4 repeat the exercise considering volumes traded, conditional on contracting. The results confirm that also along the intensive margin integrated firms trade less before and after the harvest season.[29] This evidence is consistent with trade within integrated firms being subject to less uncertainty and, therefore, not having to sign contracts before harvest nor sell unsold stock after the campaign.

Finally, Columns 5 and 6 consider unit prices (in logs). Results in Column 5 confirms the findings in Figure 4. Unit prices before harvest begins are approximately 6% lower than during harvest campaign. Unit prices after the harvest campaign are also lower, by approximately 3.5%. Remarkably, these effects are not driven by differences in the quality of coffee transacted since those are controlled for by product fixed effects (which include an indicator of when the coffee was harvested).[30] As predicted, however, the inverted-U shaped pattern is completely absent for trade occurring within integrated firms.[31] In sum, the evidence strongly supports predictions **T1.1-4**: trade within integrated firms appears to be relatively insulated from market forces.

[29] The estimates for the interaction with the before harvest dummy have the expected negative sign but are less precisely estimated due to limited observations, as implied by results in Columns 1 and 2.

[30] Note also that these effects are larger than those estimated in Figure 4 due to the fact that the Table also exploits common seasonality patterns, not just asynchronous patterns across regions.

[31] Trade within integrated firms, moreover, fetches lower average prices, as shown below.

Market Sourcing and Sales of Integrated Firms

The Carlton (1979) model offers two additional testable implications (**T2.1** and **T2.2**). Those are examined in Table 4. The first is a prediction: integrated buyers pay higher prices when sourcing from the market than when sourcing internally. This prediction, which is central to the logic based on supply assurance, directly follows from the following observation. Integrated capacity is allocated to certain demand and is therefore almost always fully utilized. In contrast, non-integrated capacity remains unutilized with some probability. Non-integrated firms carry excess capacity to serve uncertain demand during peak periods. Their pricing structure, no matter how simple or complicated, must cover marginal costs and all ex-ante capacity costs. Because of price rigidities, prices must reflect the cost of carrying underutilized capacity.

Table 4 provides strong support for this prediction. Columns 1 to 4 consider all contracts signed by vertically integrated buyers. The results compare unit prices with the integrated mills and with independent suppliers. Simply controlling for buyer fixed effects and contract volumes, Column 1 finds that integrated buyers pay almost 7% higher prices when sourcing outside. This large difference, however, could be due to differences in product characteristics or in the timing of contracting. Column 2 shows that this is only partially the case. Including both detailed product and contract date fixed effects, results show that integrated buyers still pay approximately 3.5% more for the same coffee, on the same day, when sourcing in the market relative to internal supply. This difference, however, could still be due to differences at the mill level, including location, size, and costs. Columns 3 and 4 show that this is not the case. Even after controlling for mill characteristics (which include mill type, size and audited costs) and for region specific season effects, integrated buyers still pay approximately 2% more when buying in the market. This effect, which might appear small, actually represents a sizable share of buyers' overall margins.

The final aspect of the Carlton model we want to test is an assumption. To avoid the prediction that all installed capacity would be owned by integrated firms, Carlton (1979) assumes that firms cannot freely buy/sell all they want at prevailing prices. This implies that, when internal demand isn't sufficient to cover owned capacity, vertically integrated firms will have a harder time to sell on the market. There are various ways through which this assumption can be microfounded. For instance, in the spirit of the property rights models (see, e.g., Grossman and Hart (1986)) backward integration could reduce the incentives of the upstream manager to undertake non-contractible investments to maintain and develop active marketing channels. Precisely because

output is traded inside most of the time, returns from such investments would be lower.[32]

Columns 5 to 8 in Table 4 provide evidence that, indeed, integrated mills selling in the market receive lower prices than non-integrated mills. The results focus on all "market" transactions, i.e., it excludes trade within firms. By including contract volumes and buyer fixed effects, Column 5 finds that integrated mill receive 22% lower prices when selling to the same buyer than non-integrated mills. As noted above, this difference could be driven by differences in product characteristics or in the timing of sales. Controlling for detailed product and contract date fixed effects, Column 6 shows that integrated mills still receive a 17.5% price discount when selling to the same buyer. Columns 7 and 8 consider additional controls, including mill's characteristics such as costs, size, location and ownership types. Estimates show that, when selling the same volume of the same coffee on the same date to the same buyer, integrated mills still receive approximately 11% lower prices than comparable mills with similar size, costs and location. In sum, the evidence in Table 4 strongly supports the implications of the Carlton (1979) model and provide suggestive evidence that integration insulates buyers and mills from the effects of demand uncertainty, but face a cost for the market transactions.

4.2 Forward Contracts, Relationships and Integration

In sum, the evidence described in the previous section suggests that firm's boundaries *do* matter: trade within integrated firms looks significantly different from trade between non-integrated firms. In particular, trade between integrated plants is relatively insulated from market conditions (see also Mullainathan and Scharfstein (2001)). The evidence is consistent with demand uncertainty being an important aspect of this industry and vertical integration helping firms achieve demand and supply assurance.

These findings, however, raise additional questions. In particular, why aren't forward sale contracts sufficient to satisfy parties demand for supply assurance? Indeed, as Figure 3 shows mills and exporters rely on combinations of spot market trade and forward sale contracts. The evidence in Figure 6, however, also suggests that vertical integration is a substitute for such contractual arrangements. As noted above, there

[32] Another possibility is that, in the presence of asymmetric information in the output market, vertically integrated mills that try to sell on the market face an adverse selection problem (i.e., the market might believe they are selling a lower quality good). In our specific context this explanation is unlikely to be relevant since coffee transacted within Costa Rica is a highly commodified and the board enforces contracts based on detailed standards.

are two reasons why forward contracts might not be sufficient. First, conditional on signing a contract, parties remain exposed to each other opportunism. Second, the market for forward contracts itself might leave parties exposed to uncertainty due to transaction and search costs.

Forward Contracts and Strategic Default: Empirical Strategy

We begin with evidence demonstrating that fixed price forward sale contracts are subject to opportunistic defaults. We provide evidence closely following the empirical design in Blouin and Macchiavello (2013). In particular, consider a mill and an exporter that have signed a fixed price forward sale contract at a certain date t for a future delivery at date $t' > t$. The fixed price negotiated at time t, p_t^c, reflects contracting parties expectations about prevailing spot market prices at date t'. If, at time t', spot market prices are very different from those anticipated, either the exporter or the mill will have a strong temptation to renege on the contract. In particular, if the realized spot market price at time t' is much higher than anticipated, the mill will want to renege on the contract and try to take advantage of improved spot market conditions. In principle, if spot market prices are much below expectations at the time of contracting, the buyer might have incentives to turn down delivery. In any case, contract default should be associated with large unanticipated movements in the reference price.

The key challenge to test for this type of default is to proxy for expectations of future reference prices. The coffee sector provides the advantage that liquid world futures markets for arabica coffee exist. This implies that for every contracting date t expected future prices for deliveries at, or near to, date t' are observed. For each contract c signed between mill s and exporter b at date t for deliveries at t', we can construct a measure of price surprise as

$$P_{bstt'} = \frac{p_{t'}}{\mathbf{E}\left[p_{t'}|t\right]}, \tag{1}$$

i.e., as the ratio of the realized spot price to the expected spot price at delivery at the time of contracting.

Price surprises should be associated with (strategic) contract defaults. As noted above, while the board provides contract enforcement and protects parties from counterpart risk, it allows mills (but not exporters) to cancel contracts under specific circumstances. The board allows mills to cancel contracts for one of the following reasons: (A) when there is agreement by both sides to substitute the contract for another with

a better price, (B) when the mill does not have enough coffee to honor the contract, (C) when the mill does not have coffee of the quality established in the contract to do the delivery, and (D) for exceptional causes to be evaluated by the coffee board. Unlike in international trade, a buyer, therefore, is not able to strategically default refusing to accept coffee prepared according to specifications. In contrast, a mill might get away with pretending not to have managed to produce the required coffee (e.g., changing preparation, or side-selling). As a result, we expect an asymmetric effect of price surprises and to detect opportunistic default only when the mills have incentives to default.

Strategic Default: Results

Figure 7 reports preliminary results. The Figure tests for the relationship between fixed-price contract renegotiations and price surprises, focusing on conventional coffee for which international prices are most relevant. Price surprise is defined as the ratio between the international market price at the date of delivery and the international future market price for the date of delivery at the time the contract was stipulated (i.e., registered with the National Coffee Board). A ratio below one implies a negative price surprise (which gives buyers incentives to renegotiate); while a ratio above one implies a positive price surprise (which gives sellers incentives to default). The left panel considers negative price surprises. Consistent with the fact that the board enforces contracts, there is no statistical difference in the distribution of negative price surprises for contracts that are and are not renegotiated. Sellers, however, can potentially claim not having the exact coffee type stipulated in the contract and can, therefore, opportunistically attempt to cancel contracts. The right panel shows that positive price surprises are disproportionately associated with contract cancellations.

Table 5 confirms the results using regression analysis. The analysis focuses on fixed price forward sale contracts for convencional coffee. Among forward sale contracts, approximately 97% are on fixed price.[33] The Table reports results from regressions in which the dependent variable is a dummy taking value equal to one if the contract is "canceled", i.e., defaulted, and zero otherwise. Overall, just over 1% of the fixed price contracts in the sample are renegotiated.[34] A linear probability model is used to accommodate the numerous fixed effects in the specification, but results are similar with alternative specifications.

[33] The remaining contracts are on differential. For these contracts, see the discussion below based on Blouin and Macchiavello (2013).

[34] This is significantly lower than in the sample of contracts in Blouin and Macchiavello (2013). The difference is likely due to the contract enforcement role played by the Costa Rica board.

Column 1 confirms that price surprises are associated with (strategic) default. Controlling for exporter-mill pairs, we find that price surprises are associated with an increase in the likelihood of default. A doubling of prices during the duration of the contract period more than doubles the chances of contract default. Column 2 includes an interaction between the measure of price surprise and a dummy for whether trade occurs within an integrated firm. As expected, there is no effect of price surprises on the likelihood of contract cancellation within integrated firms: when spot market prices go up, trade within integrated firms is unaffected. Note that: *i*) the manager of the integrated mill doesn't own the coffee, so she cannot sign contracts with alternative buyers (i.e., side-selling becomes "theft") and *ii*) there is no incentive for parties to renegotiate prices (as the price increase would be transmitted to farmers). Moreover, since we are now allowing the effect of price surprise to be different between integrated and non-integrated firms, the main effect becomes stronger and statistical significance also improves. The entire effect of price surprises on default is driven by trade between firms: a doubling of prices during the contract duration leads to a four time larger likelihood of contract default.[35]

The results in the previous section, however, showed that trade within integrated firms is very different from trade between firms. Results in Columns 1 and 2, therefore, could be driven by a host of confounding factors. For example, the size of the temptation to renege on the contract is proportional to the contracted volume and the increase in price. Column 3 adds detailed product fixed effects and contract controls (age of the relationship between the buyer and the mill, contracted volumes and length of contract). Integrated mills are also different from non-integrated ones. Column 4, therefore, also includes additional region-season fixed effects and interactions between mills characteristics (size, location, ownership type) and price surprises. Results are remarkably robust: price surprises increase the likelihood of contract default between, but not within, firms.

As a robustness check, Columns 5 and 6 distinguish between positive and negative price surprises (ratio in (1) respectively larger and smaller than one). Results confirm the postulated asymmetry: positive price surprises lead to a large increase in the likelihood of default. A doubling of prices increases more than 10 times the likelihood of default. There is no effect within integrated firms. In contrast, negative price

[35] The test detects strategic default by examining the impact of unanticipated variation in world prices on contract cancellations. In principle, contracts could be canceled in response to unanticipated price response also because of (implicit) insurance arrangements. If that was the case, however, contract renegotiation should not be associated with a worsening of future relational outcomes (such as likelihood and volumes of trade). Unreported results show this is not the case.

suprises do not lead to contract default and their effect is not different between or within firms.[36]

Strategic Default and Relational Trade

The evidence in Table 5 confirms that buyers are left exposed to mill's opportunism when signing fixed price forward sale contracts. In many contexts, informal relationships based on repeated and frequent trade can mitigate opportunism. So, while formal forward sale contracts might not be perfect substitutes for vertical integration, the reputational incentives embedded within relational contracts could allow a non-integrated exporter to replicate the arrangement it could guarantee through an integration strategy. The analysis in Baker, Gibbons and Murphy (2002), however, predicts that this is not the case (unless all parties are extremely patient, in which case organizational form doesn't matter). In their analysis, vertical integration is an efficient response to widely varying supply prices because it reduces temptations to renege. Under non-integrated ownership, an extreme realization of the supply price creates a large temptation to renege on a relational contract. Under integrated ownership, however, the reneging temptation is independent of the supply price, and this makes integration the more efficient governance structure when the supply price can vary widely.

Table 6 explores the role of repeated interactions in mitigating opportunism. In so doing, it allows for a comparison of vertical integration and relationships and for a detailed examination of the prediction in Baker, Gibbons and Murphy (2002). Column 1 replicates the specification in Column 5 (in which only positive price surprises are used) of the previous table and adds relationship's age, defined as the number of previous contracts between the exporter and the mill. The estimates show that the age of the relationship is associated with a lower likelihood of default. This is consistent with either selection ("better" relationships last longer and are less likely to have defaults) as well as with a causal impact of relationship age on the value of the relationship and, therefore, on the likelihood of default (see, e.g., Macchiavello and Morjaria (2015) for a discussion).

Column 2 includes the interaction between the age of the relationship and the measure of price surprise. Relationship's age mitigates the likelihood of default only in relatively older relationships. Column 3 includes the interaction between a dummy

[36] Due to the inclusion of interactions between price surprises and controls in Columns 3, 4, 5 and 6, reported coefficients on the price surprise refer to omitted categories and are therefore less precisely estimated in Columns 3 and 4. Unreported results confirm that the estimated coefficients on price surprises are jointly significant.

for integrated trade and price surpises. Results confirm the effects detected in Table 5. Comparing estimates of the two interactions, show that only a handful (i.e., less than 5%) of relationships achieve the same reduction in the effect of price surprises on default as integration. Taken together, these results strongly support the predictions of the Baker, Gibbons and Murphy (2002) model of vertical integration and relational contracting.

Finally, Column 4 investigates an additional implication of the relational contracting framework in Baker, Gibbons and Murphy (2002). A core aspect to the relational contract logic in Baker, Gibbons and Murphy (1994, 2002 and 2012) is that formal contracts and firms boundaries are allocated to minimize temptations to deviate. An implication of this observation is that, when incentive compatibility considerations are important, better outside options in net present value might hinder parties ability to sustain relational contracting. Because backward integrated exporters always have supply assurance from their integrated mills, they should have a lower relationship's value from transacting with independent suppliers. Column 4 in Table 6 tests for this hypothesis relying on the strategic default analysis. Results confirm that, all else equal, non-integrated mills that transact with integrated buyers are more likely to strategically default on their contracts.

Relational Contracts, Sourcing Costs and the Timing of Sales

There are two reasons why forward contracts might not be sufficient to achieve the degree of supply and demand assurance achieved by integration. First, conditional on signing a contract, buyers remain exposed to mills' opportunism. The evidence in Table 6 confirms that relational contracting mitigates opportunism in the use of forward sale contracts. The results on relationship's age show that, in our context, few relationships achieve the same level of protection against opportunistic default achieved by integration. As noted above, however, only a small share of contracts (around 1%) are defaulted upon. This suggests that while the analysis of strategic default might enhance our understanding of how integrated trade differs from market trade, the effects might be quantitatively small.

We now turn to the second reason: the market for forward contracts itself might leave parties exposed to uncertainty on the timing and terms of contracting. A key insights of the theoretical analysis in Dana (1998) and Carlton (1979) is that prices reflect the risk of carrying unutilized capacity. Indeed, as shown above in Table 4, backward integrated exporters are able to source (the same coffee, at the same time, produced under identical conditions) at a significantly lower unit price. A buyer that sources

from a mill through a repeated relationship, then, should allocate to the supplier the more stable part of its demand. In turn, this should be reflected into lower prices being associated with repeated transactions. A further implication is that, conditional on delivery date, the more certain demand from the buyer should translate into a lower use (or a shortening) of forward contracts. As in Table 5, therefore, we will explore how prices and contract timing correlate with the age of the relationship between the buyer and the mill. In addition, in the same spirit of the results in Column 4 of Table 6 we expect relationships between integrated buyers and independent suppliers to not feature these positive dynamics.

Table 7 explores these predictions and compares the pricing and timing of contracting between relationships and integration. Columns 1 and 2 focus on integrated buyers. Conditional on volume of trade, detailed product characteristics, the timing of contracting and suppliers characteristics, Column 1 shows that integrated buyers pay a lower price when sourcing from their integrated mill relative to sourcing in the market, confirming the results in Table 4. In addition, when integrated buyers source from independent suppliers, the age of the relationship does not correlate with lower unit prices. Column 2 confirms this last result including relationship (i.e., buyer-mill pairs) fixed effects.

Columns 3 and 4 consider non-integrated buyers and their relationships with other suppliers. The findings show a completely different pattern. In both specifications volume of trade, detailed product fixed effects, the timing of contracting and suppliers characteristics are controlled for. Column 3 controls for buyer fixed effects, while Column 4 controls for relationship's fixed effects. In both specifications the age of the relationships negatively correlates with prices. A one standard deviation increase in the age of the relationship is associated with approximately 10% lower prices. Two aspects are noteworthy. First, the relationship holds true even after controlling for an exhaustive number of potentially confounding factors. In particular, specifications in both Columns 3 and 4 control for *i*) (polynomials) of contract volumes, as relationship's age could be associated with changes in pricing due to volume discounts, *ii*) detailed product fixed effects, as relationship's age could be associated with changes in the preparation and quality specifications of the transacted coffee, *iii*) delivery date fixed effects, since relationship's age could be associated with changes in when contract is exchanged, *iv*) seasonal region fixed effects, as relationship's age could be correlated with local shocks to growing conditions which could also affect prices, *v*) mill controls (such as size, unit costs, location and ownership types) and *vi*) buyer fixed effects.

Second, although the effect is quite large, the estimates confirm that few relationships (less than 5%) achieve the age necessary to obtain the same decrease in prices associated with integration. This result is as predicted by models of relational contracts. Recall that trade between non-integrated firms is subject to strategic default. To prevent strategic default, the relational contract must provide (credible) future rents to the mills. While long-term relationships get allocated more and more stable orders and witness less defaults conditional on contracting, prices cannot converge to the levels within integrated trade since mills must be given incentives and past promises of future rents must be kept.

The evidence suggests that, as relationships develop, buyer's might allocate more stable demand to their suppliers and/or acquire a reputation for reliable demand. Columns 5 to 8 further explore this interpretation by considering the length of the contract as dependent variable. Columns 5 and 6 consider integrated buyers only. Conditional on delivery date fixed effects, Column 5 shows that integrated trade is associated with a significantly lower duration of the forward contract. This confirms the finding in Figure 6: forward contracts and integration are substitutes. In addition Column 5 shows that the age of the relationship with independent suppliers is also associated with shorter forward contracts. Column 6, however, shows that this result is driven by the selection of mills from which integrated buyers source. Once relationships fixed effects are controlled for, the age of the relationship positively correlates with the duration of the forward contract.

Columns 7 and 8 consider non-integrated buyers and, once again, find different results. Although the estimates are somewhat less precisely estimated, the age of the relationship is associated with shorter duration of forward contracts. Relative to the estimated effect of integration, however, the effect is rather small. Although buyers might allocate more certain demand to their loyal suppliers, it appears as if parties are reluctant to rely exclusively on the promise of a transaction.[37]

[37] Columns 5 to 8 examine duration of the forward contract conditional on delivery date. Conversely, conditional on contracting date, we expect good relationships (and integration) to be associated with contracts with longer duration. As duration is associated with a higher temptation to renege and only integrated firms or well established relationships are able to sustain larger temptations. Unreported evidence confirms the prediction that the age of the relationship is positively correlated with contract duration (as vertical integration is) for non-integrated buyers but not for integrated buyers.

5 Policy Discussion

In sum, the evidence presented in the previous Section provides a comprehensive picture of supply assurance and (backward) vertical integration. Taken together, the facts portrait the costs and benefits of vertical integration relative to alternative governance structures - such as forward and relational contracts. We have shown why, due to opportunism, these alternative governance forms are not perfect substitutes for integration. At the same time, we have shown that the logic behind the benefits of integration also implies its costs, in particular with respect to forming valuable relationships with independent suppliers. The results support the view that firm boundaries change temptations to renege on relational contracts and, through this channel, matter for resource allocation.

This Section offers a discussion of policy implications of this work for export-oriented agricultural chains. First, to the extent that supply assurance considerations are a motive for integration in these type of chains – a possibility entirely consistent with our evidence – markets tend to generate too much integration relative to the social optimum. This prediction holds true in the Carlton (1979) model upon which we based our analysis, but also in property-rights model such as Bolton and Whinston (1993) and in network models such as Kranton and Minheart (2000). Parties have an incentive to integrate precisely when demand is volatile, i.e., precisely when ex-post efficiency considerations would require better adaptation in the allocation of capacity to downstream demand. By vertically integrating, exporters force non-integrated mills to face an even more uncertain market demand.[38]

The evidence is consistent with additional effects of vertical integration. In particular, vertically integrated firms appear to be able to shift profits downstream by paying lower prices. It is somewhat remarkable that we are able to detect this effect in an environment in which regulations protect farmers to a large extent. We conjecture that these forces might be stronger in unregulated environments. Taken together, these two mechanisms lend some support to the view that agricultural chains dominated by backward integrated buyers are detrimental to producers and farmers' welfare (see, e.g., Talbot (1997), Gibbon and Ponte (2005), Daviron and Ponte (2005), Bair (2009)) and to bans on vertical integration as observed in the case of Ethiopian coffee, Cocoa in Ghana and Cotton in Tanzanian Cotton.[39]

[38] If this increases the incentives to integrate, such a mechanism could generate multiple equilibria. For similar ideas see Gibbons et al.(2012).

[39] On the other hand, the two sides of the market appear to be sufficiently competitive that foreclosure is unlikely to be quantitatively important in this setting.

On the other hand, vertically integrated chains might bring advantages and a tendency towards excessive integration might balance constraints to integration and larger firm size typically associated with developing countries. First, vertical integration might relax mill's credit constraints.[40] Evidence in Blouin and Macchiavello (2013) from a sample of hundreds of mills in more than twenty countries and in Macchiavello and Morjaria (2015) from a census of all mills in Rwanda confirm that, indeed, mills are often credit constrained. The bulk of mill's working capital requirements, however, originates from payments to farmers for the cherries. By guaranteeing payments at the end of the harvest campaign the process of final liquidation implemented in Costa Rica greatly reduces working capital requirements and, therefore, likely removes one of the main advantages of vertical integration.

Integration might also achieve coordination of sourcing strategies and avoid excessive entry. For the case of Rwanda, Macchiavello and Morjaria (2015) show that, due to imperfect contract enforcement between farmers and mills, there is a tendency towards excessive entry of mills. Improving contract enforcement between mills and farmers is a direct measure to curb excessive entry and reestablish the positive effects of competition.[41] The regulation implemented in Costa Rica facilitates contract enforcement between farmers and mills and likely also curb this potential benefit of integration.

Finally, due to higher margins vertically integrated exporters might have higher incentives to invest into developing demand in downstream markets. This could be beneficial for the industry as a whole, by pushing prices and contractual conditions towards more favorable terms for farmers. In practice, price risk is likely to be a key deterrent of investments to develop marketing channels. Blouin and Macchiavello (2013) use contract data on export transactions between exporters to study strategic default along the lines of the evidence presented here. Their sample covers data from hundreds of producers located in 20 different countries. They document results consistent with our analysis but also show that forward contracts on differential are much more frequent. Approximately 50% of the contracts in their sample are on differential. In this type of contracts, the final price at delivery is a negotiated differential relative to a

[40] On the subtle relationships between access to finance and vertical integration see theoretical work by Aghion and Tirole (1994), Legros and Newman (1996) and Macchiavello (2010). For empirical work see, e.g., Acemoglu et al. (2009), Macchiavello (2012), Breza and Liberman (2014) and Skrastins (2015).

[41] A favourable political economy is needed to implement the Costa Rica's regulations (see Paige 1997 for details). Countries attempting similar regulations have faced resistance from large exporters and policies aimed at influencing the spatial distribution of entrants (such as zoning regulations, monopsony licenses or minimum distance rules) have historically been much more common.

pre-specified reference price (typically, the New York standard contract for Arabicas). Contrary to fixed price contracts, differential contracts reduce counterparty risk but leave parties exposed to price fluctuations. Blouin and Macchiavello (2013) show that better relationships are more likely to sign a fixed price contract in the first place. The contract enforcement provided by ICAFE, then, is consistent with the almost universal use of fixed price forward sale contracts in the Costa Rica market. By reducing price-risk exposure for producers, the system likely encourages investment in developing downstream demand. This reduces the benefit of integration through this channel. In addition, alternative organizational forms, such as networks, alliances and consortia, might be encouraged to promote secure market participation and achieve higher exporters' margins while curbing the negative externalities associated with integration.

6 Conclusion

This paper has presented an empirical analysis of vertical integration between exporters and mills in the context of the Costa Rican coffee sector. The analysis has taken advantage of uniquely detailed data on (the terms of) transactions both *between* and *within* firms to compare vertical integration against alternative governance structures and enhance our empirical understanding of *why* firms boundaries matter. We started documenting evidence consistent with demand uncertainty and supply assurance motives being important considerations in the market under study. We then document that trade within firms behaves very differently from trade between firms: trade within is much shielded from market forces. Due to opportunism, neither formal forward nor relational contracts are perfect substitutes for integration. At the same time, we have shown that the logic behind the benefits of integration also implies its costs, in particular with respect to forming valuable relationships with independent suppliers. The results support the view that firm boundaries change temptations to renege on relational contracts and, through this channel, matter for resource allocation.

Taken together, the facts provide evidence on the fundamental transformation associated with firm's boundaries as an allocation mechanism. In addition, the paper also contributes to our understanding of the two-way relationship between market structure and firms' boundaries - two aspects that the literature has often analyzed separately (see, e.g., Bresnahan and Levin (2012)). Given the richness of our data, a number of exciting avenues for future research remain open. An analysis of forward integration, cooperatives and consortia would paint a more complete picture of organizational

forms and their interactions in the industry. Second, in ongoing work (joint with Ameet Morjaria and Nicola Pavanini) we plan to structurally estimate a model informed by this analysis using data from both Rwanda and Costa Rica. The exercise will allow us to perform counterfactual analysis and ask whether Costa Rica/Rwanda should ban vertical integration and what would be the effects of the Costa Rica regulations if adopted in Rwanda.

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Table 1: Descriptive Statistics

Variable	N. Obs.	Mean	St. Dev.	Min	Max	Integrated vs. Non-Integrated
Panel A: Sellers Characteristics						
Vertrical Integrated	175	0.05	0.21	0.00	1.00	--
Cooperative	175	0.14	0.34	0.00	1.00	--
Age	175	5.93	3.78	1.00	11.00	2.89**
Quantity	175	437.52	1036.60	0.23	7643.15	2572***
Average Price	175	4.48	0.76	2.64	7.07	0.39
Unit Processing Costs	175	269.57	229.84	64.37	2419.13	-25.58
Number of Buyers	175	3.35	2.57	1.00	16.00	-1.94**
Herfindhal Index of Buyers	175	0.65	0.27	0.15	1.00	0.17**
% Sold to Integrated Buyers	175	0.12	0.29	0.00	1.00	0.92***
% Exported	175	0.76	0.27	0.00	1.00	0.15*
Panel B: Buyers Characteristics						
Vertically Integrated	162	0.05	0.22	0.00	1.00	--
Consorcio of Exporters	162	0.01	0.11	0.00	1.00	--
Age	162	6.35	3.96	1.00	11.00	3.97***
Quantity	162	657.90	2583.39	0.18	26334.11	6536.51***
Average price (weighted)	161	4.16	1.15	1.80	8.00	1.01**
Number of Suppliers	162	4.08	8.75	1.00	64.00	22.93***
Herfindal Index of Suppliers	162	0.71	0.40	0.00	1.00	-0.54***
% bought from Integrated Seller	162	0.02	0.13	0.00	1.00	0.45***
% exported	162	0.41	0.46	0.00	1.00	0.45***
Panel C: Relationships Characteristics						
Vertical Integrated Buyer	667	0.31	0.46	0.00	1.00	--
Vertical Integrated Seller	667	0.02	0.14	0.00	1.00	--
Integrated Relationship	667	0.02	0.13	0.00	1.00	--
Relationship age (in years)	667	3.39	3.73	0.00	11.87	5.81***
Quantity	667	159.79	530.31	0.02	6296.82	1529.32***
Price	667	4.61	2.12	1.70	34.26	-1.79
Share Exported	667	0.62	0.46	0.00	1.00	-0.184
Number of Products	667	1.21	0.55	1.00	5.00	0.21

***, **, * denote statistical significance at the 1, 5 and 10% level respectively. Table 1 provides summary statistics for the 2011/12 harvest campaign. Panel A refers to mills. Vertical Integrated is a dummy =1 if the mill is owned by an exporter/roster. Cooperative is a dummy =1 if the mill is owned by a cooperative. Age (censored) is the number of harvest campaigns the mill operates in our dataset. Quantity is in '000 of tons of convencional parchment coffee. Price is a weighted average price for a Kg of coffee, in dollars. Unit processing costs refers to audited processing costs per fanega of parchment coffee. % sold to Integrated Buyers refers to backward integrated buyers only. The last column reports unconditional mean differences in the relevant variable between integrated mills and non-integrated ones. Panel B refers to buyers (exporters and domestic rosters). Variables are similarly defined. The last column reports unconditional mean differences in the relevant variable between integrated and non-integrated buyers. Panel C refers to active relationships (mills – buyer pairs). All vertical integration dummies refer to backward integrated chains only. Number of products refers to the number of product specifications (quality, type, preparation) transacted. The last column report conditional mean differences between integrated relationships and non-integrated ones controlling for both buyer and seller fixed effects.

Table 2: Characteristics of Forward Sale Contracts, Partial Correlations

	[1]	[2]	[3]	[4]
Dependent Variable:	(Standardized) Leadtime			
Contract Volume (Standardized)	-0.058***	-0.326***	-0.439***	-0.549***
	(0.017)	(0.091)	(0.102)	(0.079)
Price per Kg (Standardized)	-0.114***	-0.233***	-0.134***	-0.075**
	(0.018)	(0.032)	(0.036)	(0.038)
Product FE	no	yes	yes	yes
Season FE X Region FE	no	yes	yes	yes
Contract Date FE	no	no	yes	yes
Buyer & Mill FE	no	no	no	yes
Adjusted R2	0.02	0.12	0.22	0.29
Number of observations	7613	7613	7613	7613

***, **, * denote statistical significance at the 1, 5 and 10% level respectively. Table 2 shows that leadtime (defined as the difference between the date of delivery and the signing date) negatively correlates with both contracted volumes and unit prices. In all columns OLS are estimated and a contract between a mill and a buyer is an observation. The dependent variables leadtime, contract volumes and unit prices are all standardized. Product FE are a set of (92) dummies for product types (preparation, quality and bean grading). Season fixed effects refer to the harvest campaign. Region fixed effects refer to the region where the mill is located. The sample period covers the harvest campaigns from 2009 to 2012.. Standard errors are clustered at the relationship level (1721 clusters).

Table 3: Vertical Integration and Market Forces (Dana)

	[1]	[2]	[3]	[4]	[5]	[6]
Dependent Variable:	Trade (=0, =1)		Trade Volumes		Unit Price (ln)	
Pre-Harvest	-0.003**	0.001	4114.116***	8641.03	-0.063***	-0.066**
	(0.001)	(0.002)	(1124.35)	(3969.31)	(0.013)	(0.031)
Pre-Harvest X Integrated	-0.021***	-0.016**	-11077.92	-7901.87	0.124***	0.129***
	(0.007)	(0.008)	(8169.81)	(7305.09)	(0.037)	(0.029)
Post-Harvest	-0.002*	-0.000	-1060.52	3514.98	-0.035***	-0.014
	(0.001)	(0.001)	(1225.10)	(2456.23)	(0.007)	(0.020)
Post Harvest X Integrated	-0.021***	-0.013**	-18339.42***	-12894.33**	0.039*	0.045**
	(0.006)	(0.005)	(5963.78)	(5809.99)	(0.021)	(0.021)
Controls	yes	yes	yes	yes	yes	yes
Product FE	yes	yes	yes	yes	yes	yes
Season FE	yes	yes	yes	yes	yes	yes
Relationships FE	yes	yes	yes	yes	yes	yes
Interactions with Controls	no	yes	no	yes	no	yes
Number of observations	448645	448645	7613	7613	7446	7446

***, **, * denote statistical significance at the 1, 5 and 10% level respectively. Table 3 compares trade within integrated firms with trade between non-integrated firms. The Table shows that integrated trade is less subject to demand uncertainty. All estimated models are OLS. In columns in [1]-[2] the unit of observation is a day-relationship (defined as a buyer-mill pair). In Columns [1] – [2] the dependent variable is a dummy =1 if there is a contract in that relationship in that day. In Columns [3]-[4] the unit of observation is a contract and the dependent variable is the volume of coffee traded in that contract. In Columns [5]-[6] the unit of observation is a contract and dependent variable the log of price per Kilo in the contract. Integrated is a dummy =1 if trade occurs within a backward integrated chain. Pre (post)-Harvest are dummies taking value =1 for dates before the beginning (after the end) of the harvest time in the region to which the mil belongs in the relevant harvest campaign. Controls include age of the relationship (number of past contracts) and advance time (difference between delivery and contract date). Product FE are a set of (92) dummies for product types (preparation, quality and bean grading). Season fixed effects refer to the harvest campaign. The sample period covers the harvest campaigns from 2009 to 2012. Relationships fixed effects are dummies for buyer-mills pair that have ever traded. Interactions with controls include pre-harvest and post-harvest dummies interacted with mill level controls (size of buyer and of seller (kgs season), region). Standard errors are clustered at the relationship level (1282 clusters).

Table 4: External Trade of Integrated Firms (Carlton)

Dependent Variable:	Unit Price (ln)							
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]
	Integrated Buyers				**Market Transactions**			
Integrated	-0.067***	-0.038***	-0.039***	-0.019***	-0.225***	-0.176***	-0.175***	-0.117***
	(0.024)	(0.011)	(0.011)	(0.009)	(0.086)	(0.058)	(0.057)	(0.035)
Contract Volume (Polynom.)	yes	yes	yes	yes	yes	yes	yes	yes
Contract Date FE	no	yes	yes	yes	no	yes	yes	yes
Product FE	no	yes	yes	yes	no	yes	yes	yes
Contract Controls	no	no	yes	yes	no	no	yes	yes
Season X Region FE	no	no	no	yes	no	no	no	yes
Mill Controls	no	no	no	yes	no	no	no	yes
Buyer FE	yes	yes	yes	yes	yes	yes	yes	yes
Number of observations	14650	14650	14650	14650	15438	15438	15438	15438

***, **, * denote statistical significance at the 1, 5 and 10% level respectively. Table 4 provides evidence in support of Carlton model of vertical integration and supply assurance. In all columns OLS are estimated, a contract between a mill and a buyer is an observation and the log of price per Kilo is the dependent variable. Columns in [1]-[4] focus on vertically integrated buyers and compare the price they pay through internal and market sourcing. Integrated, then, is a dummy=1 if the contract is with a mill owned by the buyer. Columns [5]-[8] focus on contracts between buyers and mills that are not integrated with each other. It compares the price obtained in the market by integrated and non-integrated mills. Integrated, then, is a dummy=1 if the mill is owned by a buyer.

Contract volume include a third-degree polynomial in Kilos of coffee on the contract. Contract controls include age of the relationship (number of past contracts) and advance time (difference between delivery and contract date). Product FE are a set of (111) dummies for product types (preparation, quality and bean grading). Contract date fixed effects are dummies for the date in which the contract is signed. Season fixed effects refer to the harvest campaign. Region fixed effects refer to the region where the mill is located. The sample period covers the harvest campaigns from 2001 to 2012. Buyer fixed effects are dummies for buyer. Mill controls include (Unit costs are audited processing costs for the mill for the corresponding type of coffee in the harvest campaign. type of mill and size (Qs)). Sample restrictions excludes trade involving forward integrated mills. Standard errors are clustered at the relationship level (588 clusters in Columns [1]-[4] and 1941clusters in Columns [5]-[8]).

Table 5: Forward Sale Contracts and Strategic Default

	[1]	[2]	[3]	[4]
Dependent Variable:	Contract Cancellation (=1)			
Price Surprise (+ if split =1)	0.017**	0.021**	0.016*	0.015*
	(0.008)	(0.011)	(0.010)	(0.009)
Negative Price Surprise		0.006	0.004	0.004
		(0.009)	(0.011)	(0.009)
Controls	no	no	yes	yes
Product FE	no	no	yes	yes
Season FE X Region FE	no	no	no	yes
P. Surprise X Mill Controls	no	no	no	yes
Relationships FE	yes	yes	yes	yes
Price Surprise Split	no	yes	yes	yes
Number of observations	19250	19250	19250	19250

***, **, * denote statistical significance at the 1, 5 and 10% level respectively. Table 5 provides evidence that forward sale contracts are vulnerable to strategic default. Forward sale contracts are defined as those signed at least one month prior to delivery. Alternative definitions yield identical results. In all columns OLS are estimated, a contract between a mill and a buyer is an observation and the dependent variable is a dummy=1 if the contract is cancelled. Only forward sales contracts are considered. Price surprise is defined as the ratio between the spot NYC price for Arabica at the date of delivery and the NYC future price for Arabica for the delivery date at the time the contract was signed. Controls include age of the relationship (number of past contracts), advance time (difference between delivery and contract date) and contract volume (third-degree polynomial in Kilos of coffee on the contract). Product FE are a set of (111) dummies for product types (preparation, quality and bean grading). Season fixed effects refer to the harvest campaign. Region fixed effects refer to the region where the mill is located. Relationships fixed effects are dummies for buyer-mills pair that have ever traded. Controls interacted with price surprise include mill level controls (size, location, ownership type). The sample period covers the harvest campaigns from 2004/05 to 2012/13. Sample restrictions excludes trade within forward integrated mills. Column 5 focus only on positive price surprises (ratio >1) and Column 6 on the placebo given by negative price surprises (ration <1). Standard errors are clustered at the relationship level.

Table 6: Strategic Default and Relationships

	[1]	[2]	[3]	[4]
Dependent Variable:	Contract Cancellation (=1)			
Positive Price Surprise	0.015†	0.013	0.013†	-0.004
	(0.010)	(0.011)	(0.030)	(0.013)
Relationship Age	-0.007**	-0.005*	0.000	0.001
	(0.003)	(0.003)	(0.006)	(0.010)
(+) Price Surprise X Relat. Age		-0.027**	-0.078***	-0.052*
		(0.012)	(0.022)	(0.032)
(+) Price Surprise X Integrated			-0.031**	-0.043**
			(0.016)	(0.019)
(+) Price Surprise X Integ. Buyer				0.037**
				(0.018)
Controls	yes	yes	yes	yes
Product FE	yes	yes	yes	yes
Season FE X Region FE	yes	yes	yes	yes
Relationships FE	yes	yes	yes	yes
Price Surprise X Controls	yes	yes	yes	yes
Number of observations	19250	19250	19250	19250

***, **, * denote statistical significance at the 1, 5 and 10% level respectively. Table 6 shows that relational contracting mitigates opportunism. Forward sale contracts are defined as those signed at least one month prior to delivery. Alternative definitions yield identical results. In all columns OLS are estimated, a contract between a mill and a buyer is an observation and the dependent variable is a dummy=1 if the contract is cancelled. Only forward sales contracts are considered. Price surprise is defined as the ratio between the spot NYC price for Arabica at the date of delivery and the NYC future price for Arabica for the delivery date at the time the contract was signed. Age of the relationship is measured in number of past contracts (in '00) between the mill and the buyer. Integrated is a dummy=1 if trade occurs within an integrated firm. Integrated Buyer is a dummy =1 if trade occurs between an independent mill and an integrated buyer. Controls include advance time (difference between delivery and contract date) and contract volume (third-degree polynomial in Kilos of coffee on the contract). Product FE are a set of dummies for product types (preparation, quality and bean grading). Season fixed effects refer to the harvest campaign. Region fixed effects refer to the region where the mill is located. Relationships fixed effects are dummies for buyer-mills pair that have ever traded. Controls interacted with price surprise include mill level controls (size, region, ownership type). The sample period covers the harvest campaigns from XXX to XXX. Sample restrictions excludes trade involving forward integrated mills. Standard errors are clustered at the relationship level (1721 clusters).

Table 7: Supply Assurance and Relationships

	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]
Dependent Variable:	Unit Price (ln)				Advance (Days)			
Relationship Age	0.016	-0.048	-0.094**	-0.135**	-0.082**	0.180***	-0.035†	-0.061*
	(0.029)	(0.041)	(0.038)	(0.064)	(0.048)	(0.076)	(0.024)	(0.036)
Integrated	-0.131***				-0.164***			
	(0.042)				(0.060)			
Contract Volume (Polynom.)	yes	yes	yes	yes	yes	yes	yes	yes
Product FE	yes	yes	yes	yes	yes	yes	yes	yes
Date FE	Contract	Contract	Contract	Contract	Delivery	Delivery	Delivery	Delivery
Mill Controls	yes	yes	yes	yes	yes	yes	yes	yes
Buyer FE	yes	--	yes	--	yes	--	yes	--
Relationship FE	--	yes	--	yes	--	yes	--	yes
Sample of Buyers	Integrated	Integrated	Non-Integ.	Non-Integ.	Integrated	Integrated	Non-Integ.	Non-Integ.
Number of observations	11621	7972	15378	15378	11621	7972	15378	15378

***, **, * denote statistical significance at the 1, 5 and 10% level respectively. Table 7 compares relationships with independent mills between integrated and non-integrated buyers. It shows that integrated buyers relationships do not growth. Columns [1], [2], [5], [6] focus on integrated buyers, Columns [3], [4], [7] and [8] on non-integrated buyers. In all columns OLS are estimated and a contract between a mill and a buyer is an observation. The dependent variables are the log of price per Kilo in Columns [1]-[4] and the advance time (difference between the date the contract is signed and the delivery is due) in Columns [5]-[8]. Age of the relationship is measured in number of past contracts (in '00) between the mill and the buyer. Integrated is a dummy=1 if trade occurs within an integrated firm. Integrated Buyer is a dummy =1 if trade occurs between an independent mill and an integrated buyer. Controls include advance time (difference between delivery and contract date) and contract volume (third-degree polynomial in Kilos of coffee on the contract). Product FE are a set of (111) dummies for product types (preparation, quality and bean grading). Season fixed effects refer to the harvest campaign. Region fixed effects refer to the region where the mill is located. Relationships fixed effects are dummies for buyer-mills pair that have ever traded. Controls interacted with price surprise include mill level controls (size, region, ownership type and cost). Sample restrictions excludes trade within forward integrated mills. Standard errors are clustered at the relationship level.

Table A2: Forward and Backward Integrated Chains (Exporter Characteristics)

	[1]	[2]
	Buyers	
Dep. Variable:	Backward Integration	Forward Integration
Size	**1.83***	1.00
Average FOB Price	0.55	1.05
Age	2.25	4.26***
HHI Clients	0.18***	1.24
% to Traders	0.05*	5.87**
Advance Contracts	4.74**	1.30
% sold at Harvest	0.11**	0.51*

***, **, * denote statistical significance at the 1, 5 and 10% level respectively. The table reports results from a multinomial logit model in which the integration status of an exporter (backward integrated = exporter owns mills, forward integrated = the export license is owned by a mill, and non-integrated) is predicted based on mills characteristics. All independent variables are standardized. Odd ratios are reported. A coefficient >1 (respectively <1) implies the corresponding independent variable is positively (respectively negatively) associated with the corresponding definition of integration. Size measures the volume of coffee exported for the 2012/13 harvest campaign. Average FOB prices refer to exports for the 2012/13 harvest campaign. Age is the number of harvest campaign the exporter is observed in the data before the 2012/13 harvest campaign. HHI is an index of concentration of foreign buyers. % to Traders is the share sold to large traders. Traders are defined large if they are among the 100 largest foreign buyers sourcing from Costa Rica. Advance contracts measures whether the exporter contracts with foreign buyers in advance (a weighted average of the order of export sale and order of export contract signing). % sold at Harvest is the share of coffee exported before the harvest season is concluded. The export data covers the seasons from 2009 to 2013 inclusive. Robust standard errors are estimated. The Table shows that backward and forward integration have different characteristics. Backward integration is mostly associated with size, concentration in downstream markets, advance contracts and rapid delivery to Roasters. Forward integration is associated with age of the firm in the market and sales to intermediaries.

Table A3: Forward and Backward Integrated Chains (Mills)

	[1]	[2]
	Mills	
Dep. Variable:	Backward Integration	Forward Integration
Size	107.8***	3.94***
Unit Costs	1.36	0.95
Age	0.62	1.68
Share Different.	0.88	1.95*
Cooperative	0.00***	4.00***
Suitability	1796***	7.79***
Variability	4.35***	0.51

***, **, * denote statistical significance at the 1, 5 and 10% level respectively. The table reports results from a multinomial logit model in which the integration status of a mill (backward integrated = owned by an exporter, forward integrated = with export license, and non-integrated) is predicted based on mills characteristics. All independent variables are standardized. Odd ratios are reported. A coefficient >1 (respectively <1) implies the corresponding independent variable is positively (respectively negatively) associated with the corresponding definition of integration. Size measures the volume of coffee processed by the mills for the 2012/13 harvest campaign. Unit costs are audited processing costs for the 2012/13 harvest campaign. Age is the number of harvest campaign the mill is observed in the data before the 2012/13 harvest campaign. Share differentiated is the share of differentiated coffee processed by the mill. Cooperative is a dummy = 1 if the mill is a cooperative. Suitability is an index for suitability for coffee, measured as the standardized z-score of deviations from ideal altitude, rainfall and temperature conditions. Variability is a z-score of across harvest variability in rainfall and temperature deviations from ideal conditions. The Table shows that backward and forward integration have different characteristics. Backward integration is mostly associated with size, being a privately owned mill and good but uncertain growing conditions. Forward integration is associated with being a cooperative, product differentiation, good and stable growing conditions.

Table A4: Consequences of Default

	[1]	[2]	[3]	[4]	[5]	[6]
Dependent Variable:	**Relationship End**				**Future Trade Volume**	
Past Default	0.28**	033**	-0.29**	-0.29**	-4.45	-4.73
	(0.17)	(0.20)	(0.12)	(0.11)	(11.16)	(11.12)
Past Default During Positive Price Surprises	2.87*	2.75*	0.23*	0.17*	-20.36*	-25.73*
	(180)	(1.71)	(0.12)	(0.11)	(14.52)	(15.00)
Controls	no	yes	yes	yes	yes	yes
Relationships FE	no	no	yes	yes	yes	yes
Season Fixed Effects	yes	yes	yes	yes	yes	yes
Cohort Fixed Effects	yes	yes	yes	--	yes	--
Model	Poisson	Poisson	Linear	Linear	OLS	OLS
Number of observations	3607	3607	3607	3607	3607	3607

***, **, * denote statistical significance at the 1, 5 and 10% level respectively. The Table shows that past contract cancellations are associated with worse relationship outcomes if they happened on contracts with positive price surprises. A unit of observation is a relationship in a given season. In Columns [1] to [4] the outcome is weather the relationship ended. In Columns [5] and [6] is the volume of trade in the relationships. Past default is the share of pas traded volume that was cancelled. Past default during positive price surprises is the share of past traded volumes cancelled on contracts with positive price surprises. Columns [1] and [2] estimate a Poisson model and report odds ratios. A coefficient >1 (respectively <1) implies the corresponding independent variable is positively (respectively negatively) associated with the end of the relationship. Standard errors are clustered at the relationship level.

Table A1: Production volumes and share exported (Industry Evolution)

Season	Total production (in 46Kg. Bags)	Share Exported	Relative price: national/export
2002-2003	2875199	89.78%	53.2%
2003-2004	2746909	87.09%	61.1%
2004-2005	2487636	80.78%	90.3%
2005-2006	2284243	79.58%	78.1%
2006-2007	2327199	79.58%	79.8%
2007-2008	2435526	85.30%	81.3%
2008-2009	2061265	84.48%	82.4%
2009-2010	1887812	84.12%	96%
2010-2011	2062384	82.17%	104.1%
2011-2012	2316932	86.66%	69.1%

Source: Annual reports, ICAFE

Table A2: Actors in the Costa Rica coffee value chain

Season	Producers	Mills	Exporters	Roasters
1996-1997	71787	96	38	44
2001-2002	70143	93	56	34
2003-2004	60483	95	63	36
2006-2007	56896	127	64	51
2008-2009	50627	145	65	55
2010-2011	50631	172	57	32
2011-2012	52787	184	93	57

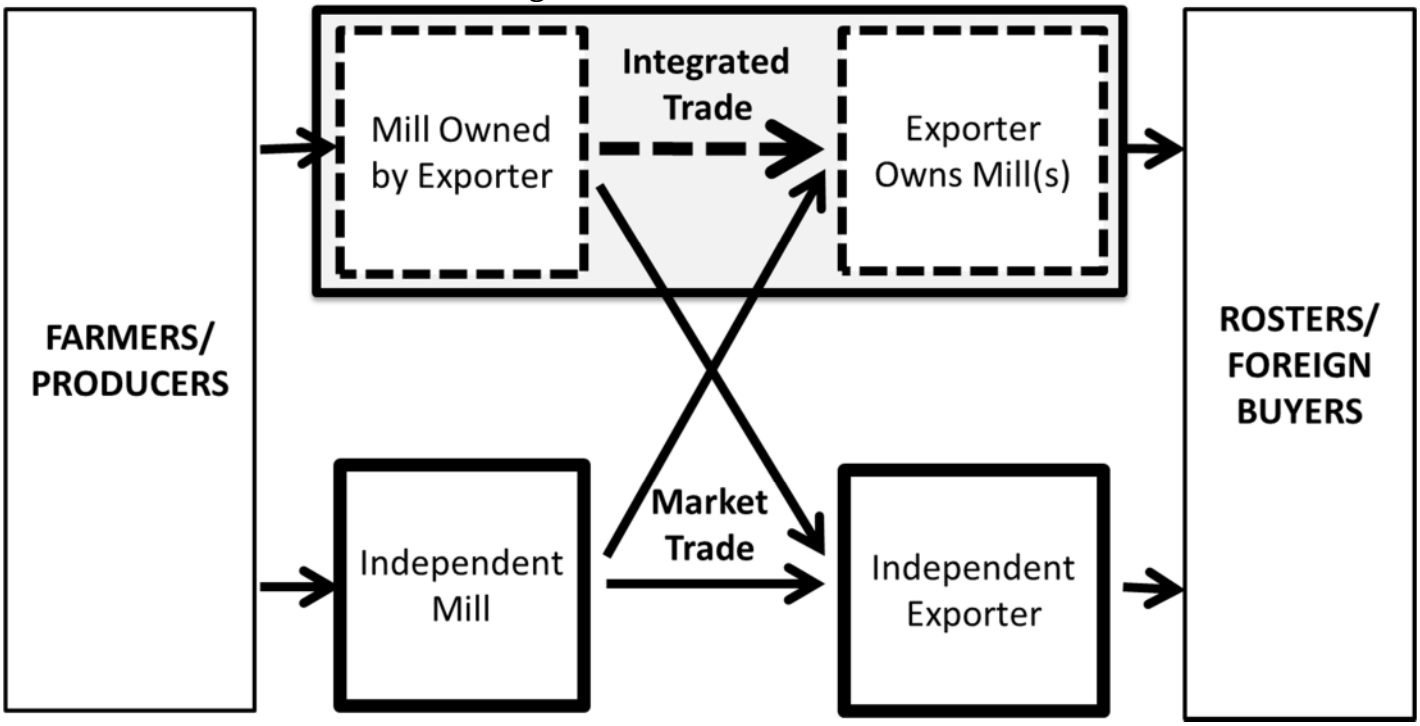
Source: Annual reports, ICAFE. Number of farmers calculated with the nominas reported by mills.

Table A3: Evolution of Mill Size Distribution

(Thousands of fanegas)		<1	1 to 3	3 to 6	6 to 10	10 to 30	30 to 70	>70	(total mills)
2006-2007	mills	25	28	13	17	16	19	9	127
	% prod.	0.44%	2.15%	2.11%	5.55%	12.34%	38%	39.37%	
2007-2008	mills	28	34	17	15	16	14	11	135
	% prod.	0.47%	2.65%	2.84%	4.3%	12.18%	27.94%	49.58%	
2008-2009	mills	45	31	18	10	17	15	9	145
	% prod.	0.86%	2.79%	3.56%	3.74%	12.25%	31.92%	44.85%	
2009-2010	mills	57	31	23	13	15	15	7	161
	% prod.	1.06%	2.48%	4.76%	5.15%	13%	34.62%	38.90%	
2010-2011	mills	69	29	23	9	21	12	9	172
	% prod.	0.98%	2.35%	4.65%	3.43%	17.26%	26.52%	44.78%	
2011-2012	mills	81	26	26	8	18	15	10	184
	% prod.	1.23%	2.07%	4.65%	2.27%	13.78%	27.19%	48.29%	
2012-2013	mills	101	37	20	8	14	13	10	203
	% prod.	1.37%	2.79%	4.01%	2.82%	10.33%	26.79%	51.86%	

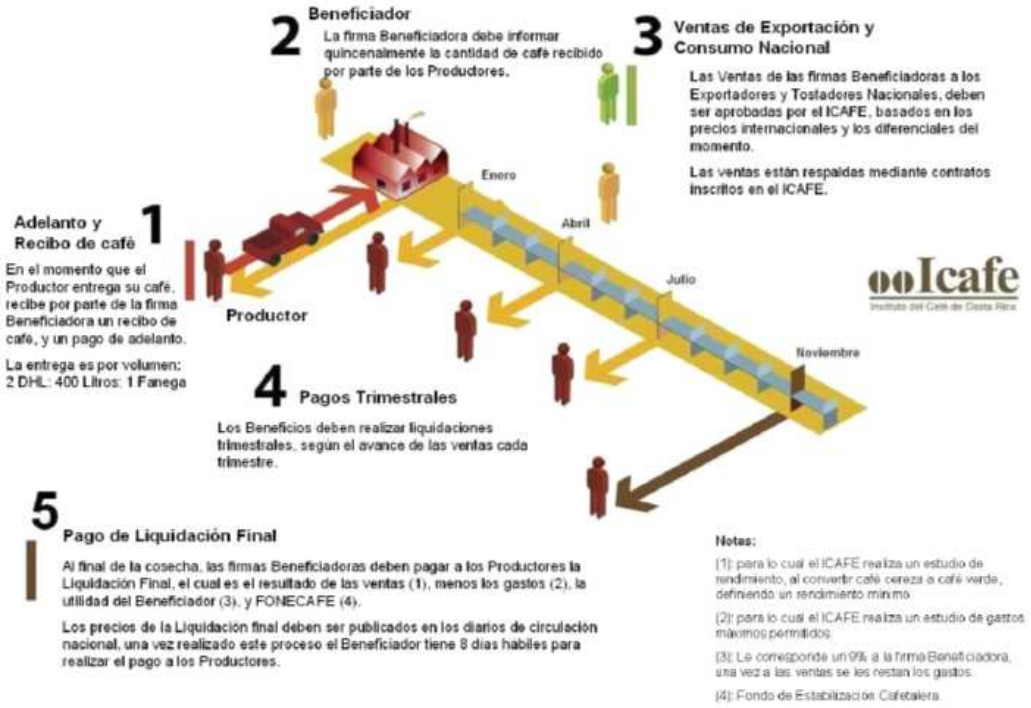
Source: Annual reports, ICAFE.

Figure 1: Coffee Value Chain



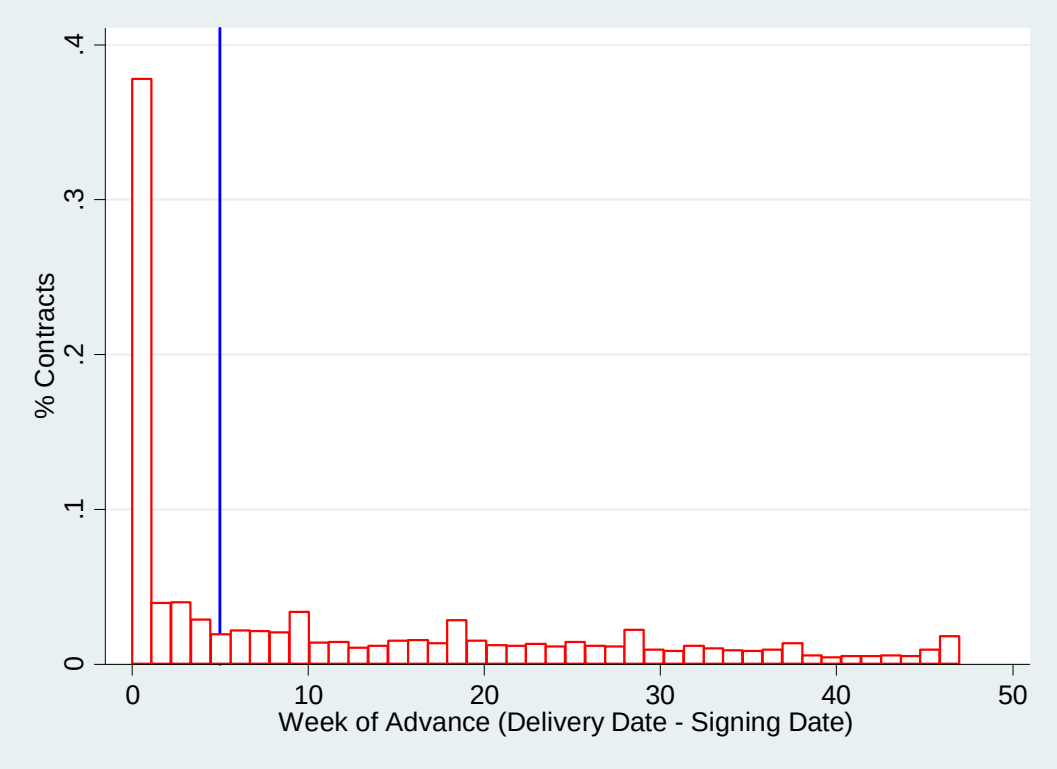
The Figure describes the coffee value chain in Costa Rica. Coffee cherries are produced by farmers and sold to Mills (Coffee Washing Stations or Beneficios). Mills sell parchment coffee to domestic buyers. These consolidate, mix and mill the coffee before selling to foreign buyers or to domestic rosters. As illustrated by the picture, some mills are owned by buyers and, therefore, some buyers are vertically integrated backward. Trade of coffee, therefore, can take four configurations: within firms, and between firms. Between firms we distinguish trade that involves only integrated buyers, only integrated sellers, or non-integrated buyers and sellers. The paper focused on the relationships between mills (sellers) and buyers and compares integrated trade with the various forms of trade in the market.

Figure 2: The Costa Rica System



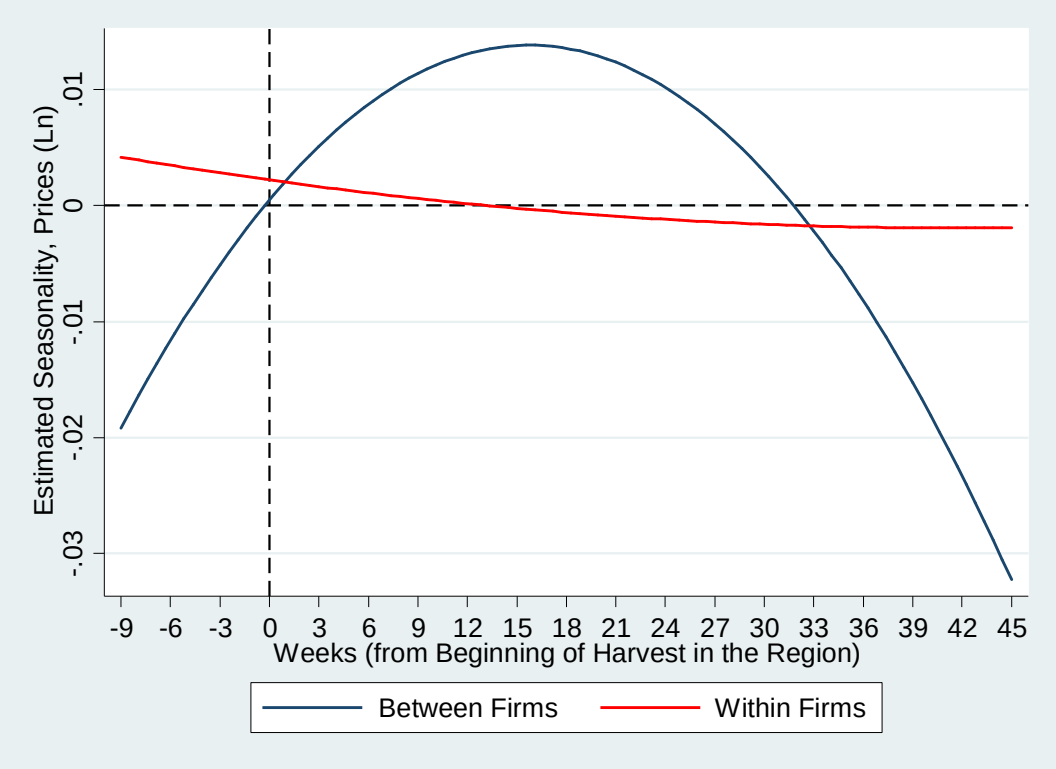
The Figure describes the Costa Rica system (Proceso de Liquidacion). At harvest time (stage 1) when the farmer delivers coffee to the mill, (s)he receives a receipt for the delivery and an advance payment. The mill must report every 15 days the amount of coffee received from farmers (stage 2). The sales of processed coffee by the mill to exporters and domestic roasters must be approved by the National Coffee Board (ICAFE). Approval is given for sales with prices in line with international market prices and differentials (stage 3). The sales are contracts enforced by the Board. The mills pays farmers every three months, according to the advances agreed in stage 1 (stage 4). Finally, at the end of the harvest season, based on sales, costs, allowed profits for mills and contribution to the national coffee fund, the final liquidation to farmers is established. The final prices paid to farmers must be published in newspapers and the corresponding payments to farmers must be executed within 8 days by the mills (stage 5).

Figure 3: Forward Sale Contracts



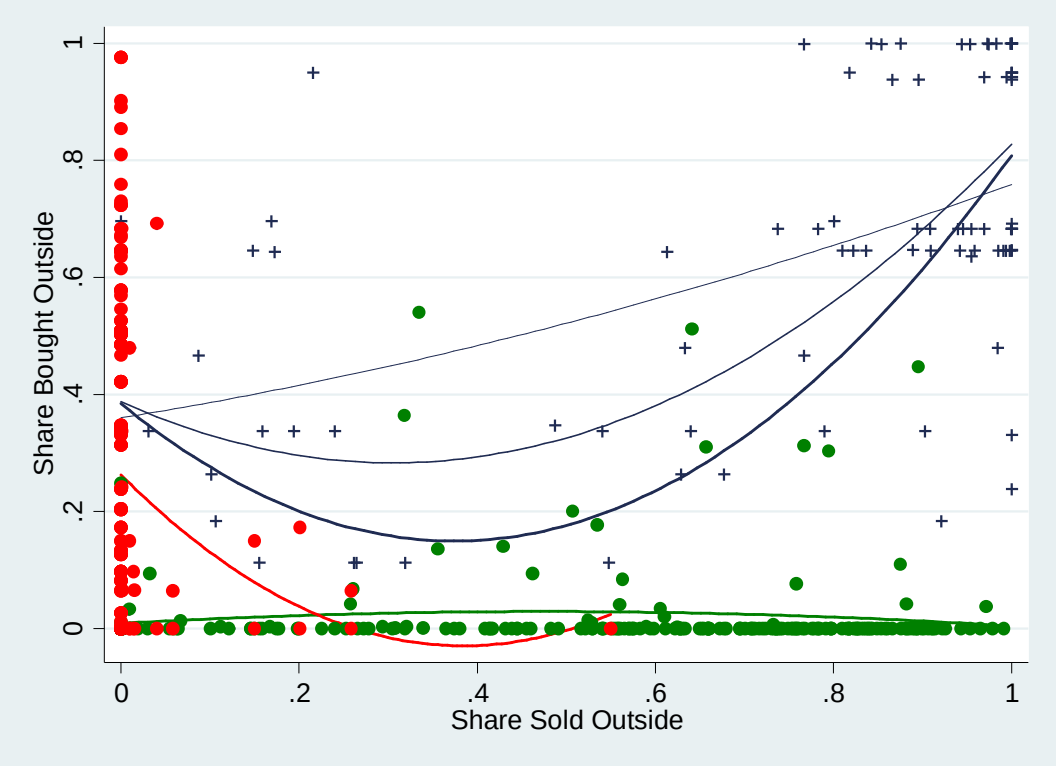
The Figure describes the distribution of forward sale contracts in the sample. The horizontal axis reports the number of weeks of advance between the date at which the contract is signed and the date at which delivery is supposed to happen. Almost 40% of the contracts signed are pure spot, i.e. delivery is due within a week of the date at which the contract is signed. Approximately 50% of the contracts signed, however, have an advance period longer than a month and a non-negligible share of contracts is signed for up to a year in advance.

Figure 4: Market Assurance



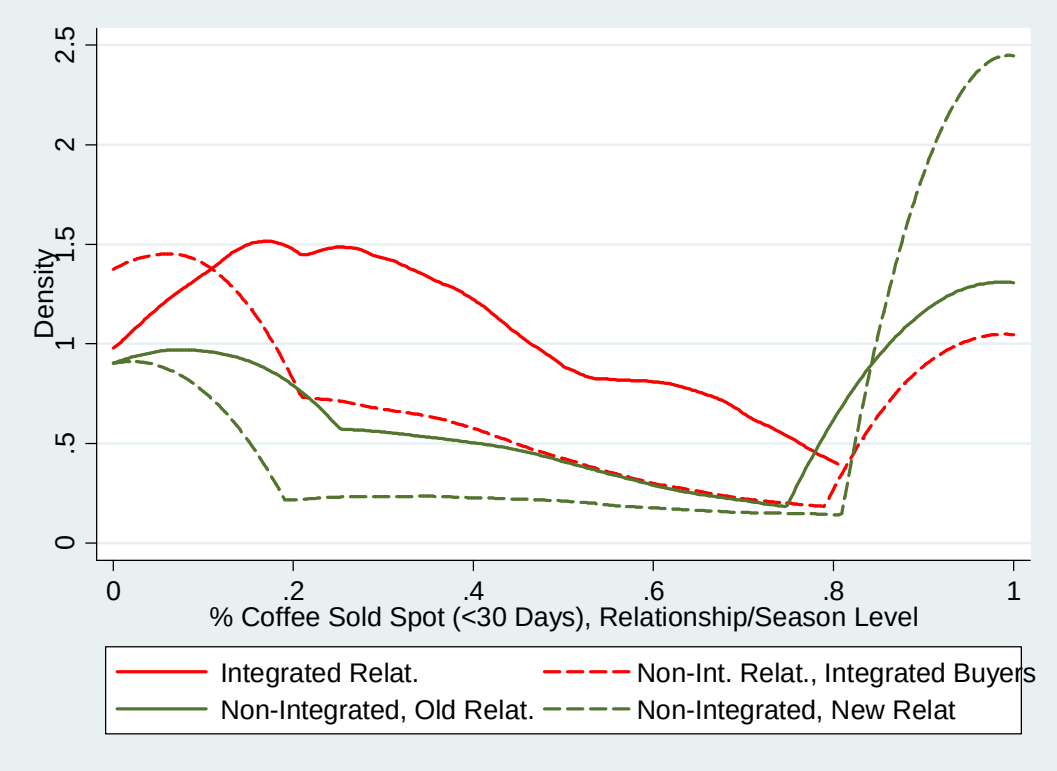
The Figure describes differential seasonality patterns in unit prices.. The (harvest) season is divided into weeks, with week zero representing the first week in which mills start receiving coffee cherries in the region. For each week in the season (from one approximately two months before the beginning of the season until approximately one year after the beginning of the season) we estimate week dummies on unit prices (logs). The regression also controls for week fixed effects, product fixed effects and buyer-seller pairs fixed effects. Identification is therefore obtained from across regions variation in harvesting time. The continuous line report lowest estimates of the estimated week dummies while the dashed line reports a quadratic fit. The Figure shows that mills receive lower prices from contracts early in the season and when they need to sell at later stages in the season. This is consistent with mills having a demand for market assurance.

Figure 5: Supply Assurance



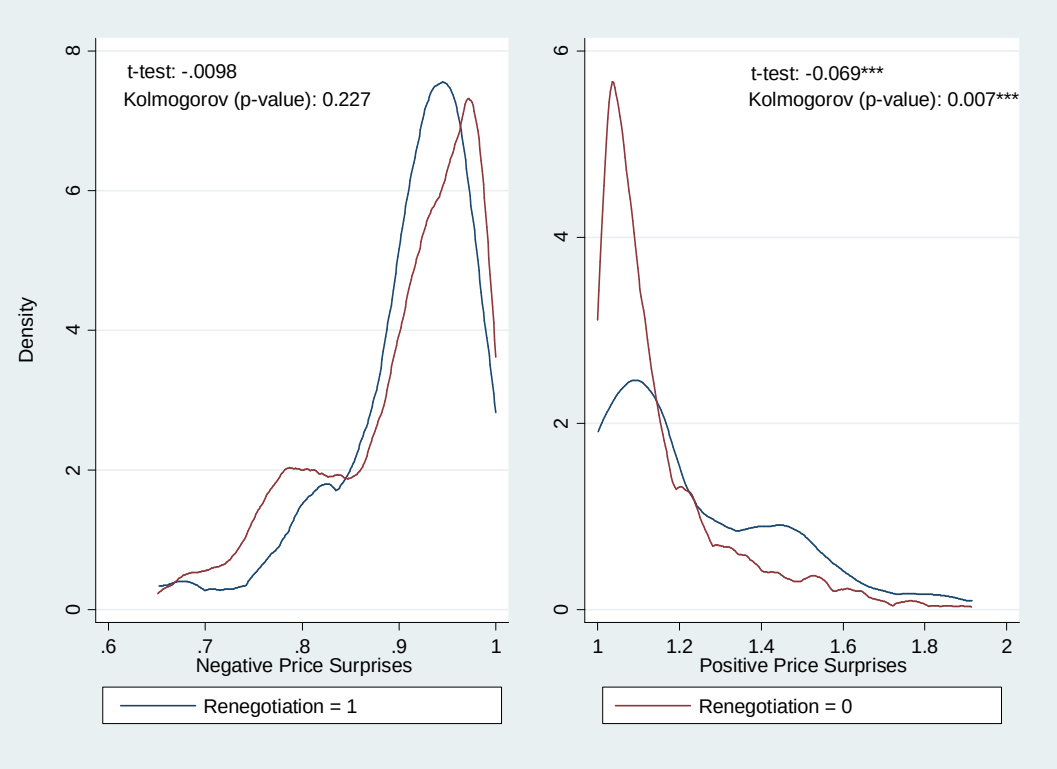
The Figure reports the shares of coffee bought and sold on the market by vertically integrated firms ("Carlton Fact 1"). A unit of observation is a vertically integrated firm in a given season. The vertical axis is the share of coffee bought in the market. The horizontal access gives the share of coffee sold on the market. The "Carlton Fact" suggests that if supply assurance considerations are important motives for integration, firms should only be on either the y-axis (they purchase in the market coffee only when their demand exceeds their production capacity) or on the x-axis (they sell in the market production in excess of their demand). As it can be seen, backward integrated firms (red dots) behave very consistently with supply assurance. Forward integrated firms (green dots), in contrast, often do sell on the market even when engaging in selling coffee purchased on the market. Appropriating some of the marketing rents downstream is likely to be a motive for forward integration. Corresponding figures for long term relationships (blue crosses) are also reported. The blue lines (thin, medium, thick) report the interpolated figure for new, young and old relationships. Although as age of the relationship increase the blue line moves towards the red line associated with backward integration, the figure shows that long term relationships *do not* converge to the trade patterns associated with integration.

Figure 6: Spot Markets, Relationships and Vertical Integration



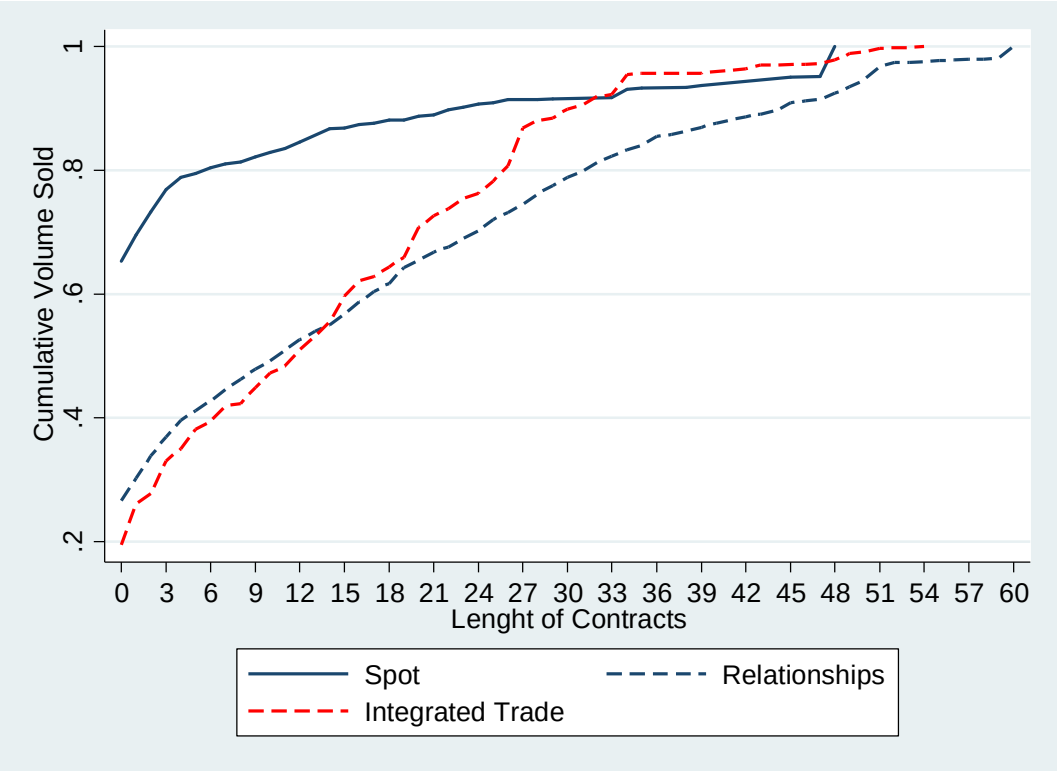
The Figure reports the distribution of the share of contracts classified as spot (i.e., with advance less than 30 days) across four different types of economic relationships: i) vertically integrated chains, ii) long term relationships involving integrated buyers, iii) long term relationships between non-integrated parties, and iv) occasional trades/new relationships between non-integrated parties. Two patterns stand out. First, young relationships between non-integrated parties are much more likely to trade (almost) exclusively based on spot transactions. Second, unlike trade involving long term relationships, trade within integrated chains is less likely to rely exclusively on spot markets or on forward sales contracts. This is consistent with integrated mills facing less demand uncertainty and integrated chains relying less on adjustments on the spot market

Figure 7: Price Surprises and Renegotiations



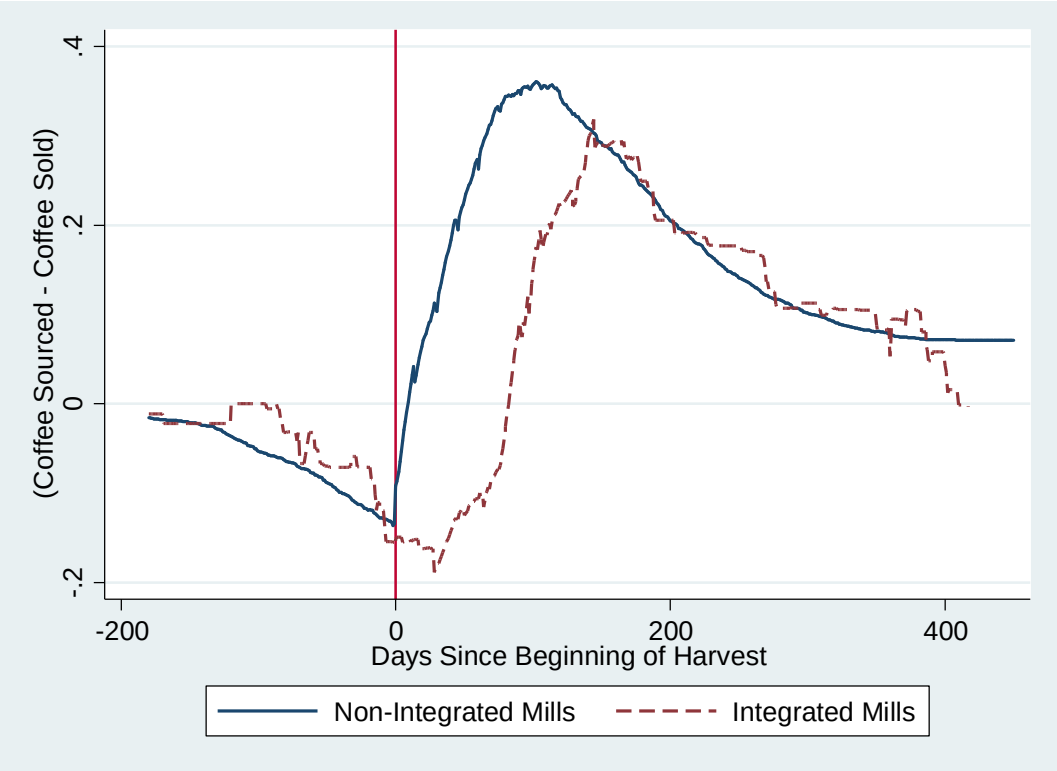
The Figure tests for the relationship between fixed-price contract renegotiations and price surprises, focusing on conventional coffee for which international prices are most relevant. Price surprise is defined as the ratio between the international market price at the date of delivery and the international future market price for the date of delivery at the time the contract was stipulated (i.e., registered with the National Coffee Board). A ratio below one implies a negative price surprise (which gives buyers incentives to renegotiate); while a ratio above one implies a positive price surprise (which gives sellers incentives to renegotiate). The left panel considers negative price surprises. Consistent with the fact that the board enforces contracts, there is no statistical difference in the distribution of negative price surprises for contracts that are and are not renegotiated. Sellers, however, can potentially claim not having the exact coffee type stipulated in the contract and can, therefore, opportunistically attempt to renegotiate prices. The right panel shows that positive price surprises are disproportionately associated with contract renegotiations.

Figure A1: Use of Forward Contracts: Market, Relationships and Firms



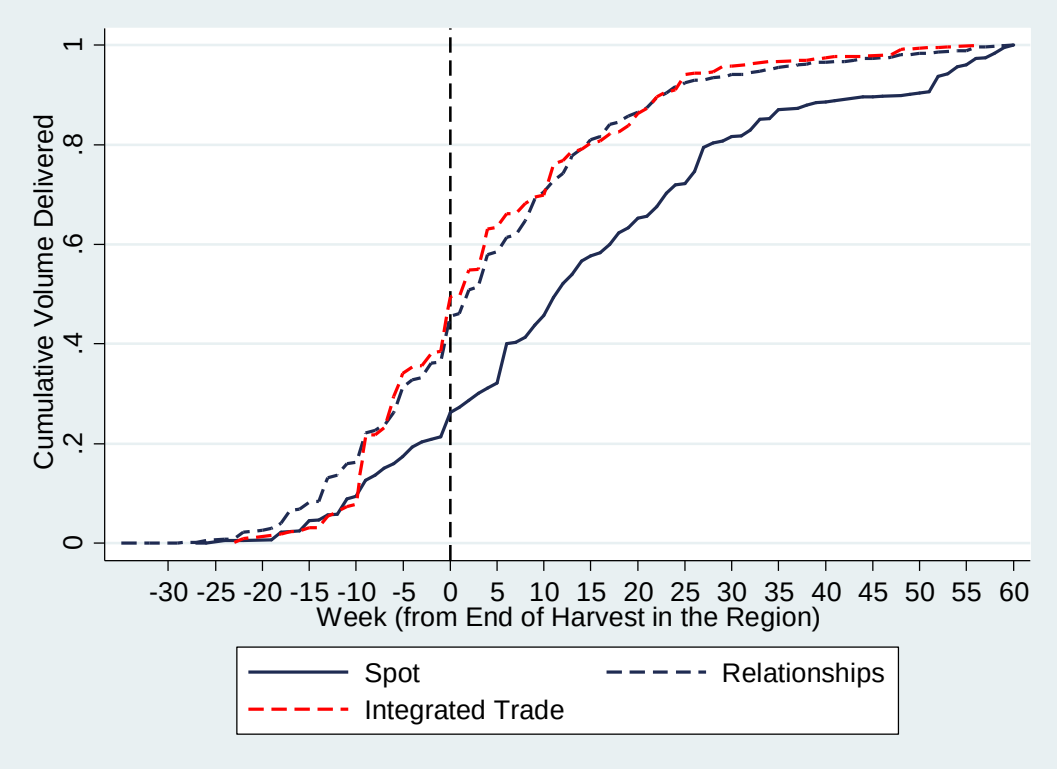
The Figure reports the cumulative share of coffee sold by length of contract, measured in weeks. The length of the contract is defined as the difference between the date in which the contract is signed and the date at which the coffee is supposed to be delivered. Contracts of length zero are "spot" contracts. Longer contracts are forward contracts. The figure shows that 60% of coffee exchanged between firms that do not have long-term relationships with each other is spot. In contrast, within firms and within long-term relationships the share of coffee sold spot is only 20%. Long-term relationships and trade within firms behave very similarly, with long-term relationships using even more forward contracting.

Figure A2: Forward Contracts, Sourcing and Inventory Risk: Market and Firms



The Figure reports the evolution of sales and sourcing during the harvest season for mills belonging to backward integrated chains and non-integrated mills. The time is measured relative to the beginning of the harvest season in the region and average figures for all seasons available are reported. The difference between coffee sourced and coffee sold is reported as a share of the coffee eventually sourced in that season. Non-integrated (blue solid line) start signing forward contracts before the beginning of the harvest campaign. As soon as harvest begins, however, the speed at which they source coffee is faster than the speed at which they sign sales contracts. Eventually, one year after the beginning of the harvest season, non-integrated mills are left with 5-7% unsold coffee. In contrast, integrated mills sign fewer contracts before harvest begins, the timing of sale contracts is more evenly spread out and – as a result – exposure (defined as coffee in stock relative to sold coffee) is always smaller. Eventually, integrated mills sell all coffee.

Figure A3: Timing of Delivery: Markets, Relationships, Firms



The Figure reports the cumulative share of coffee sold by delivery date, measured in weeks from the end of the harvest campaign in the region. The figure shows that only 20% of coffee exchanged between firms that do not have long-term relationships (blue solid line) with each other is delivered before the end of the harvest campaign. In contrast, within firms (red dashed) and within long-term relationships (blue dashed), coffee is continuously delivered as it is received and processed by the mill. Long-term relationships and trade within firms behave very similarly.

Figure A4: Geographical Location of Mills