Vertical Integration and Relational Contracts in the Costa Rica Coffee Chain*

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Abstract

Do firm boundaries establish a sharp discontinuity between "markets" and "hierarchies", or can long-term relationships between firms replicate the allocation of resources achieved by integration? We answer this question in the Costa Rica coffee chain, an environment in which we observe trade across a rich variety of organizational forms: integrated firms; long-term relationships between firms and market transactions. In a market characterized by demand uncertainty, we examine how organizational forms respond to exogenous (weather induced) changes in supply and to shocks to temptations induced by unanticipated swings in reference prices. Sufficiently long-term relationships between firms behave like integrated trade. Integrated suppliers only sell within the chain, while independent suppliers sell to multiple buyers. The closer interdependence allows integration to trade larger volumes but makes it harder to sustain relationships with independent suppliers. The evidence supports models in which firms boundaries alter temptations to renege on relational contracts and, consequently, the allocation of resources.

Keywords: Vertical Integration, Supply Chain, Relational Contracts, Demand Uncertainty, Forward Contracts.

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

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1 Introduction

Do firm boundaries establish a sharp discontinuity between "markets" and "hierarchies", or can long-term relationships between firms replicate the allocation of resources achieved by integration? 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 economics, corporate finance, and development.[1] Classic theoretical contributions recognize contractual imperfections as the keystone of any theory of the firm (see, e.g., Gibbons (2005)).[2] However, in many real-world circumstances contractual parties can also deal with these very same contractual imperfections by resorting to repeated relationships between firms.[3] While classic theories of the firm suggest a sharp discontinuity between "markets" and "hierarchies", this observation has led many scholars to emphasize the importance and stability of "hybrid" structures, such as supply-chain systems (see, e.g., Powell (1990), Williamson (1991), Sako and Helper (1998) and Menard (2004)).

A full understanding of how firm boundaries alter resource allocation, therefore, requires comparing integration against both relationships and market transactions between firms. This point, formalized in the seminal contribution by Baker et al. (2002), has largely been ignored by the empirical literature on vertical integration, presumably because of the difficulty in observing transactions within firms and hybrid structures alike. Such an omission might lead to the wrong conclusions about the motives and consequences of integration and, consequently, to wrong policy recommendations. This might be particularly problematic in developing countries, where institutional constraints limiting the efficiency of both markets and firms (are believed to) make informal relationships relatively more prevalent (see, e.g., Greif (1993), Fafchamps (2004)).

This paper asks to which extent long-term relationships between firms can replicate trade within integrated firms in the Costa Rica coffee chain. The environment allows us to overcome several empirical challenges. First, due to regulations in the industry, all transactions of coffee between mills and buyers – including those occurring within

[1] 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)). Roughly one-third of world trade occurs within firm boundaries (Antràs (2003)).

[2] Prominent theoretical contributions include Williamson (1971, 1975, 1985); Klein et al. (1978); Grossman and Hart (1986); Hart and Moore (1990), Holmstrom and Tirole (1991), Holmstrom and Milgrom (1994), Hart and Holmstrom (2010)

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

firms – are recorded by the coffee board. This allows us to observe trade across a rich variety of organizational forms: roughly 40% of coffee in the industry is exchanged within integrated firms; 40% within long-term relationships between firms and 20% between firms not trading repeatedly.[4] Second, because we observe transactions along the whole chain – from farmers, to mills, to exporters, to foreign buyers – we can study how organizational forms respond to exogenous changes in supply, demand and market conditions. We find that sufficiently long-term relationships between firms behave like integrated trade. The two forms differ in exclusivity: integrated mills only sell within the chain, while independent mills sell to multiple buyers. The closer interdependence allows integration to trade larger volumes but makes it harder to sustain relationships with independent suppliers.

The empirical analysis unfolds as follows. In Section 2 we describe the industry and patterns of trade. In the cross-section, mill characteristics that correlate with integration status (size, suitability for coffee cultivation and variability in growing conditions) also correlate with the share of coffee sold through long-term relationships on the sample of non-integrated mills. Similarly, buyers characteristics that correlate with integration (size, exporter status and, conditional on exporting, structure of contractual arrangements in foregin markets) also correlate with the share of coffee sourced through long-term relationships on the sample of non-integrated mills. These correlations suggest that integration and long-term relationships might share similar motives.

Section 3 shows that integration and long-term relationships mitigate demand uncertainty. Numerous conversations with industry practitioners and industry reports suggest that demand uncertainty is a key feature of the industry.[5] Three patterns observed in non-repeated trade between firms suggests this to be the case: 1) forward sale contracts are pervasive; 2) mills face significant inventory risk; 3) prices feature both advance-purchase and end-of-season discounts.[6] Integrated mills sell all their produce within the integrated chain and, therefore, face lower demand uncertainty. Relationships look remarkably similar to integrated trade and radically different from market trade. Non-integrated mills sign forward contracts with long-term buyers to

[4]Vertical integration is backward integration in which downstream buyers own coffee mills. Relationships are defined as mill-buyer pairs that trade for at least three consecutive years. Due to lack of similar data it is hard to benchmark these figures. In the Peruvian anchovetas industry (for which similar data is available) relationships also account for two-thirds of between firms trade. Due to a reform of the quota system, the share of integrated trade increased from 30% to 60% of the market in recent years. See Natividad (2014a, 2014b). We thank Jose Martinez for sharing these figures.

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

[6]These facts match the predictions of models with demand uncertainty (see, e.g., Carlton (1978), Dana (1998)).

secure demand early in the season and, like integrated mills, deliver coffee earlier and face lower inventory risk.

This suggestive evidence is confirmed by responses to weather conditions. Weather conditions (rainfall, temperature) during the growing season (i.e., before mill's production decisions are made) exogenously affect the supply of coffee around the mill during harvest. In response to exogenous increases in supply, sales volumes increase both within firms and between firms. When we unpack between firms responses by distinguishing long-term relationships and non-repeated market transactions, integration and long-term relationships absorb additional supply (while the market does not) and their response cannot be distinguished.[7]

Section 4 explores the mechanisms behind the similar responses of long-term relationships and integration. One possibility is that buyers willing to offer demand assurance repeatedly trade with mills demanding such assurance. Long-term relationships could entirely rely on repeated contracting without any exchange of informal promises. Another possibility, however, is that observed relationships do involve a relational contract between mills and buyers. In a relational contract (see, e.g., MacLeod and Malcomson (1989), Levin (2001)), parties promise to undertake certain costly non-contractible actions in exchange for future rewards. Parties trade off future rents against current temptations to deviate. Promises to sign contracts in the future allow parties to avoind signing contracts too early which can turn out to be costly if market conditions change. The main difficulty in providing evidence that a relational contract is in place is that the promises exchanged, the temptations to deviate and the future rents are not directly observable in the data. A key advantage of our setting is that, once a contract is signed, the mill's temptation to deviate (as well as actual deviations, if any) become directly observable. Hence, although contract cancellations are quite rare in the sample, they provide a transparent opportunity to test for the presence of a relational contract.

We distil a number of testable predictions from a framework along the lines of Baker, Gibbons and Murphy (2002). The central insight of their model is that firm boundaries affect temptations to renege on the (relational) contract. Consider a mill and a buyer that signed a forward sale contract. Unanticipated swings in reference prices change temptations to renege. In particular, if prices increase, a mill has an incentive to side-sell (or renegotiate the contract) to take advantage of improved market

[7] Appendix B uses exogenous changes in demand in foreign markets and show that integration and long-term relationships also provide supply assurance to buyers. The Appendix also explores additional dimensions of the quid-pro-quo inside relationships.

conditions. Under integration, however, the buyer owns the coffee and, therefore, the mill cannot renege. In other words, the reneging temptation is independent of reference prices. Under non-integrated ownership, extreme realizations of reference prices create large temptations for the mill to renege. If relationships provide future rents, mills will resist larger temptations. We use unanticipated changes in reference prices to test these predictions and find ample support: delivery failure within integrated firms are independent of reference prices; relationships are relatively more resiliant to those shocks.[8]

Heterogeneity across relationships provide further support for the mechanism and sheds light on the potential costs of integration. A corollary of the relational contract logic is that better outside options reduce parties' ability to sustain relational contracts. If control over (future) owned capacity gives vertically integrated buyers a better outside option, their relationships with independent suppliers will have, ceteris paribus, lower value. We find ample support for this predictions. First, shocks to reference prices are associated with default only inside relationships between integrated buyers and independent suppliers. Second, there is indeed less cooperation (i.e., lower response to supply shocks) in those relationships. Finally, integrated buyers reduce purchases from non-integrated suppliers in response to better weather conditions (and higher supply) at their own mills.

In sum, the evidence strongly supports the view that firm boundaries alter temptations to renege on relational contracts. Long-term relationships with sufficient relational capital, however, can replicate the allocation of resources achieved by integration. This supports a more fluid view of organizations in which "hybrids" can offer stable arrangements in between "markets" and "hierarchies". The exclusivity associated with integration might be necessary to resist extremely large temptations associated with larger volumes of trade. Such exclusivity, however, comes at the costs of making it harder to sustain relationships with independent suppliers.

Section 5 presents additional evidence that rules out alternative explanations as main drivers of integration in our context. We observe unusually detailed product characteristics. We can distinguish between more than three-hundred different types of (parchment) coffee.[9] This degree of detail allows us to control for (and rule out) differences in product type and quality across organizational forms. We also exploit

[8] Appendix C discusses further evidence consistent with long-term relationships involving a relational contract based on past promises.

[9] For comparison, these hundreds types of parchment coffee span only two 10-digit U.S. HS codes (0901110015 and 0901110015), the most disaggregated product classification typically used in empirical analysis of international trade.

detailed information on mill's unit processing costs and show that integrated mills do not have lower costs than similar mills that sell coffee through long-term relationships.[10] The final sections of the paper discuss policy implications for export-oriented agricultural chains in developing countries.

Related Literature

This paper merges two strands of empirical literature: the literature on vertical integration and the literature on relational contracts. With respect to the former (for reviews, see Lafontaine and Slade (2007) and Bresnahan and Levin (2012)) the paper makes two contributions. First, vertical integration is compared against a broader set of alternative organizational forms: we unpack "between" firms trade distinguishing long-term relationships from non-repeated, market, trade. We show long-term relationships behaves like integration, and differently from market trade. Second, we distil predictions from the Baker, Gibbons and Murphy (2002) framework and test them: 1) if trade is sufficiently repeated, firm boundaries do not matter; and 2) firm boundaries alter temptations to deviate on relational contracts.

A large share of the literature on vertical integration relates to antitrust concerns and exclusionary aspects (see, e.g., Hart and Tirole (1990) and Hortascu and Syverson (2007) for overviews). We study a product which is globally traded and, therefore, concerns about foreclosure and other anti-competitive concerns are less likely to be relevant. This allows us to focus on aspects of integration more closely related to adaptation and non-contractability. Within this strand of work, 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), Antràs (2003), Gil (2007), Forbes and Lederman (2009), Atalay et al. (2014), Alfaro et al. (2016)). Forbes and Lederman (2009) show that airlines tend to integrate routes that require more adaptation. Our results on the characteristics of buyers and mills belonging to backward integrated chains echo their findings. Following seminal papers by Antràs (2003) and Antràs and Helpman (2004), a large and still growing literature in trade has studied determinants of intra-firm trade in international transactions (see Antràs (2015) for a review).[11] We also study exporters, but focus on the vertical integration decision along the domestic supply chain. As also noted

[10] Anticompetitive motives are also unlikely to be key driver of integration and long-term relationships in our context since the final product is a globally traded commodity and, therefore, no firm has market power in the product market.

[11] Within this literature, Costinot et al. (2011) identifies adaptation as a key driver of intra-firm trade.

in Bresnahan and Levin (2012), a much smaller literature has asked whether "firm boundaries matter?," i.e., focused on behavioral and operational differences between integrated and non-integrated trade (see, e.g., Mullhainatan and Sharfstein (2001), Hortacsu and Syverson (2007), Gil (2009), Forbes and Lederman (2010), Atalay et al. (2014)). This paper falls more squarely within this second strand. The notable study by Atalay et al. (2014) uses plant level data from the US Longitudinal Business Database combined with the Commodity Flow Survey and find remarkably low levels of internal shipments across plants within vertically integrated firms. In contrast, we study a context in which integration is strongly associated with internal trade. In a study of integration between vinyl chloride monomer (VCM) and waterproof plastic manufacturers, Mullainathan and Scharfstein (2001) find that non-integrated VCM producers react more strongly to market demand while integrated producers focus on internal demand. While our results are in line with their evidence, the granularity of our data allows us to more precisely identify the channels through which integration affects firm's operations. In addition, we compare integration against both a market with forward contracts and relational contracting between firms.

The paper also contributes to the recent literature on relationships between firms (see, e.g., Lafontaine and Slade (2012) and Gil and Zanarone (2014) for reviews).[12]. Methodologically, Macchiavello and Morjaria (2015a) analysis of relational contracts in the flower industry is most closely related. We also use side-selling opportunities to proxy temptations to deviate and unanticipated shocks to test theoretical predictions. Temptations to deviate are also exploited in Barron et al. (2015). Blouin and Macchiavello (2013) and Gil et al. (2016) exploit both temptations to deviate and unanticipated shocks. Barron et al. (2015) and Gil et al. (2016) provide convincing evidence on the importance of (relational) adaptation in the movie distribution and airline industry respectively. In a cross-country sample of contracts between coffee exporters and foreign importers Blouin and Macchiavello (2013) show that parties adopt formal contracts to allocate scarce relational capital, as in Klein (2000) (see, also, Gil (2013)). We borrow from them the use of unanticipated shocks to reference prices to study default. None of these papers studies vertical integration.

Finally, the paper relates to the literature on firms, contracts, and organizational forms in developing countries. Banerjee and Duflo (2000), Banerjee et al. (2001), Banerjee and Munshi (2004), Fafchamps (2000, 2004), Macchiavello (2010), Macchiavello and Morjaria (2015b), McMillan and Woodruff (1999), Mookherjee et al. (2015,

[12]see also Kellogg (2011), Gil and Marion (2012), and Antràs and Foley (2015)

2016) are examples of empirical studies focusing on the importance of relationships. Vertical integration has been relatively neglected.[13] Andrabi et al. (2006) study flexible specialization in response to demand uncertainty among subcontractors in Pakistan. Fafchamps and Hill (2005, 2008), De Janvry et al. (2015), Dragusano and Nunn (2014), Macchiavello and Morjaria (2015b) and Martinez (2016) study various facets of the industrial organization of the coffee chain. None focuses on vertical integration.[14]

Roadmap

The rest of the paper is organized as follows. Section 2 describes the Costa Rican coffee sector, its regulations and market structure. Section 3 shows that integration and long-term relationships provide demand assurance to mills. Section 4 distills predictions from Baker, Gibbons and Murphy (2002) framework and tests them using unanticipated shocks to reference prices. Section 5 presents additional results in relation to alternative theories of integration. Section 6 discusses policy implications for export-oriented agricultural chains in developing countries and concludes.

2 Industry Background

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 when coffee was the main export crop for decades. Costa Rica ranks 14th among world's coffee producers (see I.C.O. (2015)). 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. Coffee is produced in seven regions that differ in altitude and climate and, therefore, in harvest timings (see Table A1 and Figure A1 in the Appendix).

Figure 2 describes the coffee chain. 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").[15]

[13] Acemoglu et al. (2009) and Macchiavello (2012) provide cross-country-industry analyses of contractual institutions and vertical integration.

[14] Dragusano and Nunn (2014) and Martinez (2016) also use some of the Costa Rican data in this paper but focus on fair trade and product differentiation respectively.

[15] In other countries the coffee cherry is directly processed by farmers. This so called "dry method"

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. The analysis compares trade within backward *integrated* firms (buyers owning mills) with trade between firms. We distinguish repeated trade between firms (*relationships*) and non-repeated trade between firms (*market*). Trade within firms is always repeated.[16]

Figure 3 illustrates the unfolding of the coffee season. During the growing season (approximately from August to November) weather conditions heavily influence the amount of coffee harvested by farmers. Coffee is harvested and processed during the harvest season (December to April). Finally, contract sales are executed before the beginning of the following harvest seasons. To reduce risk, parties contract for future delivery even before the beginning of harvest (forward sale contracts). The empirical analysis studies how different organizational forms respond to shocks. Relative to when production decisions are made, we distinguish "ex-ante" weather shocks (which drive available supply) from "ex-post" reference price shocks, which capture changing market conditions once production choices are sunk.[17]

Industry Regulations

In Costa Rica the production, processing, marketing and export of coffee are undertaken by the private sector. The state regulates the sector through the Instituto del Cafe de Costa Rica (ICAFE), a non-governmental public institution established by law in 1961.[18]

The key aspect of the regulation is the System of Final Liquidation (i.e., "Sistema de Liquidación Final"). For the system to be implemented, all transactions of coffee along the chain must be registered with the board. This requirement applies to all transactions, independently of ownership structure. This implies that terms of transactions are observed for both trade between and within firms. The regulations generate uniquely detailed data along the entire domestic chain. The process and the data used in the analysis, are described in further detail in Appendix A.

(in contrast to the "wet method" performed by mills) is extremely uncommon in Costa Rica. The washed method generally produces higher and more consistent quality.

[16]There are also mills that own exporting licenses and are, therefore, *forward* integrated. Mills can either be privately owned or cooperatives. Some cooperatives form horizontal alliances as part of marketing consortia. Forward and backward integrated chains look and behave differently. For simplicity, this paper excludes trade within forward integrated chains. Results are robust to its inclusion. Differences across the two types of integration are explored in a separate paper.

[17]We use ex-ante shocks to understand what relationships do and ex-post shocks to test predictions from the relational contract framework.

[18]ICAFE represents the interests of farmers, processors and exporters. For further details, see: www.icafe.go.cr.

As a result of the regulations, ICAFE also enforces standards and contracts. A contract between a mill and a buyer must specify type of bean (8 categories), quality of parchment (7 categories) and preparation type (8 categories). A total of 336 different types of parchment coffee are observed in the data.[19] The board also 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 under specific circumstance.[20] Below, we exploit unanticipated changes to international prices to understand the mechanisms underpinning relational contracts.[21]

Descriptive Statistics

Table 1 provides summary statistics for the 2011/12 harvest season.[22] Panel A presents mills' characteristics. Out of 175 mills, approximately 5% are owned by buyers, i.e., are part of backward integrated chains. In addition, 14% of mills are cooperatives. The ten largest mills account for 53% of production. Backward integrated mills account for 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 per year, sold 12% of their output to backward integrated buyers and exported 76% of their produce. The last column shows that 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 149 buyers, 5% are backward integrated. The buyer's side of the market is more concentrated. The ten largest buyers have a combined 77% market share, while backward integrated buyers account for 52% of market output. This implies that backward integrated buyers source approximately

[19]Mills can furthermore register up to three differentiated product lines of coffee, in addition to the undifferentiated ("convencional") line we focus on. These hundreds of products span only two ten-digit HS codes (0901110015 and 0901110025), the finest level of product classification typically used in international trade.

[20]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 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 deliver, and (D) for exceptional causes to be evaluated by the coffee board.

[21]The regulation allows vertical integration and prevents transfer pricing (in which prices are artificially depressed to shift profits downstream) by rejecting contracts with prices below an undisclosed minimum. Figure A3 shows that undisclosed minimum prices do not bind. The main empirical analysis focuses on volumes and timing of transactions, not on prices.

[22]The industry has been relatively stable throughout the sample period (see Table A2 for summary statistics). The only significant change has been the entry of a larger number of micro-mills in recent years. Those mills account for a very small share of aggregate production.

60% internally and the rest on the market. Buyers have operated an average of 6.23 years in the market, have about 4 suppliers per year and export 40% of their purchases (which implies that size is positively correlated with share exported). The last column shows that backward integrated buyers are larger, have more suppliers, export more and (possibly as a result) pay higher prices.

Panel C reports characteristics of the contracts. Approximately 20% of the contracts are for the national market, and around 50% involve an integrated buyer. The average contract is signed about 3 months before scheduled delivery.

Relationships

We define a mill and buyer pair to be in a relationship if they trade for at least four consecutive harvest seasons.[23] According to this definition, Figure 1 shows that approximately 40% of coffee is exchanged within relationships; 20% in the market and the remaining 40% within integrated firms. That is, approximately two thirds of trade between firms takes place within relationships. Panel D in Table 1A presents relationships' characteristics for the 2011/12 harvest season. There is a total of 178 relationships. The average relationship accounts for 33% of a mill sales and for 22% of a buyer sourcing. Relative to integrated trade, relatinships have smaller volumes, lower shares of exports, and register longer contracts.

The starkest difference between relationships and integrated trade is that integrated mills sell (almost) everything to their integrated buyer. Table 2 describes the use of the three organizational forms across mills and buyers depending on integration status. The Table reports average figures on the share of coffee sold and sourced through different channels in each season. Columns (1) and (2) consider mills marketing channels. Non-integrated mills market approximately 60% of their produce through relationships and the remaining 40% in the market. Mills owned by buyers sell essentially all their produce (98%) to their buyers. The very sporadic outside sales of integrated mills never involve the same buyer across harvest seasons: integrated mills do not have relationships with outside buyers. Columns (3) and (4) consider buyers sourcing chan-

[23]The definition classifies a mill and a buyer as being in a relationship from the first time they trade, provided they eventually trade at least four seasons consecutively. The definition is, therefore, forward looking but selects relationships based on success. It is also, admittedly, somewhat arbitrary. We report robustness checks using both *more* (**Alternative 1**) and *less* (**Alternative 2**) conservative definitions of relationships. Alternative 1 classifies trade in a relationship only after the fourth consecutive season a mill and a buyer have traded together. While not forward looking, this allows the relational contract to build-up over the initial years of a relationship. Alternative 2 classifies as relationship any trade between a mill and a buyer that have traded more than one year. This minimizes selection concerns. Throughout the analysis we show that results are robust to the use of different definitions. Due to age effects within relationships, however, the magnitude of the estimates does depend on the definition used. See Appendix C for a detailed discussion of relationship dynamics.

nels. Non-integrated buyers split their sourcing equally between relationships (49%) and market (51%). Backward integrated buyers source 63% of their coffee from their own mills, with the remaining split between relationships (24%) and market (13%). Due to the large size of the integrated buyers, 46% of relationships are between an independent mill and an integrated buyer.[24]

Correlates of Vertical Integration and Relationships

Tables 3 and 4 show that firms characteristics associated with vertical integration also predict the use of relationships for both mills and buyers. Table 3 presents cross-sectional correlations between mills characteristics and organizational forms in marketing channels.[25] Column (1) reports results from a Probit model predicting the integration status of a mill. A mill is integrated if it is owned by a buyer, i.e., if it belongs to a backward integrated chain. Column (1) shows that processing capacity, age, average suitability for coffee growing and weather variability around the mill's location positively correlate with integration status.[26] The positive correlation with suitability and variability of growing conditions confirms the importance of market assurance concerns and echoes findings in Forbes and Lederman (2010) on airline integration in the U.S.

The predicted integration score in Column (1) is used as independent variable and correlated with the percentage of the production sold through relationships by non-integrated mills in Columns (2) to (4). The integration score strongly correlate with the use of relationships as marketing channel (Column (2)). This result is robust to more and less conservative definitions of relationships (Columns (3) and (4)). Mill's characteristics associated with integration are also associated with more stable marketing channels.

Table 4 shows that buyer characteristics associated with integration also predict the use of relationships on the sample of non-integrated buyers. Column (1) reports results from a Probit model predicting the integration of a buyer. A buyer is integrated if it owns at least one mill. Size, age, and share exported correlate with backward

[24]Forward integrated chains look very different. Forward integrated mills sell approximately 30% of their produce directly and split the remaining between 46% in relationships and 22% in the market. They also only export coffee they produce (95%).

[25]There is little time variation in mill's integration status overtime, with less than a handful of mills switching integration status. Moreover, the main mill's characteristics of interest are also time invariant.

[26]Suitability is an index measured as the standardized z-score of deviations from ideal altitude, rainfall and temperature conditions. Variability is a z-score of across harvest season variability in rainfall and temperature deviations from ideal conditions. Each of these characteristics also correlate with integration status when considered in isolation.

integration status. The predicted integration score in Column (1) is used as independent variable and correlated with the share sourced through relationships in Columns (2) to (4). The integration score strongly correlates with the use of relationships regardless of how those are defined. Conditional on exporter status, the structure of downstream marketing channels (share sold to roaster, concentration of downstream buyers and just-in-time deliveries) is positively associated with backward integration (Column (5)) and with the use of relational sourcing (Column (6)). These contractual arrangements in foreign markets associated with integration suggest that exporters with more stable demand (and stronger supply assurance concerns) might be willing to integrate or use relationships providing mills with stable demand.[27]

3 Integration, Relationships and Supply Shocks

This Section first provides a descriptive analysis of trade under the three different organizational forms: market; relationships and integration. The evidence can be summarized as follows: *i*) the market is characterized by demand uncertainty; *ii*) trade within integrated firms is insulated from demand uncertainty; *iii*) relationships look much more similar to integration than to market. The Section then asks whether indeed integration and relationships provide market assurance. The section studies differential responses across organizational forms to weather conditions during the growing season and find that, like integration, relationships disproportionately absorb exogenous increases in production.

3.1 Demand Uncertainty: Descriptive Evidence

Numerous conversations with practitioners and industry reports suggest that demand uncertainty is a salient feature of the industry.[28] Demand assurance concerns arise in markets in which there are idiosyncratic and aggregate demand shocks, once production decisions have been sunk. These conditions fit the coffee industry well. Buyers (mostly exporters) need to manage stocks to timely deliver coffee to downstream roasters facing uncertain demand in the retail market. Furthermore, after harvest is completed, the vagaries of weather and harvest conditions in competing locations worldwide induce

[27] All specifications exclude forward-integrated chains. Results for both mills and buyers are similar if those are included. Characteristics associated with forward integrated are however quite different from those associated with backward integration. Most notably, cooperative cannot be, by definition, owned by downstream buyers but do often integrate forward.

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

fluctuations in (expected) demand and price. Since parchment coffee can be stored up to at most the following harvest, inventories can only partially help to navigate demand shocks and mills face the risk of holding unsold stocks at the end of the season.

Building on theoretical work, Figure 4 shows that demand uncertainty is an important concern in this market.[29] Figure 4 plots the difference between processed coffee and coffee committed for sales during the course of the harvest campaign. First, as further described below, mills sign forward contracts. In only less than 40% of contracts delivery occurs within a week of the signing date. The average contract is signed three months in advance of contracted delivery.[30] Even before the beginning of harvest mills sign contracts for later delivery.

Second, mills carry the risk of unutilized capacity (inventory risk). The negative balance is reduced and is turned into positive as the mills start receiving coffee during harvest. The balance peaks towards the end of harvest and then decreases as mills sell processed coffee. On average, non-integrated mills remain with a significant share of the processed coffee still to be sold well after the harvest has ended.

Finally, mills are willing to pay a price to reduce the inventory risk. The Figure also reports (estimated) seasonality effects on prices. All else constant, prices are approximately 4% lower for contracts signed before the beginning of harvest. Mills are willing to accept lower prices to avoid having to sell coffee after the end of the harvest season when prices are, all else constant, 5% lower.[31]

Vertical integration has long been seen as a solution to demand uncertainty (see, e.g., Chandler (1964), Green (1974), Carlton (1979) and Perry (1989)). As noted above, integrated mills sell almost all their produce to their buyers. As a result, they face lower inventory risk (see Figure 4). Integrated mills i) sign fewer contracts before the beginning of harvest; ii) carry a lower balance of processed coffee throughout the

[29]The analysis is mostly based on Dana (1998) and Carlton (1978) (see also Deneckere and Peck (1995) and Cachon (2004)).

[30]We study the physical market for Costa Rican coffee. In the coffee trade, as in several other commodity markets, physical markets operate alongside futures markets, in which contracts for future delivery of coffee (rather than coffee itself) are traded. The majority of futures contracts is traded for obligations in other futures contracts, i.e., contracts of coffee are very rarely "called" for actual delivery. Futures contracts are principally used for risk management. The high number of transactions makes future markets extremely useful price revelation mechanisms and futures prices provide key reference prices for contracts in physical markets.

[31]See Table A3 for regression results. These figures are estimated from contract level regressions controlling for volumes (third degree polynomials), region-specific season and seasonality effects; product fixed effects; and buyer and seller fixed effects. Identification is therefore obtained from across regions variation in the timing of harvest. These effects are not driven by differences in the quality of coffee since those are controlled for by product fixed effects (which include an indicator of when the coffee was harvested). These estimated effects on prices are large relative to average buyers (6%) and mills (9%) profit margins.

entire season; iii) are never left with unsold coffee at the end of the season.[32]

Relationships look similar to integrated trade and different from the market. The left panel of Figure 5 compares the timing of deliveries across the three organizational forms. 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. Integration and relationships deliver coffee "just-in-time", i.e., before the end of the harvest season as coffee gets processed. In contrast, only 20% of coffee exchanged in the market is delivered before the end of the harvest campaign. The right panel describes the use of forward contracts. The Figure reports the cumulative share of coffee sold by length of contract (measured as the difference in weeks between the delivery and signing dates). Spot contracts (i.e., contracts of length zero) account for 60% of trade in the market. These share drops to only 20% in both relationships and integrated trade. The overall distribution of contract length in relationships and integrated trade is almost identical. As a result, mills marketing mostly through relationships guarantee demand by signing more forward contracts before the beginning of harvest season and reduce inventory risk to the level of integrated mills (Figure 6).

3.2 Organizational Forms Responses to Weather Conditions

As shown in Figure 4 mills face demand uncertainty: they might not find buyers for their produce; receive lower prices when selling coffee at the end of the season; and are willing to accept lower prices to guarantee demand. Mills owned by buyers, however, always sell their produce internally and do not face this type of risk. Do relationships also provide demand assurance? This section uses mill specific weather shocks during the growing season to answer this question.

Reduced Form

Rainfall and temperature realizations during the growing season (from August to November) affect aggregate coffee production during the harvest campaign. Figure 7 shows that weather conditions during the growing season strongly correlate with aggregate production at the mill level across seasons. The Figure plots non-parametric lowess regression between (residuals of) the weather index (a z-score of rainfall and temperature) and (residuals of) aggregate mill production on mill and season fixed

[32]Backward integrated exporters are more likely to export through advance contracts. From a risk management perspective it is then optimal to match contract duration in export market with (reported) contracts within the integrated chain.

effects. The reduced form specification is given by

$$y_{mos} = \alpha_{mo} + \mu_s + \beta_o \times W_{ms} + \varepsilon_{mos} \tag{1}$$

where y_{mos} is tons of coffee sold by mill m through organizational form $o = m, r, v$ in season s, α_{mo} are mill marketing channel specific fixed effects and μ_s are season fixed effects. Weather realizations during growing season W_{ms} are interacted with organizational form dummies β_o at the marketing channel or firm level depending on specifications, while ε_{mos} is an error terms arbitrarily correlated within mills-channel over time and within mill-harvest season across marketing channels.

Table 5 reports the results.[33] Column (1) considers only two marketing channels: between firms (which bundles both market and relationships) and within firms. A one standard deviation increase in weather is associated with an increase of **88** tons of sales between firms and an increase of **324** tons of sales within firms. Although the two magnitudes are quite different (due to underlying differences in scale across integrated and non-integrated mills) we fail to reject a statistically significant difference in the reaction of sales to weather across the two forms (p-value 0.25). The between channel includes sales of integrated firms to the market which, as noted in Table 2, are sporadic and extremely low. When those are excluded, the coefficient on the between channel almost doubles in size rendering any difference between the two channels even less stark.

Column (2) unbundles the between firm trade distinguishing market and relationships and present the main result. A one standard deviation increase in weather conditions increases volumes sold through market sales by only 4 tons, coffee sold through relationships by 139 tons and volumes within integrated chains by 264 tons. First, volumes sold within firms respond differently from trade in the market (p-value 0.05). Within-firm trade response to weather, however, cannot be distinguished from relationships response (p-value 0.36). Like integration, relationships also provide mills with demand assurance when production exogenously increases due to favorable weather conditions.

A concern is that responses to weather conditions confound organizational forms effects and mill's scale: the response of trade within firm is larger because integrated firms are larger. Column (3) includes as further control the interaction between weather conditions and mill's capacity and find identical results. Besides capacity, Table 3

[33] For concreteness, we use the baseline definition of relationships and temperature as weather shocks. See Table 6 for robustness.

showed that age, suitability and variability in growing conditions are associated with integration. Furthermore, by definition, farmers cooperatives cannot be owned by buyers. Column (4) includes the interactions between those characteristics as well as cooperative status with weather conditions and shows that the results are remarkably robust.

Table 6 provides a number of robustness checks and shows that across several specifications integration and relationships behave similarly and differently from market trade. The Table replicates the baseline specification in Column (1). It then considers different weather conditions (rainfall in Column (2)), the z-score of rainfall and temperature in Column (3)); a broader definition of catchment area (Column (4)); a less (Columns (5), (6)) and a more conservative definition of relationships (Columns (7) and (8)). Across all specifications we reject the hypothesis that market respond like integration to weather conditions. In six out of eight specification we cannot reject that relationships respond like integration. When defining relationships as mill and buyer pairs that have traded for at least two consecutive years, relationships look similar to market. This is due to a combination of selection and age effects inside relationships (see Appendix C for details).[34]

IV Results

The results in Tables 5 and 6 show that organizational forms react differently to weather conditions: integration and relationships are used to absorb exogenous increases in supply. Table 7 directly investigates the relationship between aggregate mill production and propensity to sell coffee through different channels presenting reduced form, OLS and 2SLS results. Weather conditions are used to instrument for aggregate production at the mill level.[35]

Specifications are as in Tables 5 and 6, the dependent variable is the share of coffee sold through a given channel. Column (1) reports the reduced form results. The share sold through relationships increases in response to positive weather shocks. Integrated mills, however, almost always sell all their production to their buyers (Table 2). The share they sell to their integrated buyer can only decrease when production is very abundant. Columns (2) and (3) confirms the reduced form results splitting the sample

[34]Unreported specifications show that, at this aggregate level, prices (both conditional and unconditional of product characteristics) and characteristics of products transacted do not respond to weather conditions. The timing of contracting is however affected. In response to a one standard deviation increase in weather, integrated trade register contracts two weeks earlier, while relationships sign contracts for a couple of weeks longer. Table 10 show no effect of weather conditions during growing season on operating costs.

[35]As noted above prices, type of coffee and costs do not respond to weather conditions.

between non-integrated and integrated mills.

Column (4) presents the OLS results. The specification is given by

$$Sh_{mos} = \alpha_{mo} + \mu_s + \beta_o \times Q_{ms} + \varepsilon_{mos}. \tag{2}$$

The independent variables are given by the interaction between the marketing channel dummies and the total production of the mill Q_{ms} (in logs). The OLS results confirm the reduced form patterns: when non-integrated mills produce more, they sell a higher share of their coffee through relationships. Integrated mills reduce their share to integrated buyers as production in excess of demand is sold in the market.

The OLS coefficients, however, are likely to be biased. Mills might source more coffee from farmers in response to higher demand from buyers. If mills respond to the demand of their integrated buyer and/or buyers with whom they have relationships more (i.e., integration and relationships also provide supply assurance to buyers), the OLS coefficients will be biased away from zero: the market channel coefficient is biased downward while the integration and relational coefficients are biased upward.

Column (5) reports 2SLS results in which the interaction between mill production and marketing channels are instrumented with the interactions between weather conditions and marketing channels. The corresponding first-stages results are presented in Table A4. Conventional tests show strong first stages. Exogenous increases in supply do not increase the share sold within the firm (as this is close to 100% anyway). A disproportionately high share of additional coffee is marketed through relationships.[36] Furthermore, the instrumented coefficients for the relationship and market channels are closer to zero than the OLS estimates (although the difference is not statistically significant). This suggests that relationships might also provide supply assurance for buyers. Given the evidence in Table 4 suggesting that exporters demand structure correlates with backward integration and relational sourcing, Appendix B exploits exogenous demand shocks to investigate supply assurance in greater detail. Using aggregate imports of coffee from Latin and Central American countries in the foreign markets served by exporters, we construct exogenous "Bartick" instruments for buyers demand. In response to increases in demand, buyers source a disproportionate share of coffee from relationships. The evidence suggests a quid-pro-quo in which mills and buyers in relationships exchange demand and supply assurance. The Appendix discusses further dimensions of this quid-pro-quo.

[36]Table A5 presents a number of robustness checks. Conveniently, we can use temperature and rainfall as *separate* instruments for production. The Table shows that the two instruments give identical estimates.

4 Mechanisms

Conceptual Framework

Like integration, relationships provide demand assurance to mills. One possibility is that buyers willing to offer demand assurance repeatedly trade with mills demanding such assurance. This trade entirely relies on forward contracts enforced by the board without any exchange of informal promises. Another possibility, however, is that observed relationships do involve a relational contract between mills and buyers. In a relational contract (see, e.g., MacLeod and Malcomson (1989), Levin (2001)), parties promise to undertake certain costly non-contractible actions in exchange for future rewards. Parties trade off future rents against current temptations to deviate. In our context, an advantage of such promises is to avoid signing contracts too early which can turn out to be costly if market conditions change.

The main difficulty in providing evidence that a relational contract is in place is that the promises exchanged, the temptations to deviate and the future rents are not directly observable in the data. A key advantage of our setting is that, once a contract is signed, the mill's temptation to deviate (as well as actual deviations, if any) become directly observable. Hence, although contract cancellations are quite rare in the sample, they provide a transparent opportunity to test for the presence of a relational contract.

In an influential paper, Baker, Gibbons and Murphy (2002) (henceforth, **BGM02**) study the interaction between relational contract and firm boundaries. They offer two central insights. First, firms' boundaries matter because they change temptations to deviate and, therefore, the amount of cooperation that can be sustained in the relationship. Second, if the value of future rents is sufficiently high (e.g., because trade is very frequently repeated) firm boundaries do not matter. We derive testable prediction by considering a simple adaptation of the incentive constraint in their model to our context.

Consider a mill and an exporter that at a certain date t have signed a contract for delivery of quantity q_c at price p_c at a future date $t' > t$. Let p_w be the realized spot market price at delivery and $T(\theta, o)$ the share of contracted coffee the mill can side-sell. $T(\theta, o)$ depends on the integration status of the mill $o \in \{F, R\}$ and on (time varying, product specific) market liquidity θ.[37] If p_w is much higher than anticipated, an independent mill will want to renege on the contract and try to take advantage of

[37] F stands for firm (integration) and R for relationship (non-integration.)

improved market conditions, i.e., $T(\theta, R) > 0$. When the mill is owned by the buyer, instead, it doesn't own the coffee and cannot side-sell it (i.e., $\mathrm{T}(\theta, \mathrm{F}) = 0$). Denote with V_m^o and U_m^o the continuation values under organizational form o for the mill following delivery and default respectively. The dynamic incentive compatibility constraint for the mill is given by

$$\delta(V_m^o - U_m^o) \geq (p_w - p_c)T(\theta, o)q_c. \tag{3}$$

A number of testable predictions immediately follow. First, integrated mills have fewer defaults and those defaults do not depend on market conditions p_w. In backward integrated chains the buyer owns the coffee and, therefore, side-selling is not a concern. Second, if relationships have higher future value, they will have fewer defaults when prices p_w are unexpectedly high.

Moreover, a multi-party extension of the logic suggests that relationships between backward integrated buyers and independent mills have, all else equal, lower value. This is for two distinct reasons. First, integrated buyers might use independent suppliers only to cover demand in excess of own capacity. Mills might expect less *future* business in relationships with backward integrated buyers (i.e., lower δ). Second, the incentive constraint highlights the central role of outside options: the higher the parties continuation value following a default, the lower the temptations that can be resisted. Integrated buyers can guarantee supplies from owned mills. This has implications for the ability of integrated buyers to develop relational contracts with independent suppliers. If control over integrated capacity implies a better outside option, a vertically integrated buyer has, ceteris paribus, a disadvantage in sustaining relational contracts with independent suppliers.[38] We summarize this in the following:

Prediction:

(1) *Unanticipated increases in market prices lead to contract default but*

(2) *not within integrated firms, and*

(3) *less so as relationship's age increases,*

(4) *more so in relationships involving integrated buyers.*

[38]Note that the incentive constraint above highlights the role of the mill's continuation value U_m^o following a default. However, since parties can use transfers to sustain cooperation, a standard implication of relational contracts models is that the *sum* of continuation values determines the amount of temptations that can be resisted.

Empirical Strategy

To test these predictions we need exogenous variation in the right hand side of the constraint, i.e., in the mill's temptation to renege.[39] Although prices p_c are observable, they are not exogenous. The price negotiated at time t, p_c, reflects contracting parties expectations about prevailing spot market prices at delivery date t', denoted $\mathbf{E}\left[p_w^{t'}|t\right]$. Variation in realized market prices p_w relative to expectations induce exogenous variation in the temptation to renege on the contract. Liquid futures markets reveal for every contracting date t expected future prices for deliveries at t'. This overcomes the key empirical challenge of proxying for expectations of future prices, which are typically unobservable. For each contract signed between mill m and buyer b at date t of season s for deliveries of product p at t' we construct a measure of price surprise as

$$P_{mbpstt'} = \frac{p_w^{t'}}{\mathbf{E}\left[p_w^{t'}|t\right]}, \tag{4}$$

i.e., as the ratio between the realized spot price at delivery and the expected price at delivery at the time of contracting. The board allows mills, but not buyers, to cancel contracts under specific circumstances. As a result, we expect an *asymmetric* effect of price surprises on contract default. The empirical specification is given by

$$d_{mbpstt'} = \eta_{mb} + \delta_{st} + \mu_{sp} + \gamma_{tp} + \beta_o^+ \times P^+_{mbpstt'} + \beta_o^- \times P^-_{mbpstt'} + \varphi X_{mbpstt'} + \varepsilon_{mbpstt'} \tag{5}$$

where $d_{mbpstt'}$ is a dummy taking value one if the contract is canceled by the mill and zero otherwise, η_{mb} are relationship fixed effects, δ_{st} are contracting date fixed effects, μ_{sp} are product-season fixed effects, γ_{tp} are product-seasonality fixed effects, $X_{mbpstt'}$ are further controls and $\varepsilon_{mbpstt'}$ an error term arbitrarily autocorrelated within relationships.[40] The price surprise $P_{mbpstt'}$ is flexibly interacted with organizational form dummies β_o distinguishing the effect of positive and negative price surprises.

Results

Table 8 reports the results. Column 1 confirms that price surprises are associated with (strategic) default (prediction **(1)**). A doubling of prices during the duration of the contract more than doubles the chances of contract default. Columns 2 distinguishes between positive and negative price surprises. Results confirm the postulated asym-

[39] We borrow this empirical design from Blouin and Macchiavello (2013).

[40] Controls include third degree polynomials of contracted volume (which directly affects temptation to renege on the contract) while the combination of η_{mb}, δ_{st}, μ_{sp} and γ_{tp} control for time-varying product-specific market conditions. A linear probability model is used to accommodate the numerous fixed effects included in the specifications.

metry: 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. In contrast, negative price surprises do not lead to contract default.

Column 3 interacts price surprises with organizational forms dummies. The results confirm predictions **(1)** and **(3)**. Positive price shocks are not associated with default inside relationships, nor within integrated firms. The relationship between positive price shocks and default is entirely driven by market transactions. Column 4 also includes region-specific season and seasonality fixed effects, interactions between mills characteristics (size, location, ownership type). Results are remarkably robust: positive price surprises increase the likelihood of contract default in market transactions, but not in relationships or within firms.[41].

Table A6 shows that contract cancellations are unlikely to be agreed by both parties and are most likely associated with default. The Table shows that past contract cancellations are associated with worse relationship outcomes (relationship's death, future contract volumes) if they happened on contracts with positive price surprises.[42]

Table 9 explores predictions **(4)**. The Table focuses on the sample of relationships and distinguishes responses to various shocks between relationships involving integrated buyers and those that do not. Column 1 considers contract defaults in response to unanticipated increases in reference prices. This provides a direct comparison of the future value across similar relationships that involve integrated buyers and those that do not. Results show that, all else equal, relationships involving integrated buyers are more fragile. Unexpected increases in reference prices only lead to default in relationships involving backward integrated buyers.[43]

Column 1 shows that relationships involving backward integrated buyers can resist lower temptations, i.e., have lower future value. If this is the case, they should also be characterized by lower amounts of cooperation. Column 2 shows that this is indeed the case by considering the response of trade volumes to weather conditions. Relationships involving backward integrated buyers do not increase trade volume in response to positive weather shocks, relationships not involving integrated buyers do.

Relationships involving integrated buyers can have lower value for two reasons: lower expected future trade volumes and higher continuation values following a default.

[41] Specifications in Columns 3 and 4 also include all relevant interactions with negative price surprises. None of the coefficients is statistically significant

[42] ADD Dynamic Figure Here.

[43] The specification also includes relevant interactions with negative price surprises which are, as expected, all insignificant.

Columns 3 and 4 attempt to untangle the two mechanisms. Column 3 considers the response of trade volumes to demand shocks.[44] In response to demand shocks in export markets trade volumes respond positively but not differentially across relationships involving integrated buyers and those not involving integrated buyers. This suggests that expectations about future trade volumes might not be the primary force driving the lower value of relationships involving integrated buyers.

Column 4 focuses on the sample of relationships involving integrated buyers only and considers again trade volumes responses to weather conditions. The specification includes weather conditions at the mills owned by the integrated buyer. Controls include buyer's size and mills fixed effects. Results confirm the findings in Column 2 that volumes traded within these relationships do not respond much to positive weather conditions at the mill. More importantly, positive weather shocks at the mill owned by the integrated buyer *reduce* the volume traded in the relationship. Integrated buyers prioritize internal supply: at times of abundant supply integrated buyers reduce purchases from independent suppliers.[45]

These results suggest that relationships involving integrated buyers have lower value and provide mills with lower levels of market assurance. Table A7 in the Appendix shows that buyers pay higher prices for identical purchases of coffee when sourcing externally and that age effects on prices are very small inside relationships involving integrated buyers. Integrated buyers must compensate independent mills for lower level of demand assurance through higher prices. Integration comes with the cost of making it harder to develop relationships with external suppliers.[46]

5 Alternative Theories of Integration

The evidence is consistent with models in which vertical integration achieves demand and supply assurance (see, e.g., *Green (1974), Carlton (1979)*). These older theories of integration, however, did not offer microfoundations to distinguish integration from contracts - relational as well as formal. Relational contracts between independent

[44] See Appendix A for details on the construction of the proxy for demand shock.

[45] Results hold if weather at the mill is not controlled for. Spatially correlated weather do not drive the results. No similar spillover is found on the sample of non-integrated buyers.

[46] Table A7 in the Appendix documents a further cost of integration. Integration assigns control over outside sales to the buyer. This reduces the mill's incentives to generate valuable trading opportunities outside the relationship. Most of the time, coffee is delivered to the integrated buyer and, therefore, limiting those costly investments is beneficial for the relationship. Occasionally, however, the integrated mill might have to sell outside (e.g., when buyer's demand is lower than integrated capacity). When this happens, integrated mills receive significantly lower prices for identical deliveries of coffee than non-integrated mills.

firms also provide demand and supply assurance. The evidence supports models such as **BGM02** in which firm boundaries change temptations to renege on relational contracts and, through this channel, matter for resource allocation. In addition, we have shown costs of integration when trading with outside parties. Given these costs, firms that process and require very large volumes of coffee integrate, while other firms use relational contracts to achieve supply and demand assurance. This Section briefly considers alternative theories of vertical integration that *do not* appear to be key drivers of integration in our particular context.

Product Specificity

A prominent argument for vertical integration is to secure supply of highly differentiated inputs. A distinctive advantage of our setting is that contracts specify extremely detailed information on the type of coffee (screen size, harvest timing), preparation, and certifications. More than four-hundred different types of (parchment) coffee are observed in the data.[47] Figure 8 shows that different organizational forms trade very similar mixes of products. The Figure is constructed as follows. First, rank products according to their volumes of trade in the market. The horizontal axis reports the rank of the product and the vertical axis the cumulative distribution. The curve for the market is monotonically increasing and concave since products are ordered from the left according to their volumes of trade. The Figure shows that the overall distribution of product traded inside relationships and within firms is remarkably similar. Both curves lie close to the market curve and are concave most of the time. Product specificity is unlikely to be a major driver of organizational forms in this context.[48]

Efficiency

Another prominent rationale for vertical integration is to increase productive efficiency (see, e.g., *Williamson (1971, 1975) and Grossman and Hart (1986)*). Each season mills report (audited) operating costs figures.[49] This allows us to compare unit production

[47]For comparison, these hundreds types of parchment coffee span only two 10-digit U.S. HS codes (0901110015 and 0901110015), the most disaggregated product classification typically used in empirical analysis of international trade.

[48]Note that contract-level analysis (Table 6 and Appendix) compares the terms of sales (volumes, prices and timing) of the exact same physical product across organizational forms. Additional results show some difference in behavior between "convencional" and "diferenciado" coffee (which accounts for about 20% of the market) which are consistent with lower side-selling opportunities for diferenciado coffee (e.g., backward integrated buyers *do not* have a disadvantage in building relationships with suppliers (presumably because internal supply is a poor substitute for differentiated coffee) and contractual defaults are rarer.)

[49]Operating costs, which are separately reported for differentiated and undifferentiated coffee, include outlays associated with transport of coffee during harvest season, running the mill, financing, marketing of coffee and personnel costs. The costs do not include the price of coffee (eventually) paid

costs across organizational forms.

Table 10 reports results. Columns (1) and (2) focus on across mills comparisons. The specifications includes interactions of region, harvest season and product line to control for time-varying growing conditions around the mill, as well as number of other time-invariant mill characteristics (altitude, slope, terrain rugdness, average yearly rainfall and temperature, distances to railroads, port, road and Atlantic coast and type of mill).

Column 1 shows that mills owned by backward integrated buyers do not have significantly lower processing costs than other mills. Backward integration, therefore, do not appear to be primarily motivated by increasing production efficiency. Column 2 introduces, for the sample of non-integrated mills, a dummy equal to one for mills that have sales through relationships above the median.[50] Relative to mills not using relational contracts, integrated mills now have significantly lower costs. However, integrated mills have identical unit costs to non-integrated mills marketing through relationships. The evidence suggests that factors as well as outcomes which might correlate with integration and use of relational contracts (e.g., size and stability in demand) might affect operating costs. However, reducing operating costs is unlikely to be driving the choice of integration (versus relational marketing).

Columns (3) to (5) investigate mill's operating costs response to weather shocks during growing season (the index, temperature and rainfall respectively). The specifications focus on interactions between mill's organizational forms and weather conditions, allowing for the inclusion of mill fixed effects. Across all specification we find no evidence that operating costs respond differentially to weather shocks across organizational forms.

Property Rights

The evidence rejects models featuring ex-post (efficient) contracting, such as Grossman-Hart-Moore Property Rights model (and Bolton and Whinston (1992) model of supply assurance, which builds on it). Governance structures shape ex-post adaptation, as in some transaction costs theories (e.g., Williamson (1971, 1975, 1985)) and Baker et al. (2011). At the same time, the evidence does support the key *methodological* insights of Grossman and Hart (1986), as discussed in, e.g., Tadelis (2016). First, we find evidence of both costs and benefits associated with integration within a unified framework. Second, there are stark differences between backward and forward integration:

to farmers.

[50] Alternative thresholds provide similar results.

the two forms of integration behave differently and likely have different purposes.[51]

Foreclosure

A different strand of theoretical work is driven by anticompetitive effects of vertical integration and related arrangements (see, for instance, Hart and Tirole (1988) for a theoretical discussion and Hortascu and Syverson (2007) for empirical evidence). This type of concerns are unlikely to be key driver of integration in our context since traditional anticompetitive concerns are mitigated by the fact that the final product is a globally traded commodity and therefore no firm has market power in the product market.

Hart and Tirole (1988), however, distinguish between three reasons why firms might vertically integrate to foreclosure the market: ex-post monopolization, scarce needs and scarce supply. The first case, in which a relatively efficient upstream producer integrate downward to restrict output in the final market is clearly not relevant in our context. In the other two scenarios an upstream and a downstream firm merge to ensure that they trade with each other: the upstream firm channels scarce supplies to its downstream buyer; the downstream firm satisfies scarce needs by sourcing from its upstream supplier. Hart and Tirole (1988) note that in many real situations both effects might be expected. In these models, integration increases joint profits by appropriating the profits of the party that is now prevented to trade and potentially by leading to rivals exit. Although we cannot test the magnitude of these effects, the predictions are consistent with the evidence in the paper.[52]

6 Conclusions and Policy Implications

This paper has presented an empirical analysis of vertical integration between buyers and mills in 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 both relational and non-relational trade between firms. The paper reaches four main conclusions. First, demand assurance concerns are important in the industry and integration insulates mills and buyers from these market forces. Second, relationships between firms behave qualitatively like integration. Relationships also insulate firms from demand and supply uncertainty, albeit to a lesser extent. Third, using unanticipated shocks to reference prices, we provide empirical support for

[51] We pursue the differences between these two organizational forms in a separate paper.

[52] See also Bolton and Whinston (1992) and Kranton and Minheart (2000).

models in which firm boundaries change temptations to renege on relational contracts, such as Baker et al. (2001). Finally, we provide suggestive evidence that integration makes it harder to develop relationships with independent suppliers.

This work has policy implications for export-oriented agricultural chains in developing countries. To the extent that demand and supply assurance concerns are a motive for integration in these chains markets tend to generate too much integration relative to the social optimum. This prediction holds true in a variety of models that differ in microfoundations for demand and supply assurance concerns (Carlton (1979); property-rights models such as Hart and Tirole (1990) and Bolton and Whinston (1993); network models such as Kranton and Minheart (2000)). Parties have incentives to integrate precisely when social efficiency would require better adaptation in the allocation of demand to capacity. These considerations lend some support to the view that agricultural chains dominated by backward integrated buyers might be detrimental to farmers' welfare and market efficiency (see, e.g., Talbot (1997), Gibbon and Ponte (2005), Daviron and Ponte (2005), Bair (2009)).

Structural policies (e.g., forced divestitures and line of business restrictions) have been used to curtail the negative effects of vertical integration.[53] Ethiopian coffee, Cocoa in Ghana and Cotton in Tanzanian are examples of export-oriented agricultural chains in which regulations have banned vertical integration between processors and exporters altogether. These policies may involve substantial costs if integration is driven by efficiency considerations. These costs would be lower if relationships between firms provide effective substitutes for integration, as shown here.

A fuller understanding of the effects of vertical integration on market efficiency and farmers welfare (and optimal regulatory response) require taking into account additional forces specific to agricultural chains in developing countries. While such endeavor is left for future research, we offer here some preliminary remarks. First, integration might alleviate credit constraints.[54] To pay farmers for coffee cherries, mills have high working capital requirements. Downstream buyers are often important providers of finance in the industry (see, e.g., Blouin and Macchiavello (2013)). If loan contracts are hard to enforce, backward integration might prevent loan default and relax mill's credit constraints.

[53] Famous examples include AT&T divestiture in 1984 and forced vertical separation between breweries and pubs in the U.K. in 1989.

[54] Theoretically, the relationship between access to finance and vertical integration is quite subtle (see, e.g., 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).

Second, in an industry characterized by significant fixed costs upon entry, business-stealing effects and/or imperfect contract enforcement with farmers generate a tendency towards excessive entry (see Macchiavello and Morjaria (2015b) for evidence in Rwanda).[55] By discouraging entry of competitors, integration may counteract these forces.

Third, backward integration might give incentives to develop demand in downstream markets. This benefit the industry as a whole. Price risk likely discourages mills and producers to directly invest in developing marketing channels. In response, governments have intervened by creating marketing boards (see, e.g., coffee in Colombia). The regulations in Costa Rica reduce price-risk for mills and farmers. This is consistent with the relative prevalence of forward integration and marketing consortia.

Finally, a favorable political context is needed to implement Costa Rica's regulations (see Paige 1997). Countries attempting similar regulations have faced resistance from large exporters. An understanding of the political economy behind optimal regulations also awaits future work.

[55]These concerns have often led to regulations such as zoning requirements and catchment areas in agricultural chains (see, e.g., Mullainathan and Sukhtankar (2014) and Ammon (2016) for examples).

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A Regulations Details and System

In Costa Rica the production, processing, marketing and export of coffee are undertaken by the private sector. The state regulates the sector through the Instituto del Cafe de Costa Rica (ICAFE), a non-governmental public institution established by law in 1961. ICAFE represents the interests of farmers, processors and exporters. The main objective of the law, stated in its first article, 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".[56]

The key aspect of the regulation is the System of Final Liquidation (i.e., "Sistema de Liquidación Final"). The main feature of the system is to enforce contracts between farmers and mills and between mills and exporters. For the system to be implemented, all transactions of coffee along the chain must be registered with the board. The process, illustrated in Figure A2, is as follows:

1. *Reception of coffee cherries and initial payment.* Immediately after harvest, farmers deliver coffee to a mill. Farmers are free to deliver to any mill. Upon delivery, the mill issues a receipt for the coffee. The law establishes that the receipt has the value of a contract. The receipt records the date, type, quantity of coffee and payment, if any.

2. *Contracts between mills and buyers.* Every sale contract between mills and buyers must be registered with and approved by the coffee board. A contract is defined by a type and quantity of coffee, signing and delivery dates, and a price. Without disclosing it to market participants, the board sets minimum prices based on differential against prevailing international prices. Figure A3 shows that the regulation leaves substantial margins for price negotiations: at any date there is significant variation in contracted 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 rule that detracts from the mill's sales *i*) audited processing costs, *ii*) allowed profit margin, *iii*) any previous amount paid to farmers, *iv*) a contribution to the national coffee fund. The final price for each mill is published in newspapers and the corresponding payments to farmers must be executed by the mills within

[56]For further details, see: www.icafe.go.cr.

eight days of publication.[57]

To compute the final liquidation price, the regulation requires mills to submit all contracts with buyers for approval. This requirement applies to all transactions between mills and exporters, independently of their ownership structure. This implies that terms of 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.[58]

Registering contracts with the board improves enforcement. The board enforces standards: the contract must specify type of bean (8 categories), quality of parchment (7 categories) and preparation type (8 categories). A total of 336 different types of parchment coffee are observed in the data.[59] The board also 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 under specific circumstance.[60] Below, we exploit unanticipated changes to international prices to understand the mechanisms underpinning relational contracts.

A.1 Data

The primary data source is the ICAFE. The data include information on a total of 44282 contracts between mills and buyers spanning 12 harvest seasons (from 2001-2002 to 2012-2013). Approximately a quarter of all contracts are for the national market

[57]The system facilitates risk management and reduces mills working capital requirements. The final price paid to farmers depends on international market conditions prevailing throughout the entire season, rather than just at harvest time. Since farmers are mostly paid after sales, mills have lower working capital needs. This type of regulations are by no means unique to Costa Rica. 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 similar lines.

[58]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).

[59]Mills can furthermore register up to three differentiated product lines of coffee, in addition to the undifferentiated ("convencional") line we focus on. These hundreds of products span only two ten-digit HS codes (0901110015 and 0901110025), the finest level of product classification typically used in international trade.

[60]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 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 deliver, and (D) for exceptional causes to be evaluated by the coffee board.

while the remaining are for export. Information on contracts cancellations is available from season 2006-2007. Information about contracts is complemented by the following data: 1) history of operation and mills ownership type during the sample period; 2) mills location matched to a vector of geographical characteristics (including historical daily weather data); 3) payments made to farmers (advance payments, trimestral and final liquidations); 4) mills reported and audited costs; 5) bi-weekly reports on coffee sourced by mills and number and location of farmers supplying each mill; 6) export contracts. The time coverage varies across the different data.

B Quid-pro-Quo? Demand Shocks and Supply Assurance

Like integration, relationships provide demand assurance to mills. What do buyers get in exchange? A possibility is that integration and relationships give buyers supply assurance: when buyers need additional coffee they first turn to mills with whom they have relationships to secure supplies. Two pieces of evidence suggest this might be the case. First, exporters enter long-term supply arrangements with foreign buyers, either formal or informal. As shown in Table 4, buyers downstream market structure are both associated with integration and relational sourcing. Second, comparison of OLS and IV results in Table 7 suggest that volumes sold inside relationships might respond to buyer's demand.

This Section formally investigates supply assurance by constructing Bartik-like demand shocks for the sample of exporters. Exporter b sales to foreign market c are matched to aggregate imports of coffee in country c in year t to construct

$$Z_{bt} = \Sigma_c sh_{bct} \times I_{ct} \tag{6}$$

where I_{ct} are aggregate imports of coffee in country c in year t and sh_{bct} is the share of coffee sold by buyer b to country c in year t. The variable Z_{bt} captures idiosyncratic increases in demand originating from buyers exposure to different destination markets. Figure A4 confirms that Z_{bt} strongly correlate with aggregate sourcing at the buyer-year level. The reduced form specification is given by

$$y_{bot} = \alpha_{bo} + \mu_t + \beta_o \times Z_{bt} + \varepsilon_{bot} \tag{7}$$

where y_{bot} is volumes (share) of coffee sourced by buyer b through organizational form $o = m, r, v$ in season t, $alpha_{bo}$ are buyer sourcing-channel specific fixed effects and mu_t are season fixed effects. The demand shock Z_{bt} is interacted with organizational form dummies at the channel or firm level depending on specifications, while ε_{bot} is an error terms arbitrarily correlated within buyer-channel over time and across channels within buyer-season.

Table A8 presents the results. Column (1) considers only two marketing channels: between firms (which bundles both market and relationships) and within firms. A one standard deviation increase in the demand shock is associated with an increase of 109 tons of coffee sourced between firms and an increase of 277 tons of coffee sourced within firms. Although the two magnitudes are quite different we fail to reject a statistically significant difference in the reaction of sourcing volumes to exogenous increases in de-

mand across the two forms. Column (2) unbundles between firm trade distinguishing market and relationships and present the main result. A one standard deviation increase in foreign demand increases volumes sourced through market by 55 tons, coffee sourced through relationships by 93 tons and volumes sourced within backward integrated chains by 264 tons. [61] Like integration, relationships also provide buyers with an (implicit) guarantee of higher supply when demand exogenously increases.

A concern in Columns (1) and (2) is that responses to demand conditions confound organizational forms effects and buyer's scale: the response of trade within firm is larger because integrated buyers are much larger. Column (3) and (4) split the sample between non-integrated and integrated buyers and confirms that responses are much larger for integrated buyers. Columns (5) and (6) then report results on the split sample using the share sourced from each channel as dependent variable. On the sample of non-integrated buyers, the share sourced through relationships increases in response to higher demand. On the sample of integrated buyers, however, the shares decreases as most of the additional needs are satisfied by internal supply. The heterogeneity in the behaviour of relationships involving integrated and non-integrated buyer is further explored in Table 9.[62]

The evidence is consistent with a quid-pro-quo inside relationships: buyers provide mills with demand assurance; mills provide buyers with supply assurance. The quid-pro-quo could entail other forms of cooperation. This happens along (at least) two margins. Although prices do not respond to shocks, contract level specifications in Table A9 show that prices decrease with the age of the relationships and converge to the level observed within firms.[63] This result, derived from an analysis at the transaction level, holds controlling for detailed product, time and relationship (i.e., mills and buyer pair) fixed effects as well as mill and buyer time varying controls. Lower prices are consistent with lower costs of carrying underutilized capacity and unsold stocks for mills marketing through relationships (see, e.g., Carlton (1979), Dana (1998) and Figures 4 and 6). Moreover, in response to higher demand, mills source a higher share of coffee paying farmers during harvest. This is consistent with buyers

[61] The coefficient on integrated trade is also imprecisely estimated.

[62] Results are robust to i) considering total volumes sourced rather than volumes sourced only for export markets; ii) alternative definitions of demand shock (using only imports from Latin American Countries); iii) both more and less conservative definitions of relationships. 2SLS results in which aggregate volumes sourced are instrumented with the foreign demand shocks and provide similar results. Results available upon request.

[63] While reported prices within integrated firms might confound other forces (e.g., removal of double marginalization, transfer pricing) a similar convergence between age effects inside relationships and integrated trade is observed with respect to timing of contracting and contract default. See Table A9 and Table A7 for further details.

providing working capital finance in exchange for deliveries.[64]

C Relationship Dynamics

TO BE ADDED

[64]Blouin and Macchiavello (2013) and Macchiavello and Morjaria (2015) provide evidence for the pervasive use of these arrangements in the coffee chain. We explore relationships between mills and farmers in a separate paper.

Table 1: **Descriptive Statistics**

Panel A: Sellers Characteristics

Variable	N. Obs.	Mean	St. Dev.	Min	Max	Int. vs. Non-Int.
Vertically Integrated	182	0.0440	0.206	0	1	
Cooperative	182	0.126	0.333	0	1	
Quantity	182	5.675	12.359	2,300	76.431	
% Exported	182	0.777	0.263	0	1	0.1456+
Average price	182	4,583	0.846	2,602	7,932	0.2444
Number of Buyers	182	3,665	2,927	1	21	.-2.002*
Herfindhal Index of Buyers	182	0.645	0.274	0.152	1	0.1305
% Sold to Integrated Buyers	182	0.115	0.281	0	1	0.924***
Age	182	6,236	3,698	1	11	2.8908**

Panel B: Buyers Characteristics

Variable	N. Obs.	Mean	St. Dev.	Min	Max	Int. vs. Non-Int.
Vertically Integrated	170	0.0412	0.199	0	1	
Age	170	6.235	4.008	1	11	3.926*
Quantity	170	6,090	24,658	0.440	261,336	73,705***
Average price (weighted)	170	4.114	1.086	1.807	7.065	1.012**
% exported	170	0.409	0.463	0	1	0.572***
% bought from Integrated Seller	170	0.0220	0.126	0	1	0.5145***
Herfindal Index of Suppliers	170	0.726	0.385	0.000372	1	.-0.5489***
Number of Suppliers	170	3.935	8.562	1	64	26.2901***

Panel C: Contract Characteristics

Variable	N. Obs.	Mean	St. Dev.	Min	Max
National market	4,089	0.200	0.400	0	1
Vertical Integrated Buyer	4,089	0.453	0.498	0	1
Vertical Integrated Seller	4,089	0.143	0.350	0	1
Vertically Integrated Relationship	4,089	0.143	0.350	0	1
Quantity	4,089	24,965	29,827	31.44	259,817
Leadtime	4,089	98.59	123.5	0	393

Panel D: Relationship Characteristics

Variable	N. Obs.	Mean	St. Dev.	Min	Max	
Age	178	6.69	4	12		
Tons of Sales	178	230	416	0.1	2570	1931***
% of Mill Sales	178	0.33	0.33	0	1	0.61***
% of Buyer Sourcing	178	0.22	0.34	0	1	0.08
% Exported	178	0.74	0.40	0	1	0.18**
Average Leadtime	178	126.7	108.9	0	361	-49.4**

Standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1 Table 1 provides summary statistics for the 2011/12 harvest campaign. Panel A refers to mills. Vertically integrated is a dummy equal to one if the mill is owned by an exporter/roaster. Cooperative is a dummy that takes value one if the mill is owned by a farmer's cooperative. Age (censored) is the number of harvest campaigns the mill operates in our dataset. Quantity is in tons of parchment coffee. Price is a weighted average price for a Kg of coffee, in dollars. % 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 presents the summary statistics for contracts. Leadtime is defined as the difference in days between contract signature and delivery. Panel D presents summary statistics for relationships, defined as mill-buyer pairs that trade more than three consecutive years. % of mills sales (buyer sourcing) is the share of the mill (buyer) business accounted for by the relationship. Average leadtime is a weighted average. The last column reports unconditional mean differences in the relevant variable between integrated and non-integrated buyers.

Table 2: **Use of Organizational Forms**

	(1)	(2)	(3)	(4)
	Mills: % Sold		Buyers: % Sourced	
	Non-Integrated	Integrated	Non-Integrated	Integrated
Between Firms:				
Market	38%	4%	51%	23%
Relationships	62%	0%	49%	20%
Within Firms:				
Integration	–	96%	–	56%
N. of Mills / Buyers	144	25	145	10
Relationship Definition	Baseline	Baseline	Baseline	Baseline

The table summarizes the use of the three organizational forms for mills and buyers depending on their integration status. Relationships are defined as mill-buyer pairs that have traded for more than three season consecutively (baseline definition of relationships). Figures are averages across firms and harvest seasons.

Table 3: **Correlates of Integration and Relationships: Mills**

	(1)	(2)	(3)	(4)
Dependent variable:	Integration = 1	% Sold Through Relationships		
Integration score		1.0550*	1.0827**	0.6628*
		(0.617)	(0.481)	(0.379)
Capacity	1.1224***			
	(0.335)			
Age	0.1412**			
	(0.068)			
Suitability	1.5733***			
	(0.603)			
Variability	0.7607*			
	(0.408)			
Observations	203	193	193	193
Sample	All	Non-integrated	Non-integrated	Non-integrated
Relationship definition	n/a	Baseline	Alternative I	Alternative II
Region FE	Yes	Yes	Yes	Yes
Estimation	Probit	OLS	OLS	OLS

Standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1. The Table shows that mill characteristics that predict integration also predict sales through relationships on the sample of non-integrated mills. Column (1) reports results from a probit model predicting weather a mill belongs to a backward integrated chain. All independent variables are standardized. Capacity is proxied by the maximum volume of coffee processed by the mill during a two week period. Age is the number of harvest seasons the mill has been operating (left censored). 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. Region FE indicate the region where the mill is located. The predicted integration score in Column (1) is correlated with the percentage of the production sold through relationships in Columns (2) to (4). Column (2) uses the baseline definition of relationship (mill-buyer pairs that have traded more than three consecutive seasons are classified as relationships). Column (3) uses a less conservative definition (mill-buyer pairs that have traded at least two consecutive seasons). Column (4) uses a more conservative definition (mill-buyer pairs trading in their fourth or higher consecutive season are classified as relationships). Bootstrapped standard errors in Columns (2) to (4). All specifications exclude forward-integrated mills.

Table 4: **Correlates of Integration and Relationships: Buyers**

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable:	Integration = 1	% Sourced Through Relationships			Integration= 1	% Relationships
Integration score		1.8240***	1.5776***	1.3624***		1.0251**
		(0.232)	(0.216)	(0.211)		(0.402)
Size	0.9165**				0.3127*	
	(0.362)				(0.173)	
Age	0.0940+					
	(0.060)					
Share exported	3.8586***					
	(1.325)					
Share sold to roasters					4.7892+	
					(3.053)	
Concentration of buyers					13.1986*	
					(7.256)	
Share sold out of harvest					4.4309+	
					(3.249)	
Observations	199	192	192	192	96	89
Sample	All	Non-integrated	Non-integrated	Non-integrated	Exporters	Exporters Non-integrated
Relationship definition	n/a	Baseline	Alternative I	Alternative II	Baseline	Baseline
Estimation	Probit	OLS	OLS	OLS	OLS	OLS

Standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1, + p<0.15. The Table shows that buyer characteristics that predict integration also predict relational sourcing on the sample of non-integrated buyers. Column (1) reports results from a probit model predicting weather a buyer is backward integrated. All independent variables are standardized. Size measures the average volume of coffee bought during the 2008-20011 harvest campaigns. Age is the number of harvest seasons the buyer has been operating (left censored). Share exported is the average percentage of sourced coffee that is exported by the buyer. The predicted integration score in Column (1) is correlated with the percentage of the production sourced through relationships in Columns (2) to (4). Column (2) uses the baseline definition of relationship (mill-buyer pairs that have traded more than three consecutive seasons are classified as relationships). Column (3) uses a less conservative definition (mill-buyer pairs that have traded at least two consecutive seasons). Column (4) uses a more conservative definition (mill-buyer pairs trading in their fourth or higher consecutive season are classified as relationships). Columns (5) and (6) focus on the sample of exporters for which information on the structure of relationships downstream is available. Column (5) reports results from a probit model predicting weather a buyer is backward integrated. Share sold to roasters, concentration of foreign buyers and share exported during harvest are computed matching transactions level export data that include the name of foreign customers. The predicted integration score in Column (5) is correlated with the percentage of the production sourced through relationships in Column (6) using the baseline definition of relationship (mill-buyer pairs that have traded more than three consecutive seasons are classified as relationships). Bootstrapped standard errors in Columns (2) to (4) and (6). All specifications exclude export licenses held by forward-integrated mills.

Table 5: **Weather Conditions and Sales: Reduced Form**

	(1)	(2)	(3)	(4)
Dependent variable:		***Volumes Sold (in Tons)***		
Weather X:				
Between Firms [0]:	84.7149*			
	(47.566)			
Market [0]		4.5625	-13.7640	-17.7083
		(23.466)	(23.298)	(25.562)
Relationships [2]		138.9551***	125.6869***	129.0666***
		(42.338)	(36.961)	(37.828)
Within Firms:				
Integration [1]	340.7346*	264.6024**	216.7790*	218.1595*
	(174.677)	(118.356)	(113.674)	(112.944)
F-test [0] vs. [1]	1.542	3.413	2.810	2.821
p-value	0.216	0.0647	0.0937	0.0930
F-test [2] vs. [1]		0.820	0.443	0.402
p-value		0.365	0.506	0.526
Observations	1,173	2,152	2,152	2,098
R-squared	0.806	0.507	0.509	0.511
Margin	Intensive	Intensive	Intensive	Intensive
Relationship Definition	Baseline	Baseline	Baseline	Baseline
Weather X Capacity	No	No	Yes	Yes
Weather X Controls	No	No	No	Yes
Season FE	Yes	Yes	Yes	Yes
Mill Channel FE	Yes	Yes	Yes	Yes

Robust standard errors (two way clustered mill-season and mill-channel) in parentheses. *** p<0.01, ** p<0.05, * p<0.1, + p<0.15. The Table shows that in response to better weather conditions during growing season mills sells higher volumes within integrated chains and relationships, but not in the market. The dependent variable is tons of coffee sold by the mill in each marketing channel in each harvest season. Weather conditions are given by average temperature during growing season at the mill's location (standardized). Column (1) interacts weather conditions with dummies for "between" firms and "within" firms sales channels. Columns (2) to (4) distinguish relationships and market as two separate between firms marketing channels. Column (3) includes the interaction between weather conditions and (standardized) mill's capacity. Column (4) includes the interaction between weather conditions and additional mill's control (cooperative status, suitability for coffee, variaility in conditions, age and distance to port). These variables are standardized and as defined in Table 2A. The sample covers all 12 harvest seasons (2000-2001 to 2011-2012) and 251 mills. All specification exclude forward integrated mills.

Table 6: **Weather Conditions and Sales: Robustness**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent variable:	***Volumes Sold (in Tons)***							
Weather X:								
Between Firms:								
Market [0]	4.5268	23.0507	9.5175	-3.8218	65.7160**	57.9801*	-65.7078**	-2.6257
	(29.776)	(30.095)	(34.736)	(29.103)	(31.487)	(33.383)	(30.315)	(29.983)
Relationships [2]	139.0063***	103.7515***	150.6316***	133.8823***	51.4172*	53.9872*	208.3740***	121.2912***
	(28.148)	(31.820)	(34.424)	(27.251)	(29.895)	(32.034)	(30.950)	(27.885)
Within Firms:								
Integration [1]	264.5912**	239.8763**	350.9554***	199.3671*	283.8083**	250.3613**	368.0759**	178.2735
	(126.689)	(110.163)	(126.456)	(114.782)	(126.838)	(109.791)	(153.940)	(130.723)
F-test [0] vs. [1]	4.279**	3.864**	7.215***	3.114*	3.00*	3.046*	8.211***	1.985+
p-value	0.039	0.049	0.007	0.078	0.083	0.081	0.004	0.149
F-test [2] vs. [1]	0.969	1.472	2.115	0.316	3.294*	3.086*	1.073	0.189
p-value	0.325	0.225	0.180	0.574	0.070	0.079	0.300	0.664
Observations	2,150	2,150	2,150	2,150	2,150	2,150	2,130	2,130
R-squared	0.726	0.724	0.731	0.727	0.709	0.710	0.732	0.713
Shock	Temperature	Rain	Index	Temperature	Temperature	Rain	Temperature	Rain
Shock Location	Local	Local	Local	Catchment	Local	Local	Local	Local
Margin	Intensive	Intensive	Intensive	Intensive	Intensive	Intensive	Intensive	Intensive
Relationship Definition	Baseline	Baseline	Baseline	Baseline	Alternative I	Alternative I	Alternative II	Alternative II
Season FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mill, Channel FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors (cluster season-channel and seller-channel) in parentheses. *** p<0.01, ** p<0.05, * p<0.1, + p<0.15. The presents a battery of robustness checks to the baseline specification in Column (2) of Table **??** Across all specifications results show that in response to better weather conditions during growing season mills sells higher volumes within integrated chains and relationships, but not in the market. Column (1) reports the baseline specification. Column (2) uses average rainfall during growing season at the mill's location (standardized) as weather conditions. Column (3) uses the z-score of temperature and rainfall. Column (4) measures weather in the catchment area of the mill. The catchment area is defined as the areas from which the mill sources coffee. Columns (5) and (6) use temperature and rainfall respectively and a less conservative definition of relationships (mill-buyer pairs that have traded at least two consecutive seasons). Columns (7) and (8) use temperature and rainfall respectively and a more conservative definition of relationship (mill-buyer pairs trading in their fourth or higher consecutive season are classified as relationships). The sample covers all harvest seasons (2000-2001 to 2011-2012) and 251 mills. All specification exclude forward integrated mills.

Table 7: **Mill Production and Sales: Reduced Form, OLS & 2SLS**

	(1)	(2)	(3)	(4)	(5)
	Reduced Form			OLS	2SLS
Dependent variable:	***% Sold in each channel***				
Variable X Marketing Channel:	***Weather Conditions***			***Seasonal Mill Production (Ln)***	
Between Firms [0]:					
Market [0]	-0.0562***	-0.0730***	0.0047+	-0.1823***	-0.1101***
	(0.016)	(0.020)	(0.003)	(0.012)	(0.036)
Relationships [2]	0.0825***	0.0730***		0.1942***	0.1496***
	(0.026)	(0.020)		(0.013)	(0.050)
Within Firms:					
Integration [1]	-0.0238**		-0.0047+	-0.1207***	-0.0242
	(0.011)		(0.003)	(0.029)	(0.059)
Cragg-Donald F-test					28.523
Kleibergen-Paap rk F-test					9.364
Observations	2,150	1,968	182	2,150	2,150
Sample	All	Non-integrated	Integrated	All	All
Margin	Intensive	Intensive			Intensive
Relationship Definition	Baseline	Baseline	Baseline	Baseline	Baseline
Season FE	Yes	Yes	Yes	Yes	Yes
Mill, Channel FE	Yes	Yes	Yes	Yes	Yes

Robust standard errors (cluster season-channel and seller-channel) in parentheses. *** p<0.01, ** p<0.05, * p<0.1, + p<0.15. This Table studies the propensity to sell additional production across the three different channels. The dependent variable is the share of production sold by each mill in each channel. Columns (1) to (3) consider the reduced form. Weather conditions are given by average temperature during growing season at the mill's location (standardized). Column (1) focuses on the intensive margin only. Columns (2) and (3) split the sample between non-integrated mills and integrated mills.

Columns (4) and (5) consider OLS and 2SLS results. The marketing channel dummies are interacted with total mill production (in logs). In Column (5) the interactions between marketing channels and mill production are instrumented with the interactions between weather conditions and marketing channels. The first stages are reported in Table A4 in the Appendix. Table A5 in the Appendix reports robustness checks, including results using interactions with rainfall as instrument. The sample covers all 12 harvest seasons (2000-2001 to 2011-2012) and 251 mills. All specification exclude forward integrated mills.

Table 8: **Price Surprises and Strategic Default**

	(1)	(2)	(3)	(4)	(5)
Dependent variable:	***Contract Cancellation = 1***				
Price Surprise	0.0152**				
	(0.007)				
positive		0.0192**	0.0219*		
		(0.009)	(0.013)		
negative		0.0066	-0.0040		
		(0.009)	(0.013)		
Positive Price Surprise X					
Market [0]				0.0800**	0.0700*
				(0.0387)	(0.0369)
Relationships [1]				0.0145	0.0135
				(0.0135)	(0.0133)
Integration [2]				-0.0137	0.00432
				(0.0222)	(0.0251)
F-test [0] vs. [1]				2.786*	2.145+
p-value				0.0953	0.143
F-test [2] vs. [1]				1.427	0.152
p-value				0.233	0.697
Observations	21,331	21,331	21,175	21,175	21,175
R-squared	0.154	0.155	0.309	0.310	0.310
Relationship definition	n/a	n/a	n/a	Baseline	Baseline
Relationship FE	Yes	Yes	Yes	Yes	Yes
Contract controls	No	No	Yes	Yes	Yes
Day of sale and Product FE	No	No	Yes	Yes	Yes
Price surprise x controls	No	No	No	No	Yes

Robust standard errors (clustered by relationship) in parentheses. *** p<0.01, ** p<0.05, * p<0.1, + p<0.15. This table shows that relationships and integration mitigate opportunism. 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 canceled. 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. Positive (negative) price surprises are for ratios above (below) one. Controls include contract volume (third-degree polynomial in Kilos of coffee on the contract), a dummy for national market contracts, the month of the contract signature, mill size and region where the mill is located. Product FE are a set of (311) dummies for product types (preparation, quality and bean grading). Columns (4) and (5) include the interaction between negative price surprises and marketing channels. All the (unreported) coefficients are nearly zero and none is significant. Relationships fixed effects are dummies for buyer-mills pair that have ever traded. Controls interacted with price surprise include mill level controls as in Table **??**. The sample period covers the harvest campaigns from 2004/05 to 2012/13. The sample excludes trade involving forward integrated mills.

Table 9: **Heterogeneity**

	(1)	(2)	(3)	(4)
Dependent variable:	***Default***	***Quantity traded***		
Non-Integrated Buyer X Shock	-0.0205	28.97**	11.8879*	
	(0.024)	(10.01)	(7.040)	
Integrated Buyer X Shock	0.0564*	3.04	24.3356+	
	(0.034)	(7.90)	(16.677)	
Own Shock				16.5919
				(20.242)
Shock to Mills owned by integrated buyer				-32.2231**
				(14.737)
Observations	11,876	1,602	1,301	676
R-squared	0.331	0.617	0.349	0.372
Shock	Price Surprise	Weather	Foreign Demand	Weather
Relationship Definition	Baseline	Baseline	Baseline	Baseline
Controls	Yes	yes	yes	yes
Season FE	Yes	yes	yes	yes
Partners FE	Relationship	Buyer	Seller	Seller

Robust standard errors (cluster relationship) in parentheses. *** p<0.01, ** p<0.05, * p<0.1, + p<0.15. The Table explores heterogeneous responses to shock between relationships that involve backward integrated buyers and those that do not. The Table shows that relationships involving backward integrated buyers are more fragile and provide less demand assurance. In all Columns, the sample is restricted to trade within relationships and excludes forward integrated chains. Column (1) reproduces the specification in Column (4) of Table **??** distinguishing the effect of positive price surprise by type of relationships. The unit of observation is a contract, and the dependent variable a dummy taking value equal to one if the contract is canceled. In Columns (2) to (4) the dependent variable is tons of coffee traded inside a relationship in a given year. Column (2) uses the baseline weather condition as supply shock. Column (3) uses foreign demand like Table A8 in the Appendix. Column (4) focuses on the sample of relationships with backward integrated buyers only, and distinguishes between weather conditions at the supplying mill and at the mills owned by the integrated buyers.

Table 10: **Unit processing costs**

	(1)	(2)	(3)	(4)	(5)
Dependent variable:			***Unit Processing Costs (ln)***		
Integrated Mill	-0.0053	-0.2229***			
	(0.058)	(0.077)			
Integration X Weather			-0.0145	0.0239	-0.0276
			(0.035)	(0.052)	(0.029)
Relationship Mill		-0.2447***			
		(0.073)			
Relation. Mill X Weather			-0.0518	-0.0165	-0.0499
			(0.056)	(0.070)	(0.039)
F-test [0] vs [1]		0.174	1.027	0.515	0.761
p-value		0.676	0.311	0.473	0.383
Observations	532	532	779	779	779
R-squared	0.072	0.162	0.007	0.007	0.006
Weather	–	–	Index	Temperature	Rainfall
Relationship Definition	Baseline	Baseline	Baseline	Baseline	Baseline
Season X Region X Product FE	Yes	Yes	Yes	Yes	Yes
Mill, Channel FE	Yes	Yes	Yes	Yes	Yes

Robust standard errors (cluster relationship) in parentheses. *** p<0.01, ** p<0.05, * p<0.1, + p<0.15. This table reports results on unit processing costs across mills. Columns (1) and (2) focus on across mills comparisons. The specifications include interactions of region, harvest season and product line to control for time-varying growing conditions around the mill, as well as number of other time-invariant mill characteristics (altitude, slope, terrain ruggedness, average yearly rainfall and temperature, distances to railroads, port, road and Atlantic coast and type of mill). Column 1 shows that mills owned by backward integrated buyers do not have significantly lower processing costs than other mills. Column 2 introduces, for the sample of non-integrated mills, a dummy equal to one for mills that have sales through relationships above the median. Relative to mills not using relational contracts, integrated mills now have significantly lower costs. However, integrated mills have identical unit costs to non-integrated mills marketing through relationships. Columns (3) to (5) investigate mill's operating costs response to weather shocks during growing season (the index, temperature and rainfall respectively). The specifications focus on interactions between mill's organizational forms and weather shocks and include mills fixed effects. Across all specification we find no evidence that operating costs respond differentially to weather shocks across organizational forms.

Table A1: **Coffee producing regions**

Regions:	Coto Brus	Los Santos	Perez Zeledon	Turrialba	Central Valley	West Valley	North
Harvest season (aprox.):							
Start:	September	November	August	June	November	November	July
End:	February	March	February	February	March	February	December
Share of cherries produced (by season):							
2005-2006	8.6%	27.4%	14.7%	6.9%	19.7%	21%	1.8%
2006-2007	11.4%	30.5%	13.9%	7.5%	17.1%	17.4%	2.2%
2007-2008	7.8%	29.4%	12.9%	7.6%	19.4%	21.2%	1.7%
2008-2009	9.2%	29.9%	11.9%	7.4%	18.2%	21.7%	1.7%
2009-2010	9.1%	32.2%	13.7%	6.9%	18.3%	18.6%	1.2%
2010-2011	6.5%	31.6%	10.1%	6.9%	20.6%	23%	1.3%
2011-2012	9.5%	29.5%	12.8%	7.7%	17.1%	21.3%	2%

Source: Annual reports, ICAFE.

Table A2: **Active mills and exporters per season selling conventional coffee**

	Mills	Exporters	Total production (in 46Kg. Bags)	Share exported
2002-2003	92	105	2875199	89.78%
2003-2004	96	112	2746909	87.09%
2004-2005	98	113	2487636	80.78%
2005-2006	108	109	2284243	79.58%
2006-2007	124	127	2327199	79.58%
2007-2008	133	124	2435526	85.30%
2008-2009	140	124	2061265	84.48%
2009-2010	155	123	1887812	84.12%
2010-2011	166	134	2062384	82.17%
2011-2012	175	149	2316932	86.66%
2012-2013	175	108	2160865	81.31%

Source: Annual reports, ICAFE.

Table A3: **Seasonal evolution of prices**

	(1)	(2)	(3)	(4)
Dependent variable:		***Unit price (ln)***		
Pre-Harvest	-0.0254*	-0.0232+	-0.0449***	-0.0415***
	(0.015)	(0.015)	(0.016)	(0.016)
Post-Harvest	-0.0547***	-0.0552***	-0.0568***	-0.0570***
	(0.008)	(0.008)	(0.009)	(0.009)
Observations	5,618	5,618	2,279	2,279
Product FE	Yes	Yes	Yes	Yes
Season FE	Yes	Yes	Yes	Yes
Relationship FE	Yes	Yes	Yes	Yes
Integrated Excluded	No	No	Yes	Yes
Contract controls	No	Yes	No	Yes

Robust standard errors (cluster relationship) in parentheses. *** p<0.01, ** p<0.05, * p<0.1, + p<0.15
The dependent variable is the log of price per Kilo. Integrated is a dummy=1 if the contract is with a mill owned by the buyer. Contract controls include a third-degree polynomial in Kilos of coffee on the contract and a dummy indicating whether the contract is for the national or export markets. Product FE is a set of (311) dummies for product types (preparation, quality and bean grading). Data include seasons 2008/9 to 2011/12.

Table A4: **First stages Weather shocks**

	(1)	(2)	(3)
Dependent Variable:			
Mill Production (ln) interacted with:	Market =1	Integration =1	Relationship =1
Weather X Market	0.2179***	-0.0003	-0.0974***
	(0.020)	(0.005)	(0.017)
Weather X Integration	0.0431**	0.0813***	-0.0272***
	(0.020)	(0.024)	(0.009)
Weather X Relationships	-0.1712***	-0.0001	0.2973***
	(0.027)	(0.003)	(0.025)
Angrist-Pishke F-test	50.60	7.76	48.35
AP p-value	0.000	0.000	0.000
Observations	2,156	2,156	2,156
Season FE	Yes	Yes	Yes
Mill FE	Yes	Yes	Yes

Robust standard errors (cluster season-channel and seller-channel) in parentheses. *** p<0.01, ** p<0.05, * p<0.1, + p<0.15
The table presents the first stages from the results presented in Table XXX. Data includes 12 harvest seasons (2000-2001 to 2011-2012) and 251 mills. All specification exclude mills that sell more than 30% of their harvest on direct sales. The weather shocks are measured by the temperature in the harvest growing season at the mill's location. The intensive margin is defined by excluding the relationship channel for integrated mills and the within firm channel for non-integrated.

Table A5: **Robustness to Reduced Form and IV for Seller Shocks**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent variable:	***% Sold in each channel***							
	Reduced form robustness				*IV robustness*			
Between Firms:								
Market [0]	-0.0562**	-0.0534**	-0.0599**	-0.0377**	-0.1101***	-0.1019***	-0.1296***	-0.1248***
	(0.023)	(0.023)	(0.025)	(0.015)	(0.036)	(0.037)	(0.033)	(0.034)
Relationships [2]	0.0825***	0.0796***	0.0877***	0.0505***	0.1496***	0.1396***	0.1767***	0.1716***
	(0.028)	(0.027)	(0.029)	(0.017)	(0.050)	(0.052)	(0.046)	(0.048)
Within Firms:								
Integration [1]	-0.0238**	-0.0209**	-0.0249**	-0.0231**	-0.0242	-0.0218	-0.0307	-0.0292
	(0.011)	(0.010)	(0.012)	(0.011)	(0.059)	(0.055)	(0.060)	(0.057)
Observations	2,156	2,156	2,156	2,156	2,156	2,156	2,156	2,156
Shock	Temperature	Rainfall	Temperature	Temperature	Temperature	Rainfall	Temperature	Temperature
Relationship Definition	Baseline	Baseline	Alternative I	Alternative II	Baseline	Baseline	Alternative I	Alternative I
Season FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mill, Channel FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors (cluster season-channel and seller-channel) in parentheses. *** p<0.01, ** p<0.05, * p<0.1, + p<0.15. The table presents the robustness of the reduced form Table XXX for the different definitions of relationship and different instruments. Data includes 12 harvest seasons (2000-2001 to 2011-2012) and 251 mills. All specification exclude forward integrated mills.

Table A6: Consequences of default

	(1)	(2)	(3)	(4)
Dependent variable:	End of the relationship		Future trade volumes	
Past Default			-18.8967	-19.2228
			(14.215)	(14.261)
Past default during	1.0006*	0.2094*		-56.4748***
positive price surprise	(0.561)	(0.118)		(20.144)
Observations	2,021	2,021	2,467	2,467
Controls	Yes	Yes	No	No
Relationship FE	Yes	Yes	Yes	Yes
Season FE	Yes	Yes	Yes	Yes
Cohort FE	No	No	No	No
Model	Poisson	Linear	Linear	Linear

Robust standard errors (cluster relationship-season) in parentheses. *** p<0.01, ** p<0.05, * p<0.1, + p<0.15
The table

Table A7: **External Trade of Integrated Firms**

Panel A: External trade of integrated buyers:

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable:	***Advance contracting, Days***			***Unit price (ln)***		
Buyers:	*Integrated*					
Mills:	*All*		*Independent*	*All*		*Independent*
Integrated relationship	-30.0768***	-12.1840***		-0.1115***	-0.0265***	
	(5.483)	(3.955)		(0.015)	(0.007)	
Relationship Age			-5.2072**			-0.0064**
			(2.122)			(0.003)
Observations	17,796	17,796	11,359	17,796	17,796	11,359
R-squared	0.185	0.704	0.694	0.814	0.959	0.967
Contract controls	Yes	Yes	Yes	Yes	Yes	Yes
Buyer FE	Yes	Yes	Yes	Yes	Yes	Yes
Season x Region FE	Yes	Yes	Yes	Yes	Yes	Yes
Month of sale X Region	Yes	Yes	Yes	Yes	Yes	Yes
Date FE	No	Delivery	Delivery	No	Contract	Contract
Product FE	No	Yes	Yes	No	Yes	Yes
Mill Controls	No	Yes	Yes	No	Yes	Yes

Panel B: External trade of integrated mills:

	(1)	(2)	(3)	(4)
Dependent variable:	***Advance contracting, Days***		***Unit price (ln)***	
Buyers:	*Non-integrated*			
Mills:	*All*			
Integrated mill	-26.6574+	-16.3329***	-0.1994***	-0.1421***
	(16.799)	(5.950)	(0.056)	(0.040)
Observations	24,317	24,317	24,317	24,317
R-squared	0.336	0.790	0.847	0.940
Contract controls	Yes	Yes	Yes	Yes
Buyer FE	Yes	Yes	Yes	Yes
Season x Region FE	Yes	Yes	Yes	Yes
Month of sale X Region	Yes	Yes	Yes	Yes
Date FE	No	Delivery	No	Contract
Product FE	No	Yes	No	Yes
Mill Controls	No	Yes	No	Yes

Robust standard errors (cluster relationship-season) in parentheses. *** p<0.01, ** p<0.05, * p<0.1, + p<0.15

The table looks at the external trade of integrated buyers and sellers. In all columns OLS are estimated, a contract between a mill and a buyer is an observation. The dependent variables are *Advance contracting in days*, defined as the difference between the date of delivery and the signing date, and the *log of price* per Kilo.

Panel A focuses on vertically integrated buyers and compares the timing and pricing of their contracts through internal and market sourcing. Integrated, then, is a dummy=1 if the contract is with a mill owned by the buyer. Columns (3) and (6) focus on the relationships of integrated buyers with independent mills, and age of relationship is measured in number of past contracts (in '00) between the mill and the buyer. Panel B focuses 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 controls include a third-degree polynomial in Kilos of coffee on the contract and a dummy indicating whether the contract is for the national or export markets. Buyers fixed effects are dummies for buyer. Region fixed effects refer to the region where the mill is located, and are interacted with the season (harvest campaign from 2001/02 to 2011/12) and the month in which the contract is signed. Contract dates fixed effects are dummies for the date in which the contract is signed, and Delivery dates fixed effects are dummies for the date in which the coffee in the contract is delivered. Product FE is a set of (111) dummies for product types (preparation, quality and bean grading). Mill controls include the size of the mill (coffee traded in the season).

Table A8: **Demand shocks**

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable:	***Volume Sourced (in Tons)***				***% Sourced***	
Demand Shock X:						
Between Firms [0]:	149.6849**					
	(59.850)					
Market [0]		62.8072+	45.8223	400.7170*	-0.0347*	-0.0257
		(38.634)	(35.218)	(230.430)	(0.018)	(0.028)
Relationships [2]		87.8934**	50.9981+	588.8954+	0.0347*	-0.0760**
		(40.992)	(33.936)	(359.042)	(0.018)	(0.037)
Within Firms:						
Integration [1]	259.5909	237.1281		489.7625		0.1018**
	(423.517)	(411.739)		(445.371)		(0.049)
Observations	355	643	490	153	490	153
Sample	All	All	Non-integrated	Integrated	Non-integrated	Integrated
Margin	Intensive	Intensive	Intensive	Intensive	Intensive	Intensive
Relationship Definition	Baseline	Baseline	Baseline	Baseline	Baseline	Baseline
Season FE	Yes	Yes	Yes	Yes	Yes	Yes
Buyer, Channel FE	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors (cluster season-channel and buyer-channel) in parentheses. *** p<0.01, ** p<0.05, * p<0.1, + p<0.15. The Table shows that non-integrated exporters disproportionately use relationships to source additional coffee in response to demand shocks; integrated exporters disproportionately use integrated supply. The dependent variable in Columns (1) to (4) is tons of coffee sourced from the different channels, in Columns (5) and (6) the share of exports sourced by each exporter in each channel. The intensive margin is defined by excluding the within firm channel for non-integrated exporters. The demand shock is constructed as the weighted average of imports of Latin and Central American coffee in the countries to which exportsers sell coffee. The sample covers exporters for the years 2005 to 2013 and excludes export licenses operated by forward integrated mills.

Table A9: **Timing and pricing of contracts**

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable:	***Advance contracting, Days***			***Unit price (ln)***		
Buyers:	Non-Integrated	Integrated	Integrated	Non-Integrated	Integrated	Integrated
Sellers:	Independent	Independent	All	Independent	Independent	All
Relationship Age	-17.6156***	-14.5206**		-0.0191**	0.0033	
	(4.402)	(6.123)		(0.008)	(0.006)	
Integrated			-17.6349***			-0.0289***
			(3.574)			(0.008)
Observations	11,267	7,313	12,069	11,000	6,912	11,771
R-squared	0.813	0.728	0.713	0.958	0.978	0.966
Contract controls	Yes	Yes	Yes	Yes	Yes	Yes
Relationship FE	Yes	Yes	No	Yes	Yes	No
Season x Region FE	Yes	Yes	Yes	Yes	Yes	Yes
Month of sale X Region	Yes	Yes	Yes	Yes	Yes	Yes
Date FE	Delivery	Delivery	Delivery	Contract	Contract	Contract
Market conditions	Contract	Contract	Contract	Contract	Contract	Contract
Product FE	Yes	Yes	Yes	Yes	Yes	Yes
Mill Controls	Yes	Yes	Yes	Yes	Yes	Yes
Buyer FE	No	No	Yes	No	No	Yes

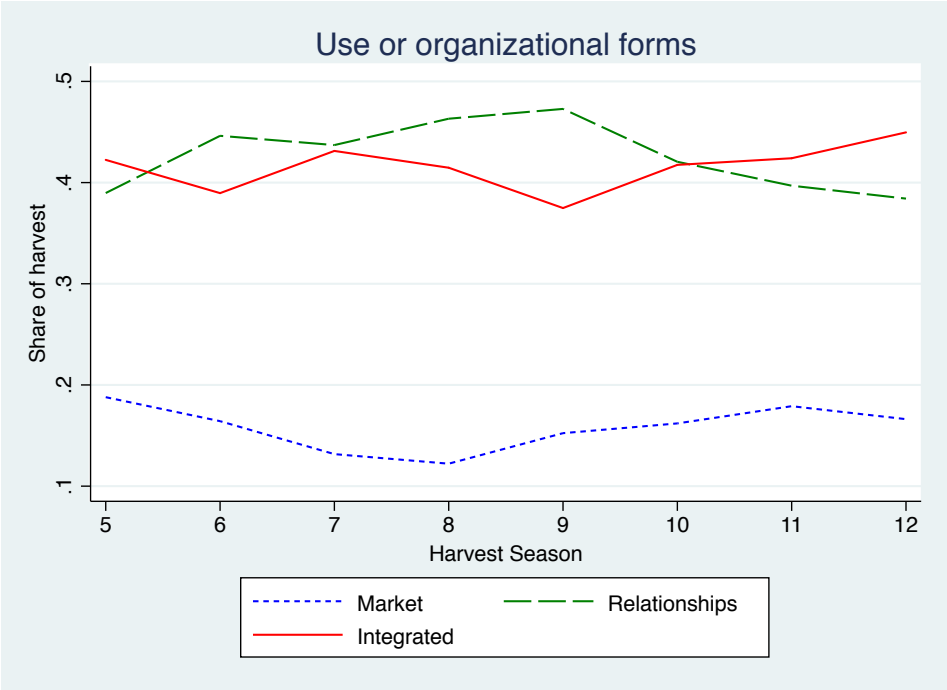
Robust standard errors (cluster relationship-season) in parentheses. *** p<0.01, ** p<0.05, * p<0.1, + p<0.15
The dependent variables are *Advance contracting in days*, defined as the difference between the date of delivery and the signing date, and the *log of price* per Kilo. Integrated, then, is a dummy=1 if the contract is with a mill owned by the buyer.
Contract controls include a third-degree polynomial in Kilos of coffee on the contract and a dummy indicating whether the contract is for the national or export markets. Buyers fixed effects are dummies for buyer. Region fixed effects refer to the region where the mill is located, and are interacted with the season (harvest campaign from 2001/02 to 2011/12) and the month in which the contract is signed. Contract dates fixed effects are dummies for the date in which the contract is signed, and Delivery dates fixed effects are dummies for the date in which the coffee in the contract is delivered. Product FE is a set of (111) dummies for product types (preparation, quality and bean grading). Mill controls include the size of the mill (coffee traded in the season).

Table A10: Dynamics [label: **Dynamics**]

	(1)	(2)	(3)	(4)
Dependent variable:	***Volume Transacted (Tons)***			
Between Firms:				
Market [0]	-16.6469	-35.3604	68.5154+	43.3872
	(46.197)	(44.028)	(45.991)	(46.122)
Relationships [2]	146.9138***	141.7682***	104.9035**	79.7753*
	(54.284)	(53.220)	(45.672)	(44.763)
Within Firms:				
Integration [1]	177.6844	9.5582	30.8870	-46.7061
	(257.254)	(234.743)	(262.827)	(256.403)
Observations	1,706	1,670	483	483
R-squared	0.516	0.500	0.003	0.010
Past Shock	Weather	Weather	Demand	Demand
Current Shock Included	No	Yes	No	Yes
Sample	All	All	All	All
Margin	Intensive	Intensive	Intensive	Intensive
Relationship Definition	Baseline	Baseline	Baseline	Baseline
Season FE	Yes	Yes	Yes	Yes
Firm, Channel FE	Yes	Yes	Yes	Yes

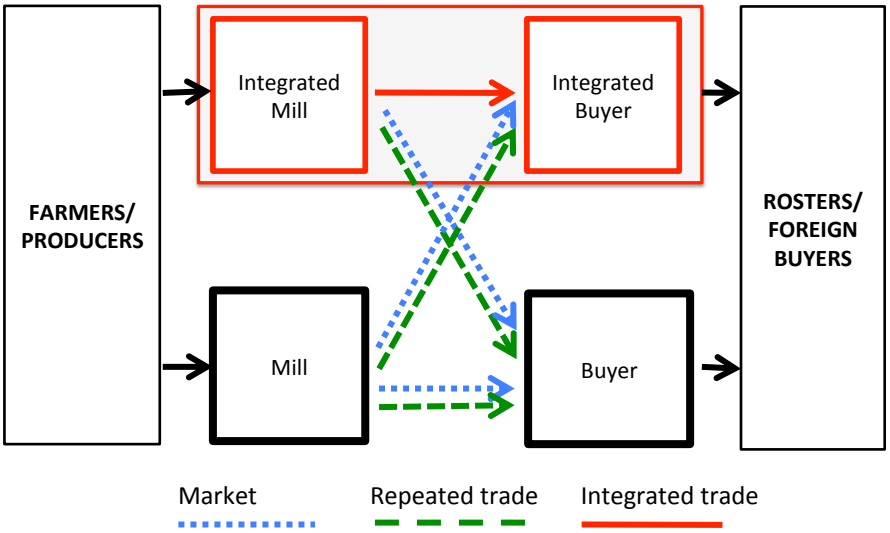
Robust standard errors (cluster relationship) in parentheses. *** p<0.01, ** p<0.05, * p<0.1, + p<0.15
The table includes sale seasons 2004/2012.

Figure 1: **Use of Organizational Forms**



The Figure reports the share of coffee sold by relationships under each organizational form (baseline definition) for seasons 2004/5 to 2011/12.

Figure 2: **The 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 3: **Timing of Contracts, Production and Sales**

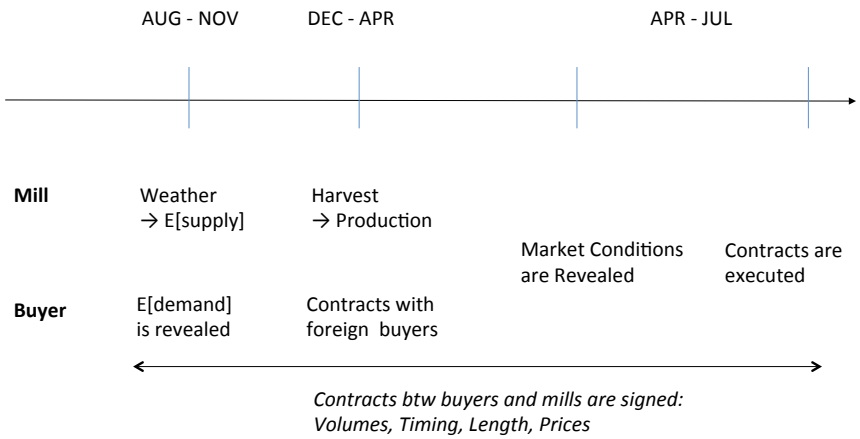
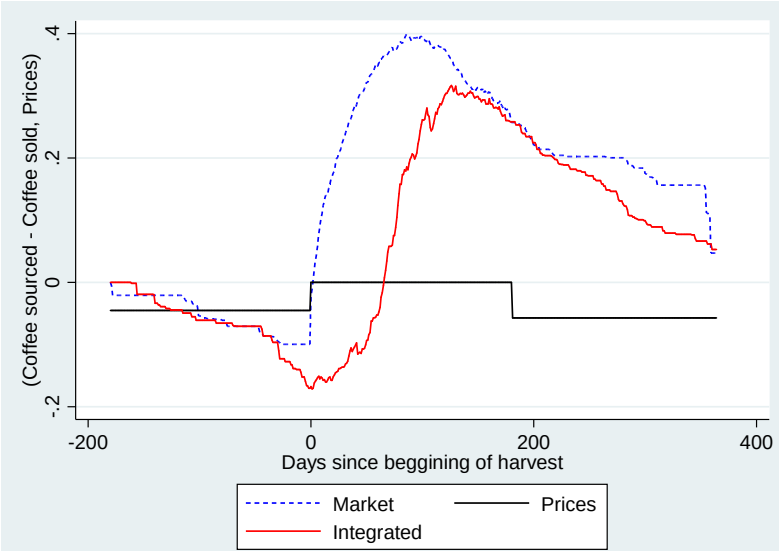
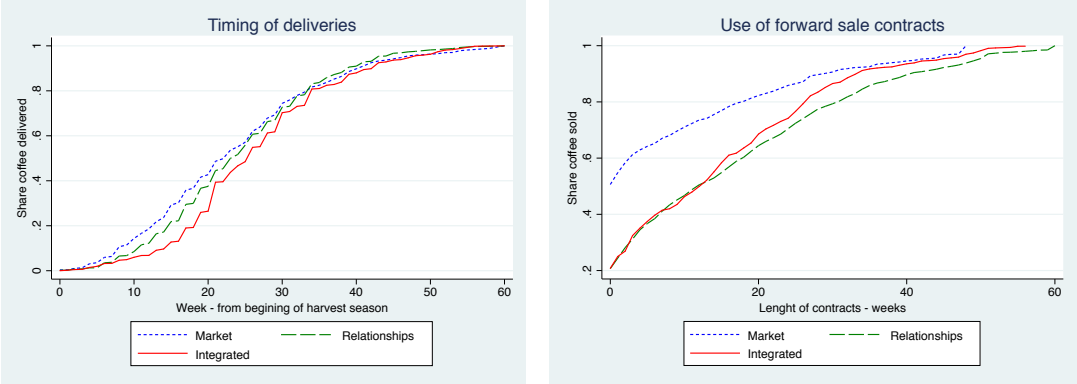


Figure 4: **Inventory Risk**



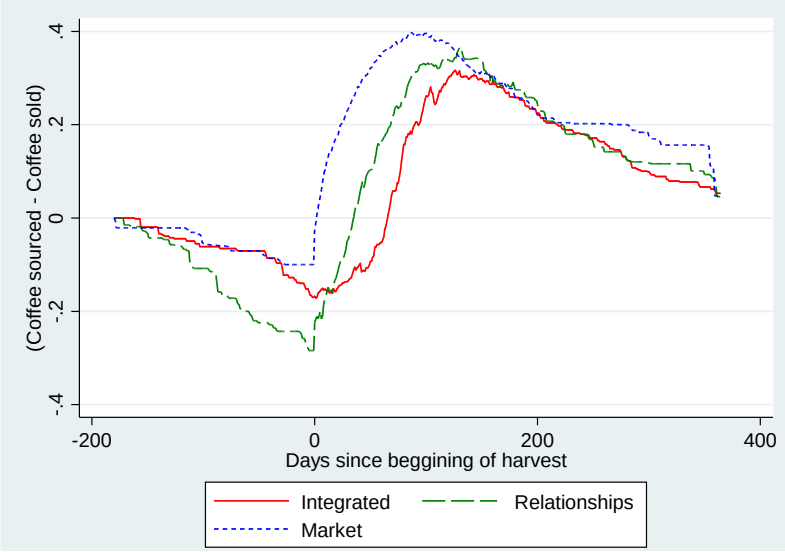
The Figure reports the evolution of sales and sourcing during the harvest season for mills selling their produce under the different organizational forms. A mill will be considered as selling through relationships when it wells more than half of its coffee through relationships (baseline definition). The time is measured relative to the beginning of the harvest season in the region and average figures for all seasons where data on coffee received by the mill is available (2008/9 to 2011/12) are reported. The vertical axis plots the difference between coffee sourced and coffee sold as a share of the coffee eventually sourced in that season. Mills selling more than half of their production on the market (blue dotted 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, these mills are left with 5-7% unsold coffee. In contrast, integrated mills (red line) 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.

Figure 5: **Timing of Contracting**



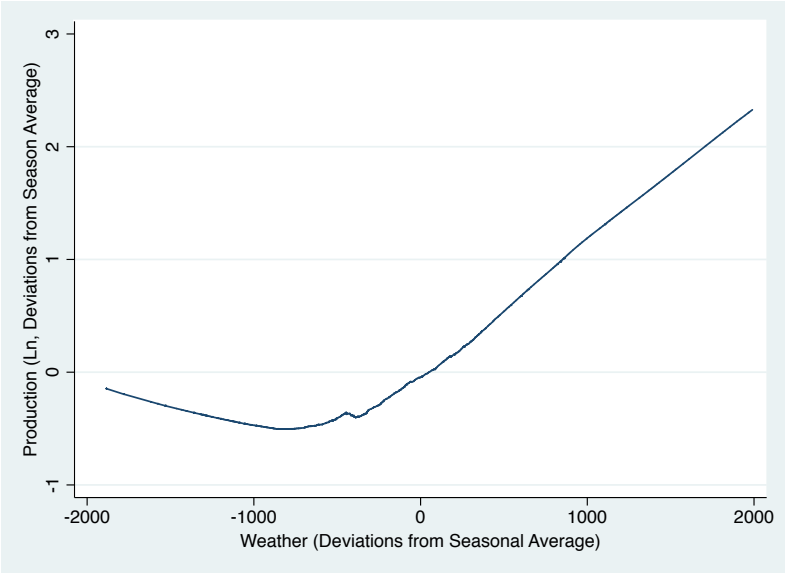
The Figure shows that relationships and integration have similar timing patterns. The Left Panel reports the cumulative share of coffee sold by delivery date, measured in weeks from the end of the harvest campaign in the region, across organizational forms. The Right Panel reports the cumulative share of coffee sold by length of contract, measured in weeks, across organizational forms. 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. The Figure are constructed averaging contracts seasons 2008/9 to 2011/12 and excluding trade inside forward integrated chains.

Figure 6: **Inventory Risk Across Organizational Forms**



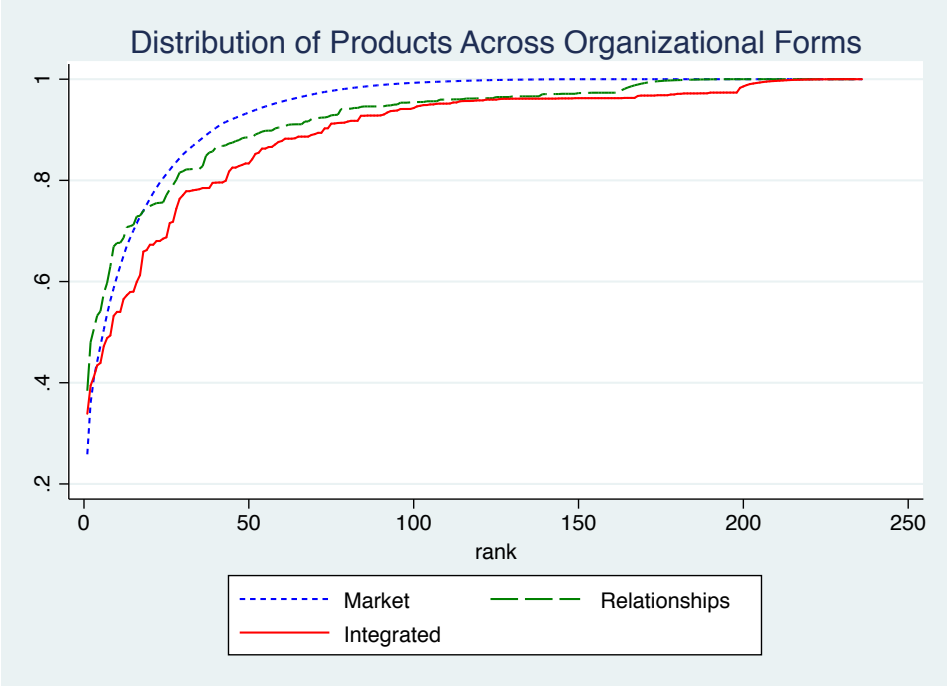
The Figure reports the evolution of sales and sourcing during the harvest season for mills selling their produce under the different organizational forms. A mill will be considered as selling through relationships when it wells more than half of its coffee through relationships (baseline definition). The time is measured relative to the beginning of the harvest season in the region and average figures for all seasons where data on coffee received by the mill is available (2008/9 to 2011/12) are reported. The vertical axis plots the difference between coffee sourced and coffee sold as a share of the coffee eventually sourced in that season. Mills selling more than half of their production on the market (blue dotted 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, these mills are left with 5-7% unsold coffee. In contrast, integrated mills (red line) 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. Relationships (green dash line) are during all the year in an intermediate position.

Figure 7: **Weather Conditions and Mills Production**



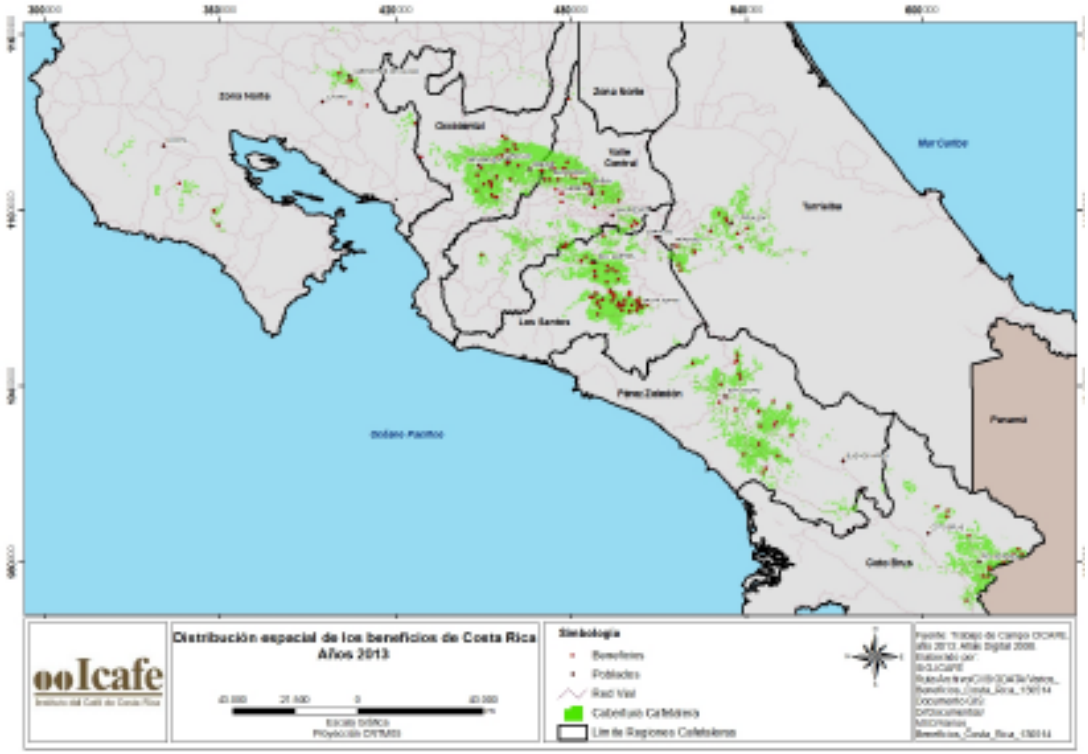
The Figure report non-parametric (lowess) regression of quantity produced by the mill and weather conditions. Plotted quantity produced at the mill level and weather conditions are residuals from a regression including mill and season fixed effects.

Figure 8: **Distribution of Products across Organizational Forms**



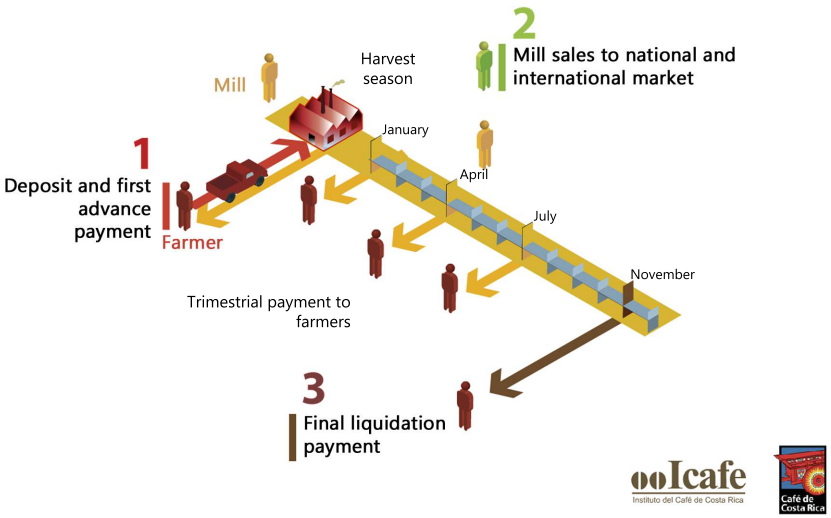
The figure shows that different organizational forms trade very similar mixes of products. The Figure is constructed as follows. First, rank products according to their volumes of trade in the market. The horizontal axis reports the rank of the product and the vertical axis the cumulative distribution. The curve for trade in the market is then monotonically increasing and concave since products are ranked according to their volumes of trade. Notably, the Figure shows that the overall distribution of product traded inside relationships and within firms is remarkably similar. Both curves lie close to the market curve and are concave most of the time. Product specificity is unlikely to be a major driver of organizational forms in this context.

Figure A1: Geographical location of mills



Costa Rica has 7 different coffee producing regions: Central Valley, Turrialba, Coto Brus, Los Santos (Tarrazú), Pérez-Zeledón, West Valley and North. These regions differ on altitude, and they are distributed between low areas - less than 1000m. altitude - and high areas - over 1200m.- where soils are of volcanic origin. The different regions have significant variation on timing of the harvest season, that starts from june to november depending on the region and lasts on average three months.

Figure A2: 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 translated from the ICAFE site.

Figure A3: Within Date Variation in Prices



Figure A4: Foreign Demand and Buyer Sourcing

