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

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**Abstract**

Can long-term relationships between firms replicate the allocation of resources achieved by integration? We answer this question in the context of the Costa Rica coffee chain, an environment in which trade occurs across a rich variety of organizational forms: integrated firms; long-term relationships between firms and market transactions. We examine firm level correlates of these organizational forms and how organizational forms respond to exogenous changes in supply and unanticipated swings in market conditions. We find that suppliers and buyers characteristics associated with integration also correlate with the use of long-term relationships on the sample of non-integrated firms. Long-term relationships between firms respond to shocks like integrated trade and differently from non-repeated trade between firms. Integration and long-term relationships between firms differ in exclusivity: integrated suppliers only sell within the integrated chain, while independent suppliers rarely sell only to one buyer. Relative to long-term relationships, integration allows parties to trade larger volumes but makes it harder to sustain relationships with independent suppliers and buyers. The evidence supports models in which firms boundaries alter temptations to renege on relational contracts and, consequently, the allocation of resources.

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

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

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# 1 Introduction

Can long-term relationships between firms replicate the allocation of resources achieved by integration? Since Coase (1937) seminal contribution, economists in fields as diverse as industrial organization, international trade, public economics and corporate finance have been interested in understanding how resource allocation within firms differs from allocation between firms.[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 circumstances repeated relationships between firms also mitigate the same contractual imperfections.[3] A full understanding of how integration determines resource allocation therefore requires comparing integration against both relationships and market transactions between firms.

This point, formalized in the seminal theoretical contribution by Baker et al. (2002), has however been largely ignored by the empirical literature on vertical integration. This is because of three inherent empirical challenges. First, it is difficult to observe similar transactions under different organizational forms - particularly within firms. Second, organizational forms are endogenously chosen.[4] Third, relationships between firms cannot be distinguished from non-repeated trade, as transacting parties identities are seldom recorded in standard datasets. Such an omission might lead to erroneous conclusions about the motives and consequences of integration and result in misguided policy recommendations. This would be particularly problematic in developing countries, where institutional constraints limiting the efficiency of both markets and firms (are believed to) make informal relationships between firms relatively more prevalent (see, e.g., Fafchamps (2004)).

This paper compares integration and long-term relationships between firms in the Costa Rica coffee chain. The environment allows us to overcome the main empirical challenges mentioned above. Due to regulations in the industry, all transactions of coffee between suppliers (mills) and buyers – including those occurring within firms – are recorded by the coffee board. These records specify unusually detailed product char-

[1] In the United States transactions *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). This observation has led scholars to emphasize the importance of hybrid organizational forms, such as relationship-based supply-chains, in contrast to the sharp discontinuity between markets and firms implied by earlier theories. See, e.g., Powell (1990), Williamson (1991), Sako and Helper (1998) and Menard (2004)).

[4] These two challanges are common to all empirical studies of vertical integration.

acteristics. This allows us to compare trade of the same product across a rich variety of organizational forms: backward integrated firms; long-term relationships between firms and non-repeated trade between firms.[5] Furthermore, because we observe transactions along the whole chain – from farmers, to mills, to exporters, to foreign buyers – we can study how trade carried under different organizational forms respond to a variety of shocks, holding constant firm characteristics that drive organizational decisions. We revisit the two questions in the empirical literature on vertical integration: what drives organizational forms? and, do organizational forms behave differently? On both counts, we find that long-term relationships between firms look similar to integration and very different from non-repeated market trade between firms.

On the first question (what drives organizational forms?) we find that 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 results suggest that integration and long-term relationships might share similar motives.

Consistently with our conversations with industry practitioners and industry reports, the characteristics of firms associated with integration and long-term relationships point at demand uncertainty as a potential driver of organizational forms.[6] Mills have demand assurance concerns due to idiosyncratic and aggregate demand shocks that arise once production decisions have been sunk. We therefore examine our second question (do organizational forms behave differently?) by exploring how organizational forms respond to weather induced supply shocks. Weather conditions during the growing season (i.e., before mill's production decisions are made) exogenously affect the supply of coffee around the mill during harvest. This allows us to examine whether integration and long-term relationships provide demand assurance. In response to exogenous increases in supply, sales volumes increase both within firms and between firms: the difference between the two organizational forms is not statistically signifi-

[5]Roughly 40% of coffee in the industry is exchanged within integrated firms, 40% within long-term relationships (defined as mill-buyer pairs that trade for at least three consecutive years) and the remaining 20% by firms not trading repeatedly.

[6]See, e.g., reports by I.T.C. (2012), I.C.O. (2014) and World Bank (2015). Furthermore, non-repeated trade between firms displays three patterns predicted by models with demand uncertainty (see, e.g., Carlton (1978), Dana (1998)): 1) forward sale contracts are pervasive; 2) mills face significant inventory risk; and 3) prices feature both advance-purchase and end-of-season discounts.

cant. When we distinguish long-term relationships between firms from non-repeated market trade, we find that in response to exogenous increases in supply trade volumes in long-term relationships increase while trade volumes in the market do not. The response within integrated firms is statistically different from the response in the market, but not (statistically) different from the response inside long-term relationships.[7]

We then examine the mechanisms underpinning the behaviour of long-term relationships between firms. To ensure demand, mills and buyers sign forward sale contracts that are enforced by the board. Signing contracts too early, however, can turn out to be costly if market conditions change. Do long-term relationships entirely rely on repeated contracting or do they also rely on relational contracts? 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 in the relationship against current temptations to deviate. In our context, parties might promise to each other to sign contracts in the future. Such promises would guarantee mills (buyers) a certain demand (supply) reducing the need for very long forward contracts. The main difficulty in providing direct evidence of a relational contract is that the promises, the temptations to deviate and the future rents are not observable in the data. A key advantage of our setting, however, is that, once a contract is signed, the mill's temptation to deviate (as well as actual deviations, if any) become directly observable. This provides an opportunity to directly test for the presence of a relational contract.

We adapt the framework in Baker et al. (2002) to our context and derive a number of testable predictions. The central insight is that firm boundaries affect temptations to renege on the (relational) contract. Consider a mill and a buyer that sign a forward sale contract. Unanticipated swings in reference prices over the duration of the contract change temptations to renege. In particular, if reference prices increase, a mill has an incentive to side-sell (or renegotiate the contract) to take advantage of improved market conditions. Under integration, however, the buyer owns the coffee and, therefore, the mill cannot renege: the reneging temptation is independent of reference prices. If relationships between firms provide future rents, mills will also resist larger temptations to renege on contracts signed with long-term partners. We use unantici-

[7]These results control for harvest season fixed effects (i.e., exploit mill's idyosincratic weather conditions); mill-organizational forms fixed effects (which control for time invariant determinants of organizational forms); and interaction of weather conditions and time invariant mill-characteristics, including those associated with different organizational forms. The results are also robust to a large number of robustness checks, including i) using either rainfall, temperature or both to proxy for weather conditions and alternative definition of relationships.

pated changes in world coffee prices to test these predictions and find ample support. Contract defaults increase significantly in response to unanticipated increases in reference prices between firms not trading repeatedly. In contrast, contract defaults within both integrated firms and long-term relationships between firms are independent of unanticipated increases in reference prices. As for weather shocks, the response to unanticipated shocks to reference prices within integrated firms is statistically different from the response in the market, but not (statistically) different from the response inside long-term relationships.[8]

Heterogeneity across relationships provide further support for the relational contract 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 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, unanticipated shocks to reference prices are associated with contract default in relationships between integrated buyers and independent suppliers; but not in those that do not involve an integrated buyer. Second, there is less cooperation in relationships involving integrated buyers: in response to weather induced supply shocks trade volumes do not increase in these relationships. Finally, integrated buyers reduce purchases from non-integrated suppliers in response to better weather conditions (and higher supply) at their own mills. Relationships between integrated buyers and independent suppliers appear to exclusively rely on repeated contracting.

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. The main difference between integration and long-term relationships between firms is exclusivity: integrated suppliers only sell within the integrated chain, while independent suppliers rarely sell only to one buyer. To better understand exclusivity, we compare volumes of coffee transacted inside integrated firms against those transacted inside long-term relationships. We focus on the main (i.e., largest in terms of volume) relationships of mills with size similar to those of integrated mills. Even after restricting attention to (nearly) exclusive relationships, we find that volumes transacted within

[8]We compute contract-specific price surprises as the ratio between realized spot market prices at delivery over futures prices at delivery quoted at the contracting date. This variation allows us to control for current market conditions, including delivery date fixed effects, as well as mill and buyer fixed effects. We also document that contractual defaults are associated with worse future relationship outcomes.

firms are (statistically) larger than those transacted by nearly exclsuive relationships of mills of comparable size. The exclusivity associated with integration might be necessary to resist extremely large temptations associated with larger volumes of trade. The sharp discontinuity in terms of trade volumes achieved by exclusivity, however, comes at the costs of making it harder to sustain relationships with independent suppliers.[9]

***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 both long-term relationships and non-repeated market trade between firms. Long-term relationships behaves like integration, and differently from market trade. Second, we distil predictions from the framework in Baker et al. (2002) 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.

Much attention in the literature on vertical integration has been devoted to antitrust concerns and exclusionary aspects (see, e.g., Hart and Tirole (1990) and Hortascu and Syverson (2007) for overviews). We study a globally traded product for which concerns about foreclosure and other anti-competitive motives are less likely to be relevant. This allows us to focus on adaptation and non-contractability as possible drivers of organizational forms. Within this strand of work, the majority of empirical studies of vertical integration asks "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). We also study exporters, but focus on the vertical integration decision along the domestic supply chain. A smaller literature asks "do firm boundaries matter?" These contri-

[9]Section 5 presents additional evidence that rules out alternative explanations as main drivers of organizational forms in our context. Exploiting unusually detailed product characteristics we rule out differences in product type and quality across organizational forms. We also show that integrated mills do not have lower unit processing costs than similar mills that sell coffee through long-term relationships. Finally, anticompetitive motives are also unlikely to be key driver of integration and long-term relationships since firms have no or little market power in the global coffee market.

bution focus on operational differences between integration and non-integration (see, e.g., Mullhainatan and Sharfstein (2001), Baker and Hubbard (2004), 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) combines plant level data with the commodity flow survey in the U.S. 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 in waterproof plastic, Mullainathan and Scharfstein (2001) find that non-integrated producers react more strongly to market demand while integrated producers focus on internal demand. Our results are in line with their evidence. The granularity of our data allows us to more precisely identify the channels through which organizational forms affects firm's operations. Forbes and Lederman (2010) find that integrated airlines perform better than nonintegrated airlines (and particularly so when adaptation needs increase due to adverse weather and airport congestion). Like their study, our empirical strategy compares responses to shocks/market conditions across organizational forms, holding constant the characteristics of the product transacted as well as firm-level characteristics (including drivers of organizational forms). These studies, however, do not compare integration against long-term relationships between firms.

The paper also contributes to the recent literature on relationships between firms.[10] Macchiavello and Morjaria (2015a) analysis of relational contracts in the flower industry is most closely related from a methodological point of view. We also use side-selling opportunities to proxy temptations to deviate on relational contracts and unanticipated shocks to identify mechanisms. Barron et al. (2015) and Gil et al. (2016) provide evidence on the importance of (relational) adaptation in the movie distribution and airline industry respectively. Blouin and Macchiavello (2013) show that parties adopt formal contracts to allocate scarce relational capital using a cross-country sample of contracts between coffee exporters and foreign importers. 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,

[10]See Gil and Marion (2012) and Antràs and Foley (2015) for early contributions and Lafontaine and Slade (2012) and Gil and Zanarone (2014) for reviews).

2016) are examples of empirical studies focusing on the importance of relationships. Vertical integration has been relatively neglected.[11] 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.[12]

***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 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. The country ranks 14th among world's coffee producers and exports the vast majority of its coffee (see I.C.O. (2015)). Coffee is produced in seven regions that differ in altitude, climate and harvest timings (see Table A1 and Figure A1 in the Appendix).

Figure 2 describes the coffee chain. Coffee cherries are harvested by farmers and delivered to mills within a few hours of harvest. Mills remove the pulp from the cherries, wash and dry the bean. After these processes the output becomes storable and is called parchment coffee (or "cafe oro").[13]

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

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

[12] 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.

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

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.[14]

Figure 3 illustrates the unfolding of the coffee season. During the growing season (approximately from August to November) weather conditions influence the amount of coffee eventually harvested by farmers. Coffee is harvested and processed by mills 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).

***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).[15] 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 are registered as contracts 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.

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.[16] Buyers and sellers often sign forward contracts for future delivery. Sharp changes in market conditions leave parties exposed to strategic default: if prices go up (down), mills (buyers) have an incentive to renege on the deal. The board only allows mills to cancel contracts under specific

[14]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.

[15]ICAFE is a non-governmental public institution established by law in 1961. For further details, see: www.icafe.go.cr.

[16]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.

circumstances.[17]

***Descriptive Statistics***

Table 1 provides summary statistics for a representative harvest season.[18] Panel A presents mills' characteristics. Out of 175 mills, approximately 5% are owned by buyers, i.e., are part of backward integrated chains. These mills account for 30% of coffee transacted. The ten largest mills account for 53% of production. 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 60% internally and the rest from independent suppliers. Buyers have operated an average 6.23 years during the sample period, 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.[19] Approximately 20% of the contracts are for the national market, and around 50% involve an integrated buyer. Forward contracts are pervasive. The average contract is signed about 3 months before scheduled delivery. In only less than 40% of contracts delivery occurs within a week of the signing date (spot contracts).[20]

[17]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.

[18]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.

[19]Recall that, due to the regulations, all transactions - including those within firms - must be registered with the board on a contract.

[20]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.

***Relationships***

We define a mill and buyer pair to be in a relationship if they trade for at least four consecutive harvest seasons.[21] 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.[22] Panel D in Table 1A presents relationships' characteristics for a typical 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 channels. Non-integrated buyers split their sourcing equally between relationships (49%) and market (51%). Backward integrated buyers source 63% of their coffee from their

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.

[21]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. Figures 9, 10 and 11 show that our main results are robust to alternative thresholds to classify a pair as being in a relationships. The Figure show robustness using thresholds spanning from two to eight consecutive years. In the Tables 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. Appendix C provides a detailed discussion of relationship dynamics.

[22]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.

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.[23]

***Organizational Forms and Demand Uncertainty: Descriptive Evidence*** Our conversations with practitioners and industry reports suggest that demand uncertainty is a salient feature of the industry.[24] We conclude the background session by providing a preliminary descriptive analysis of organizational forms under demand uncertainty. Demand assurance concerns arise in markets in which firms face idiosyncratic and aggregate demand shocks once production decisions have been sunk. These conditions fit the coffee industry well. Buyers (mostly exporters) manage inventories 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 fluctuations in demand and prices. Since parchment coffee can be stored up to at most the following harvest, inventories can only partially help navigate demand shocks and mills face the risk of holding unsold stocks at the end of the season.

Figure 4 shows that demand uncertainty is an important concern in this market.[25] The Figure plots the difference between processed coffee and coffee committed for sales during the course of the harvest campaign. For each day relative to the beginning of harvest, the Figure averages the net inventory position of different types of mills across seasons.

Three features of the market stand out. First, mills and buyers sign forward sale contracts even before the beginning of harvest. This gives a negative net inventory position since mills commit to sales of coffee they haven't yet processed. Second, mills carry a significant 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 that sell most of their coffee through non-repeated trade remain with a significant share of the processed coffee still to be sold when the following harvest begins. Finally, mills are willing to pay a price to reduce inventory risk. The Figure also reports (estimated) seasonality effects on prices. All else constant, prices are

[23]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%).

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

[25]The Figure captures the main features of a market characterized by demand uncertainty as implied by models such as Carlton (1978) and Dana (1998).

approximately 4.15% 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, 5.7% lower.[26]

Vertical integration has long been seen as a solution to demand uncertainty (see, e.g., Chandler (1964), Green (1974), Carlton (1979) and Perry (1989)). Integrated mills sell almost all their produce to their buyers. As shown in Figure 4 integrated mills sign fewer contracts before the beginning of harvest, carry a lower balance of processed coffee throughout the entire season and are never left with unsold coffee at the end of the season.[27]

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. 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 between firms at arm's lenght is delivered before the end of the harvest campaign. The right panel describes the use of forward contracts. Spot contracts (i.e., those for delivery within a week) account for 60% of arm's lenght trade between firms. These share drops to 20% in both relationships and integrated trade. The overall distribution of contract length in relationships and integrated trade is almost identical. Finally, Figure 6 shows that mills that sell most of their coffee through long-term relationships sign more forward contracts before the beginning of harvest season and reduce inventory risk to the same level as integrated mills.

# 3 Main Results

This Section compares integration and long-term relationships between firms by revisiting the two questions in the empirical literature on vertial integration: 1) what drives organizational forms, and 2) do organizational forms behave differently? The first part of the Section asks the first question by presenting correlations between mills

[26] See Table A3 for regression results. These seasonality effects 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 more than three hundreds product fixed effects (which include an indicator of when the coffee was harvested). These estimated effects on prices are quite large relative to buyers and mills margins.

[27] From a risk management perspective backward integrated exporters match contractual structure in export market with (reported) contracts within the integrated chain.

and buyers characteristics and organizational forms. The main finding is that the similarity between long-term relationships and integration documented in the previous section with respect to the patterns of trade extends to firm characteristics. Furthermore, for both mills and buyers, the characteristics that correlate with integration and use of long-term relationships are consistent with demand uncertainty concerns being mitigated by these organizational forms. We then turn to the second question by asking how organizational forms respond to shocks. We distinguish two types of shocks: "ex-ante" shocks that occur before production decision are made, and "ex-post" shocks that occur once production decisions have been made. This Section uses "ex-ante" weather conditions during growing season to investigate whether indeed integration and relationships provide market assurance. We find that find that, like integration, relationships absorb a disproportionate share of exogenous increases in production. The next Section uses "ex-post" shocks to reference prices to understand the mechanisms underpinning these findings.

### 3.1 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.[28] 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.[29] 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

[28]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.

[29]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.

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 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.[30]

These results suggest that integration and long-term relationships might share similar motives. Furthermore, the reported correlations are also consistent with integration and long-term relationships being used to mitigate demand uncertainty, consistently with the descriptive evidence presented in Section 2.

### 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 always sell their produce internally and do not face this type of risk. Long-term relationships are mostly used to sell (source) coffee by mills (buyers) with similar characteristics of integrated ones. Do long-term relationships also provide demand assurance? This Section uses mill specific weather conditions during the growing season to answer this question.

[30] 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.

***Reduced Form***

Weather conditions 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 effects.

Through which organizational forms is the additional production induced by more favourable weather conditions sold? We distinguish three organizational forms: market trade between firms, $m$, long-term relationships between firms, $r$, and integration $v$. To answer this question we estimate the following reduced form specification

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

where $y_{mos}$ is tons of coffee sold by mill $m$ through organizational form $o \in \{m, r, v\}$ in season $s$, $\alpha_{mo}$ are mill marketing channel specific fixed effects and $\mu_s$ are season fixed effects. Weather realizations during growing season $W_{ms}$ are interacted with organizational form dummies $\beta_o$ at the marketing channel or firm level depending on specifications, while $\varepsilon_{mos}$ is an error terms arbitrarily correlated within mills-channel over time and within mill-harvest season across marketing channels. The inclusion of season fixed effects and mills-channel fixed effects implies we identify response to idyosincratic weather conditions. Furthermore, the inclusion of mills-channel fixed effects allows us to control for time-invariant mill characteristics, including those that drive the choice of organizational forms.[31]

Table 5 reports the results.[32] Column (1) considers only two marketing channels: between firms (which bundles arm's lenght and relationships) and within firms. A one standard deviation increase in weather is associated with an increase of 84 tons of sales between firms and an increase of 340 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

[31] Specifications at the season-mill-channel level are better suited at capturing the choice of marketing channel used by the mill to respond to the shock, since all channels can potentially be used by each mill. By conducting the analysis at this level of aggregation, however, we cannot control for buyer and product characteristics. This is however done in specifications in Tables 8 (which is at the contract level) and 9 (at the relationship-season level).

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

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) presents the main result. The specification unbundles the between firm trade distinguishing market from long-term relationships. A one standard deviation increase in weather conditions increases volumes sold through market sales by only 4 tons (not statistically different from zero), 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 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. In all cases, the response of volumes of trade inside integration is statistically different from the response in the market (which is never statistically different from zero) but cannot be distinguished from the response inside long-term relationships.

Figure 9 explores the robustness of our findings to alternative definitions of relationships. The Figure reports estimates from the baseline specification in Column (2) using different thresholds for the definition of relationships. We use thresholds spanning from one season to eight seasons. Each specification reports results defining a mill and buyer being in a relationship if they have traded consecutively for a number of seasons equal or above the threshold. The baseline specification corresponds to a threshold equal to three. Although the magnitudes change across specifications, across all definition we find that the response of integrated trade is (statistically) different from the response in the market but not different from the response inside long-term relationships.[33]

[33]As the threshold necessary for a pair to be classified as in a relationship increases the estimated responses inside long-term relationships and arm's lenght market trade get closer. This is a result of the

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 in their fourth or higher consecutive year of trade, 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 absorb most of the exogenous increases in supply due to better weather conditions. 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 between non-integrated and integrated mills.

fact that as the threshold is increased more and more relationships are classified as arm's lenght trade and as relationship age they account for larger shares of mills aggregate businesses (reducing the scope for larger responses). Figure 10 repeats the exercise looking at share sold across marketing channels and considering responses both along the intensive and extensive margins and find that responses inside relationships converge to the response of integrated trade as the threshold increases.

[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.

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 $\theta$.[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 $\delta$). 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, $\eta_{mb}$ are relationship fixed effects, $\delta_{st}$ are contracting date fixed effects, $\mu_{sp}$ are product-season fixed effects, $\gamma_{tp}$ 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 $\beta_o$ 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 $\eta_{mb}$, $\delta_{st}$, $\mu_{sp}$ and $\gamma_{tp}$ 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].

Figure 11 explores the robustness of our findings to alternative definitions of relationships. The Figure reports estimates from the baseline specification in Column (4) using different thresholds for the definition of relationships, like Figure 9. Across all specifications, we confirm that in response to unanticipated price shocks, likelihood of contractual defaults increases in arm's lenght trade between firms but not in long-term relationships between firms or integrated trade.

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

[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.

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. 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]

[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.

# 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. This paper has shown that relational contracts between independent 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.[47]

A distinctive prediction of Carlton (1979) is that larger buyers integrate backward to guarantee supply to satisfy the most stable part of their demand. Buyers do not acquire capacity to satisfy all their demand as firm boundaries are *assumed* to induce costs when selling excess capacity outside. The prediction is clearly consistent with the patterns in our industry. Furthermore, Table **??** in the Appendix provides empirical support for the assumption: integrated mills receive significantly lower prices than similar independent mills when selling the same quantity of the same coffee under the same market conditions to the same buyers.

Integration, therefore, is associated with costs when trading with outside parties (both when selling outside, as well as in building relationships with independent suppliers). What are the benefits of integration? A possibility is that integration is required to trade large volumes of coffee that would otherwise induce too large temptations to renege on promises.[48]

Suggestive evidence in support of this hypothesis comes from Figure 12. As noted above, the main difference between integration and long-term relationships is exclusivity: integrated suppliers only sell within the integrated chain, while independent suppliers rarely sell only to one buyer. The Figure shows that integrated relationships trade higher volumes of coffee than (nearly) exclusive relationships of mills of comparable size. On the y-axis the Figure reports average (and confidence interval) volumes of coffee traded by different types of relationships in a given season. Relationships are classified according to i) size of the mill, and ii) degree of exclusivity. Mills are classified in three categories: small (1st quartile of size distribution), medium (2nd and 3rd quartiles) and large (4th quartile). All but one integrated mills are in the 4th

[47] Baker et al. (2002) model predicts that integration is preferred when market conditions are highly variable and provides a micro-foundation for Carlton (1979) observation.

[48] We refer here to promises to trade i.e., sign contracts. Temptations to renege on signed contracts examined in the previous sections control for contract volumes.

quartile (one mill in the 3rd quartile). The Figure considers only main relationships, defined as those that account for the largest share of sales for a mill in a given year. Relationships are split by the share of a mill's sales they account for (deciles at 60%, 70% ... 100%).

First, the Figure confirms that integrated trade is exclusive. Volumes transacted within firms are (statistically) larger than those transacted by nearly exclsuive relationships of mills of comparable size. Firm boundaries might be necessary to achieve the sharp discontinuity in trade volumes. The exclusivity imposed by firm boundaries, however, comes at the costs of making it harder to trade outside. Given these costs, firms that process and require very large volumes of coffee integrate, while other firms use long-term relationships (partly sustained by relational contracts) to achieve similar degrees of supply and demand assurance.

The rest of this Section briefly considers alternative theories of vertical integration that *do not* appear to be key drivers of organizational forms 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.[49] 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.[50]

[49]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.

[50]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.)

***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.[51] This allows us to compare unit production 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.[52] 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

[51] 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 to farmers.

[52] Alternative thresholds provide similar results.

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: the two forms of integration behave differently and likely have different purposes.[53]

***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.[54]

# 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

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

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

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 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.[55] 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.[56] To pay farmers for coffee cherries,

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

[56] Theoretically, the relationship between access to finance and vertical integration is quite subtle

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.

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).[57] 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.

(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).

[57] 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".[58]

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

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

eight days of publication.[59]

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.[60] Figure A3 shows that undisclosed minimum prices do not bind. The main empirical analysis focuses on volumes and timing of transactions, not on prices.

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.[61] 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.[62] Below, we exploit unanticipated changes to international prices to understand the mechanisms underpinning relational contracts.

[59]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.

[60]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).

[61]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.

[62]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.

## 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 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 $\varepsilon_{bot}$ 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. [63] 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.[64]

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.[65] 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

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

[64] 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.

[65] 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.[66]

# C Relationship Dynamics

TO BE ADDED

[66] 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 |

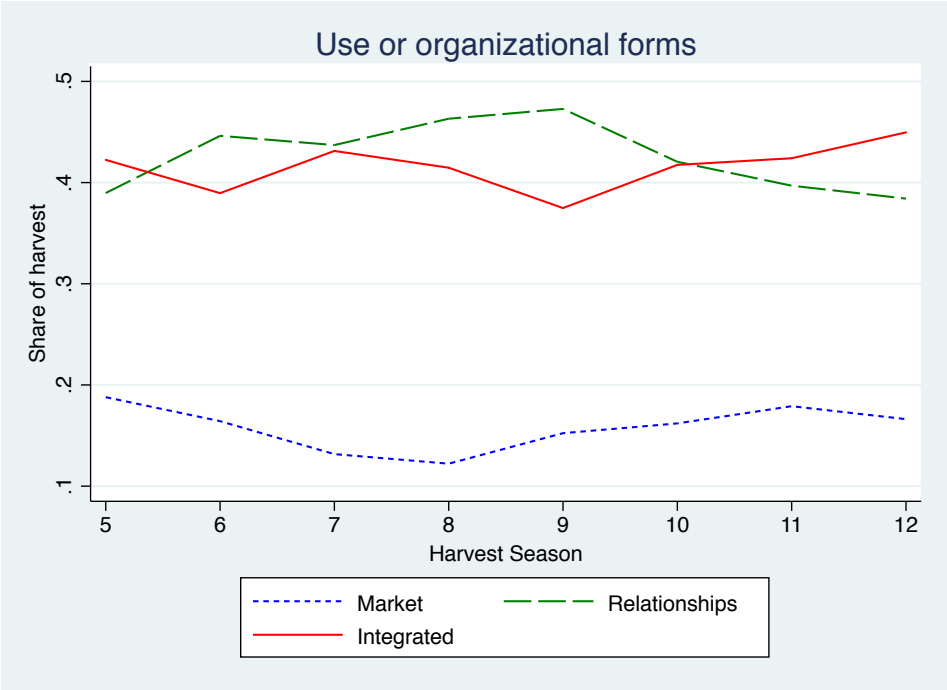
Robust standard errors (cluster relationship-season) in parentheses. *** p<0.01, ** p<0.05, * p<0.1, + p<0.15
The dependent variables are *Advance contracting in days*, defined as the difference between the date of delivery and the signing date, and the *log of price* per Kilo. Integrated, then, is a 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 |

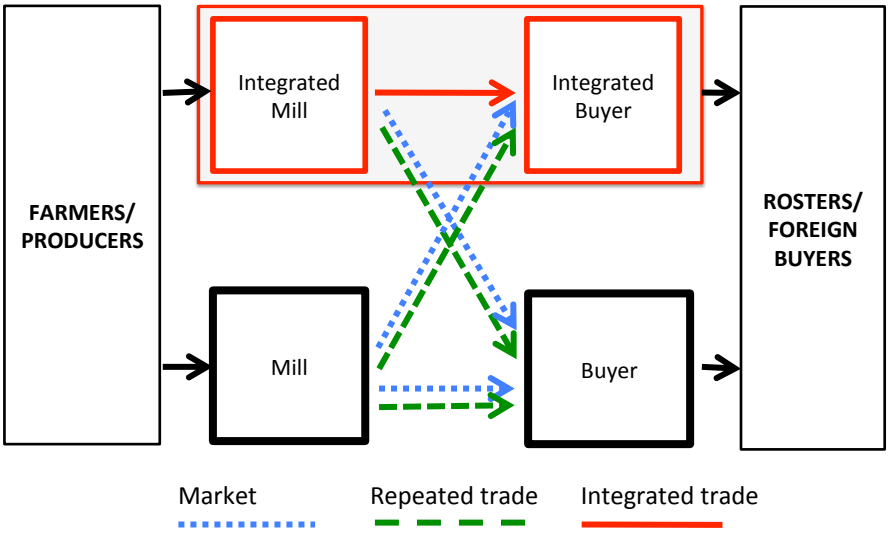
Robust standard errors (cluster relationship) in parentheses. *** p<0.01, ** p<0.05, * p<0.1, + p<0.15
The table includes sale seasons 2004/2012.

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**

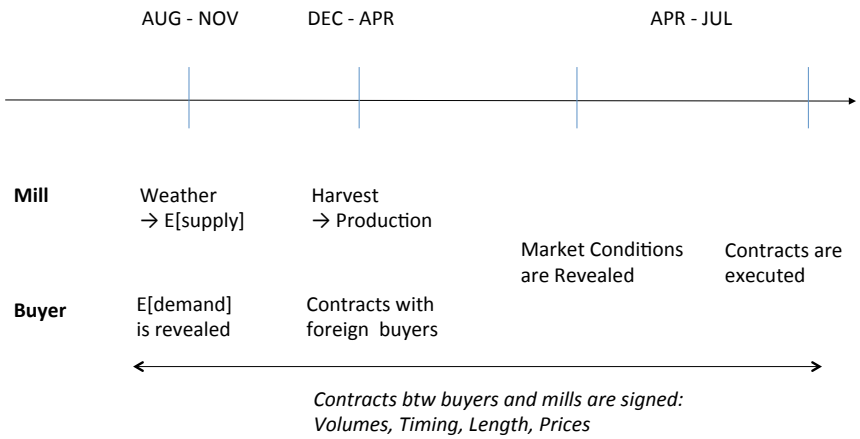
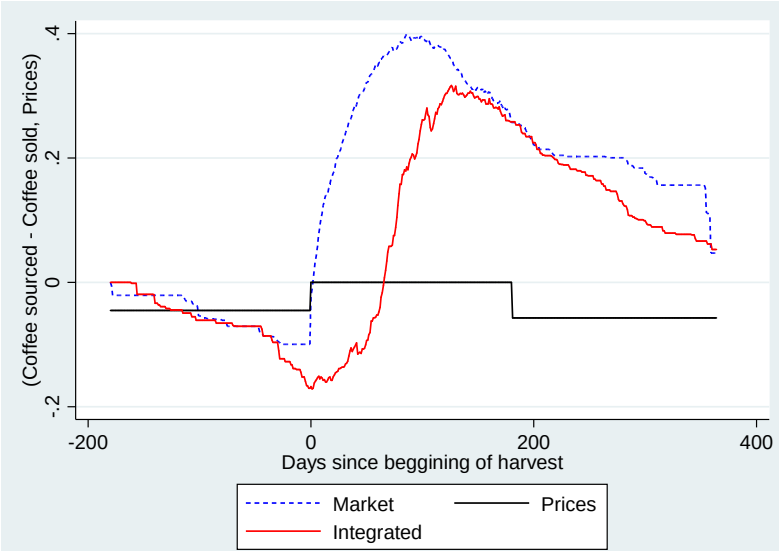
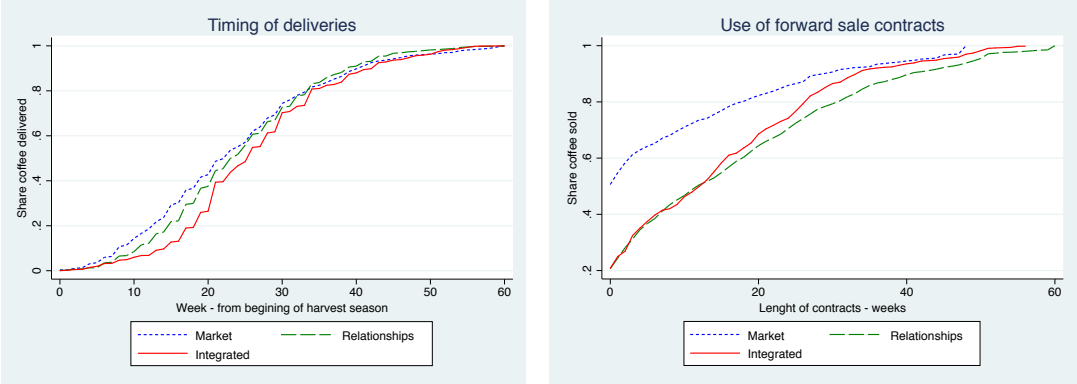


Figure 4: **Inventory Risk**



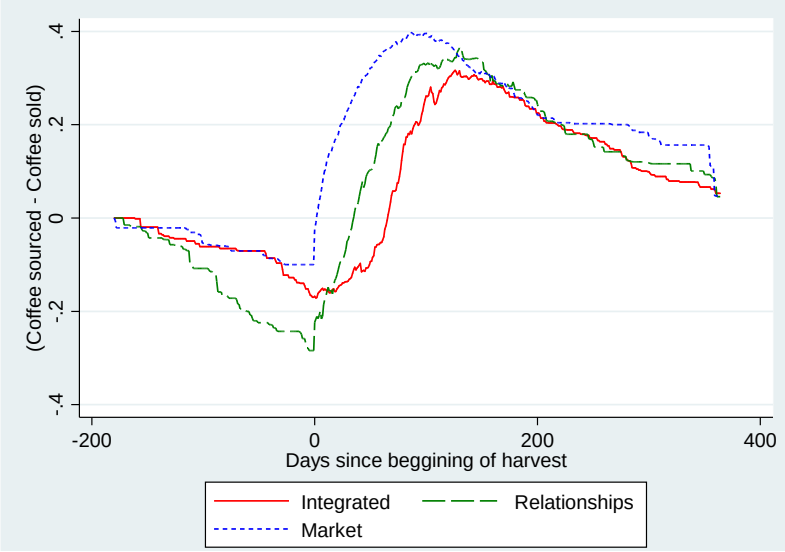

The Figure reports the evolution of sales and sourcing during the harvest season for mills selling their produce under the different organizational forms. A mill will be considered as selling through relationships when it wells more than half of its coffee through relationships (baseline definition). 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**



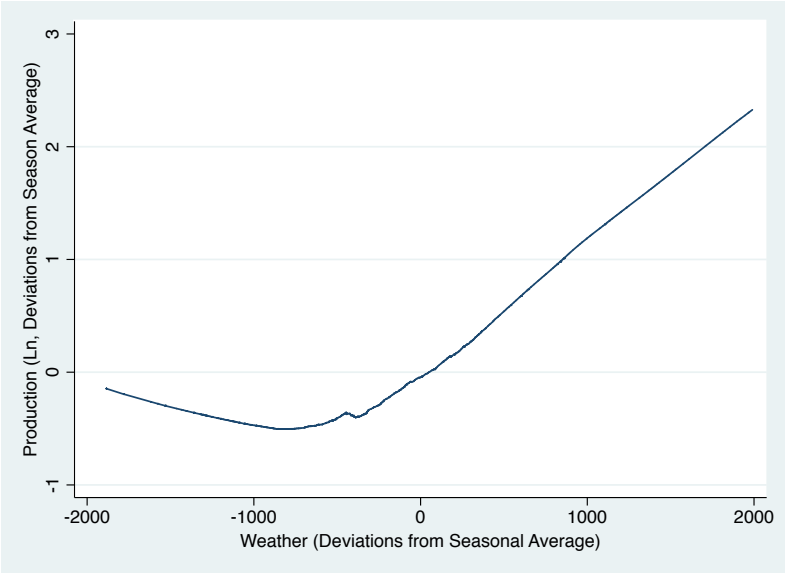

The Figure shows that relationships and integration have similar timing patterns. The Left Panel reports the cumulative share of coffee sold by delivery date, measured in weeks from the end of the harvest campaign in the region, across organizational forms. The Right Panel reports the cumulative share 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**



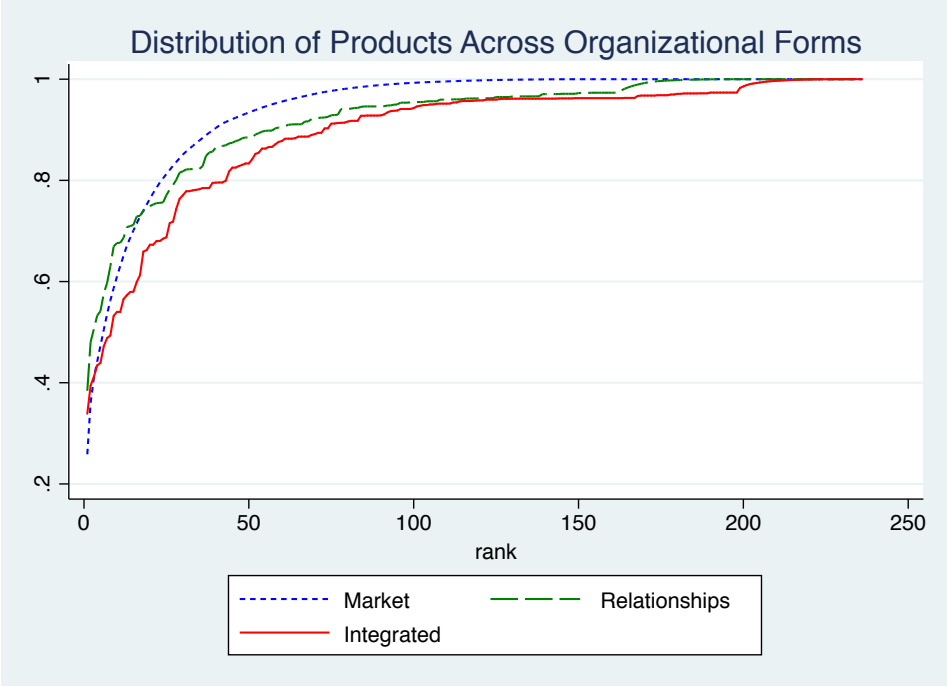

The Figure reports the evolution of sales and sourcing during the harvest season for mills selling their produce under the different organizational forms. A mill will be considered as selling through relationships when it wells more than half of its coffee through relationships (baseline definition). 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**



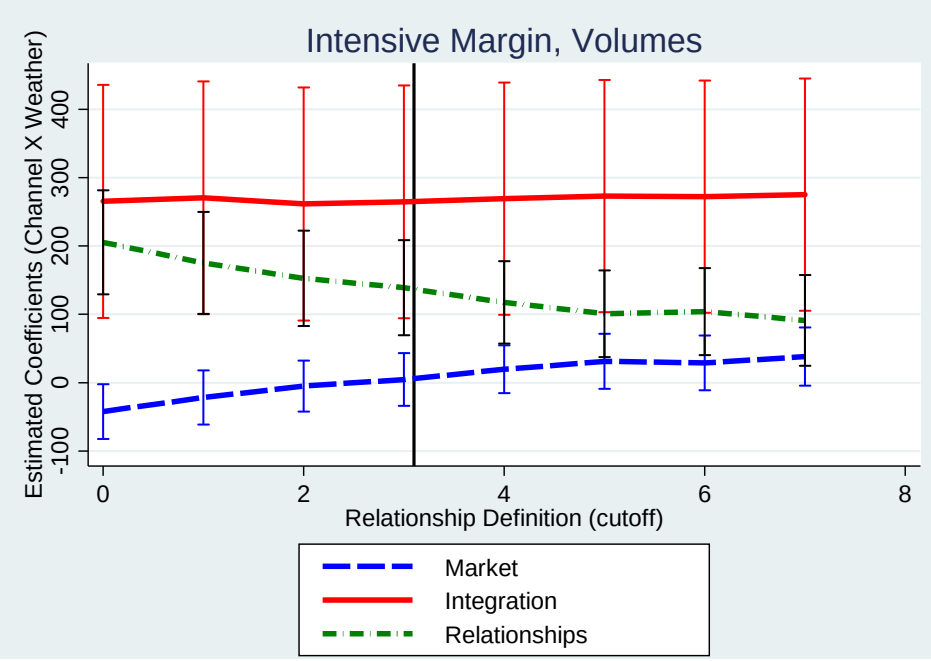

The Figure report non-parametric (lowess) regression of quantity produced by the mill and weather conditions. Plotted quantity produced at the mill level and weather conditions are residuals from a regression including mill and season fixed effects.

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



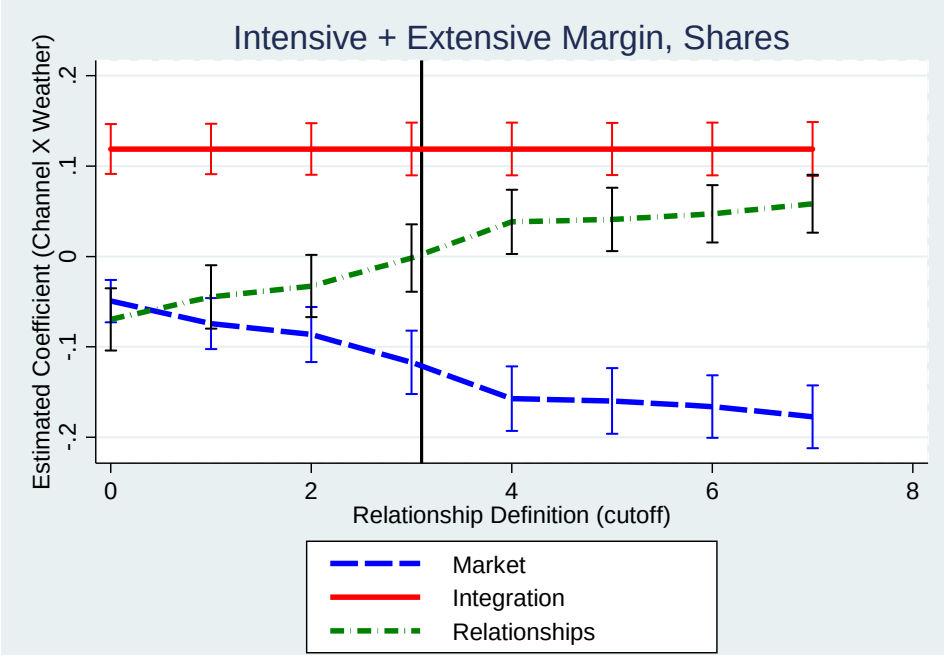

The figure shows that different organizational forms trade very similar mixes of products. The Figure is constructed as follows. First, rank products according to their volumes of trade in the market. The horizontal axis reports the rank of the product and the vertical axis the cumulative distribution. 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 9: **Robustness to Relationship Definition**



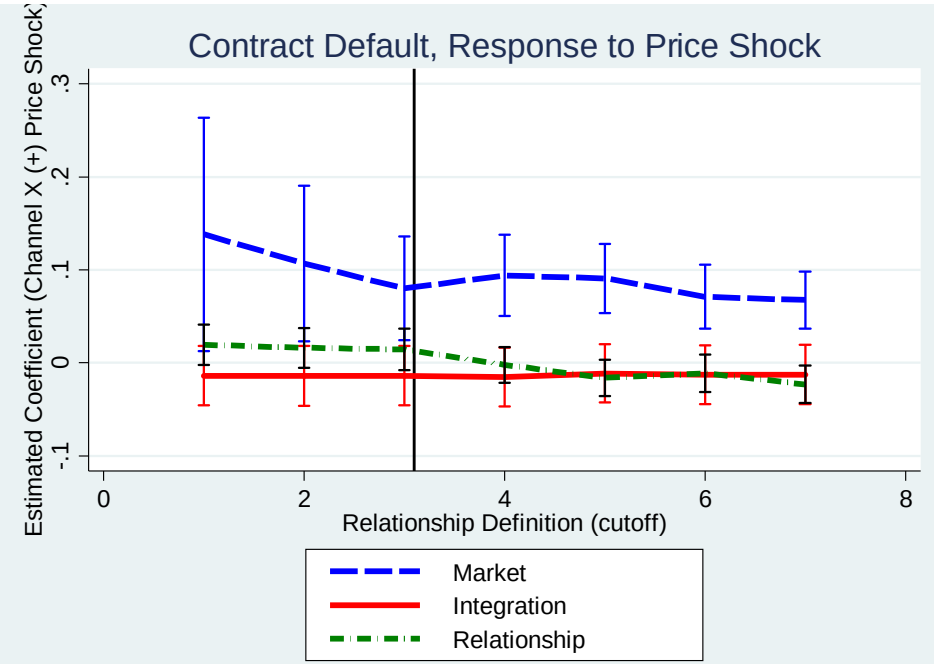

The figure shows that different definition of relationships give qualitatively identical results. The y-axis reports estimated coefficients (and 95% confidence intervals) for the interaction between marketing channels and weather conditions. The underlying estimated regrssions are like those in Column 2 of Table 5: the dependent variable is tons of coffee sold; only the intensive margin is considered, mill-channels and season fixed effects are controlled for. The x-axis reports the cut-off $r$ used to distinguish market and relationships: mill-buyer pairs that trade for more than $r$ consecutive season are defined to be in a relationship. The figure reports results from $r \in 0, 1, 2, ...7$.. The reference line at $r = 3$ is the baseline definition. As $r$ increases more transactions inside "relationships" are classified as market: the estimates of the two channels converge. The two main results are robust regardless of the definition used: the effect of weather conditions inside integration 1) is statistically different from the market; and 2) not statistically different from relationships.

Figure 10: **Robustness to Relationship Definition**



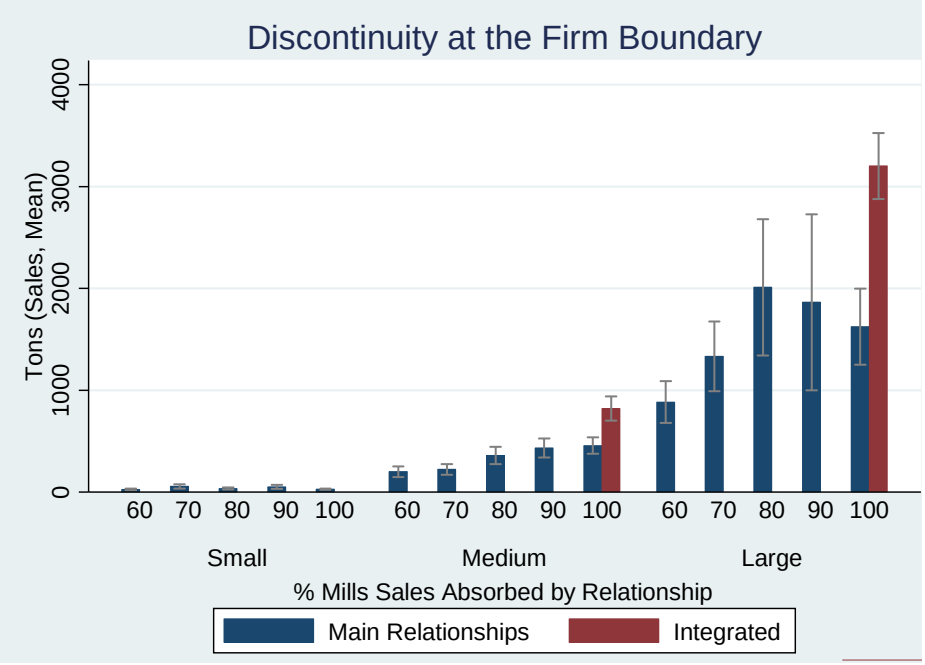

The figure shows that different definition of relationships give qualitatively identical results. The y-axis reports estimated coefficients (and 95% confidence intervals) for the interaction between marketing channels and weather conditions. The underlying estimated regrssions are like those in Column 1 of Table 7: the dependent variable is the % of coffee sold, the intensive and extensive margins are both considered, mill-channels and season fixed effects are controlled for. The x-axis reports the cut-off $r$ used to distinguish market and relationships: mill-buyer pairs that trade for more than $r$ consecutive season are defined to be in a relationship. The figure reports results from $r \in 0, 1, 2, ...7$.. The reference line at $r = 3$ is the baseline definition. As $r$ increases more transactions inside "relationships" are classified as market. The Figure illustrates that relationships build up and converge to integrated trade.

Figure 11: **Robustness to Relationship Definition**



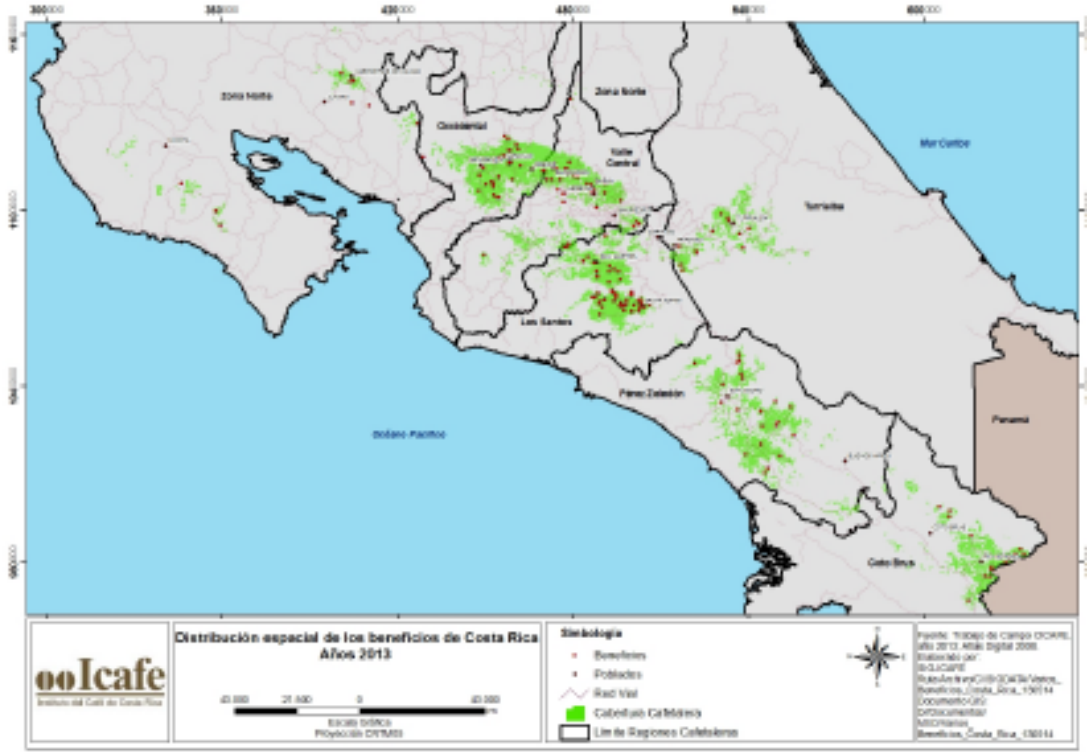

The figure shows that different definition of relationships give qualitatively identical results. The y-axis reports estimated coefficients (and 95% confidence intervals) for the interaction between positive price surprises and marketing channels. The underlying estimated regrssions are like those in Column 4 of Table 8. The x-axis reports the cut-off $r$ used to distinguish market and relationships: mill-buyer pairs that trade for more than $r$ consecutive season are defined to be in a relationship. The figure reports results from $r \in 0, 1, 2, ...7$.. The reference line at $r = 3$ is the baseline definition. As $r$ increases more transactions inside "relationships" are classified as market. Across all specifications the main results are confirmed: positive price surprises 1) are associated with contract default in the market; but 2) not inside integrated firms and 3) relationships "converge" to integration.

Figure 12: **Discontinuity at the Firm Boundary**



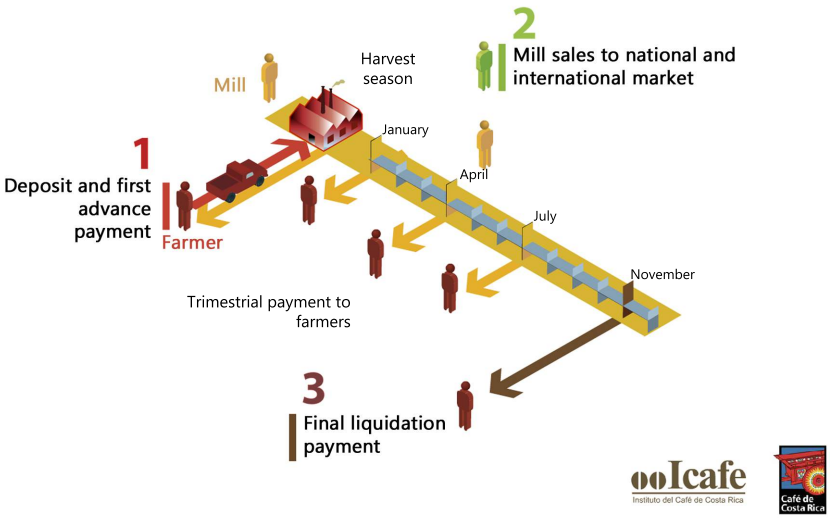

The Figure shows that integrated relationships trade higher volumes of coffee than (nearly) exclusive relationships for mills of comparable size. On the y-axis the Figure reports average (and confidence interval) volumes of coffee traded by different types of relationships in a given season. Relationships are classified according to i) size of the mill, and ii) degree of exclusivity. Mills are classified in three categories: small (1st quartile of size distribution), medium (2nd and 3rd quartiles) and large (4th quartile). All but one integrated mills are in the 4th quartile (one mill in the 3rd quartile). Only main relationships are considered. Main relationships are those that account for the largest share of sales for a mill in a given year. Main relationships are split by the share of a mill's sales their account (deciles at 60%, 70% ... 100%). All integrated relationships have exclusivity near 100%. The Figure shows that compared to (nearly) exclusive relationships of mills of comparable size integrated relationships trade higher volumes. The Figure excludes forward integrated mills.

**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**