THE UNIVERSITY OF WARWICK

Nov 2014 No.211

Tropical Lending: International Prices, Strategic Default and Credit Constraints among Coffee Washing Stations

Arthur Blouin and Rocco Macchiavello

WORKING PAPER SERIES

Centre for Competitive Advantage in the Global Economy

Department of Economics

CAGE Competitive Advantage in the Global Economy

E·S·R·C ECONOMIC & SOCIAL RESEARCH COUNCIL

Tropical Lending: International Prices, Strategic Default and Credit Constraints among Coffee Washing Stations

Arthur Blouin
Warwick

Rocco Macchiavello
Warwick, *BREAD* and *CEPR*

August 2013*

Abstract

We use detailed contract level data on a portfolio of 197 coffee washing stations in 18 countries to identify the sources and consequences of credit markets imperfections. Due to moral hazard, default rates increase following unanticipated increases in world coffee prices just before (but not just after) the maturity date of the contract. Strategic default is deterred by relationships with the lender and foreign buyers: the value of informal enforcement amounts to 50% of the value of the sale contract for repaying borrowers. A RDD shows that firms are credit constrained. Additional loans are used to increase input purchases from farmers rather than substituting other sources of credit. Prices paid to farmers increase implying the existence of contractual externalities along the supply chain.

Keywords: Credit Constraints, Commodity Prices, Relationships, Exports, Account Receivable.

JEL Codes:O12, O16, L14, F14, G32, Q13, Q14.

*First draft: comments welcome. We are grateful to Marcel Fafchamps, Daniel Paravisini, Cecilia Parlatore, Adriano Rampini and numerous people working at the institution that has shared the data used in this paper for helpful comments. Niclas Moneke provided outstanding research assistance. We also thank seminar and workshop participants in ESSFM Gerzensee, Gremaq, Manchester, IPA, Leicester, Oslo, Oxford, PSE, SSE, UPF and Warwick. We gratefully acknowledge IPA financial support.

1 Introduction

Developing countries are poorer largely because they are less efficient at allocating factors of production across different uses (see, e.g., Banerjee and Duflo (2005) and Hsieh and Klenow (2009)). Imperfections in the credit markets, in particular, are believed to be an important source of misallocation of capital both across sectors (see, e.g., Buera et al. (2011)) as well as across firms within sectors (see, e.g., Banerjee and Munshi (2004)). Consistently with this view, an active empirical literature has documented high and extremely heterogeneous returns to capital among microenterprises in a variety of contexts (see, e.g., De Mel et al. (2008, 2009), Fafchamps et al. (2011), Kremer et al. (2011), Karlan et al. (2012)).

To fully understand the role of credit market imperfections in constraining efficiency in developing countries and provide guidance to design appropriate policy responses, however, the existing evidence must be complemented in two important ways. First, sources of imperfections must be identified in specific settings (see, e.g., Paulson et al. (2006)).[1] Second, the relevance of credit constraints must be assessed among larger firms, where most capital is invested. Relative to the empirical literature discussed above, however, progress in both directions has been significantly more limited. Disentangling sources of credit market imperfections requires exogenous variation in incentives (see, e.g., Karlan and Zimman (2009)) while testing for credit constraints requires exogenous variation in capital (see, e.g., Banerjee and Duflo (2012)). Both sources of variation are rarely available to the econometrician, particularly since experimental approaches are impractical when studying large firms.

This paper contributes to our understanding of the sources and consequences of credit constraints among large firms in developing countries using coffee washing stations as a sector study. The paper exploits comprehensive data from an international lender on a portfolio of working capital loans to around two hundreds coffee washing stations in eighteen countries. Besides the richness of the data, the sector provides an ideal set-up to overcome the challenges highlighted above. First, the stark separation in the timing at which contracts are signed (pre-harvest), loans disbursed (during harvest) and sales realized (post harvest) can be combined with unanticipated fluctuations

[1] The theoretical literature on sources of credit market imperfection is vast. Stiglitz and Weiss (1981) is the classical reference on adverse selection. Holmstrom and Tirole (1997) and Burkart and Ellingsen (2004) emphasize ex-ante moral hazard in the form of private benefits (effort) and loan diversion respectively. Lacker and Weinberg (1989) and Ellingsen and Kristiansen (2011) emphasize ex-post moral hazard: due to costly monitoring and/or contract incompleteness borrowers strategically default on loan obligations. Besley (1995) and Ghosh et al. (2000) provide useful discussion in a development context.

in international coffee prices to test for, and distinguish, ex-ante and ex-post moral hazard. Second, knowledge of the relatively simple technology of coffee washing stations enables a transparent test for credit constraints. The test is based on a regression discontinuity design in which essentially identical loan applications end up with loans of different size.[2]

After describing the sector and the data sources, we present a simple theoretical framework of the lending model used by our lender to extend working capital loans to coffee washing stations. The lender provides working capital loans to coffee washing stations around the world based on a system of account receivables in which sales contracts with foreign buyers are used as collateral.[3] The model emphasizes limited contract enforcement and uncertainty over output prices, two salient features of the environment under consideration. The model shows that unanticipated ex-post increases in world prices increase the likelihood of default only if ex-post moral hazard, i.e., strategic default, is present. The associated incentive compatibility constraint clarifies how contract level data on loans and sales can be combined to quantify the value of informal enforcement.

The empirical analysis is divided in two parts. First, we investigate the determinants of loan default and find evidence of strategic default (ex-post moral hazard). Unanticipated increases in international coffee prices just before the loan maturity date significantly increase the likelihood of delayed payments and defaults. Consistently with the predictions of the model, price increases lead to defaults when the station has entered fixed price contracts with the foreign buyer and when there is no previous history with the lender. These results hold across a number of different specifications and samples, including an event-study methodology.

Given the evidence of ex-post moral hazard, we provide a simple calibration of the associated ex-post incentive compatibility constraint to assess the importance of informal enforcement, intended as the value of the relationship with the lender and foreign buyer. We derive lower (upper) bounds to the value of informal enforcement for repaying (defaulting) borrowers. We find this value to be large: it is at least (most) 54% (21%) of the value of sales for repaying (defaulting) borrowers on average.

Despite the lending arrangements put in place by our lender, evidence of strategic

[2] Besides the advantages from a research design point of view, the coffee sector is important in its own right. Coffee is produced by an estimated 30 milion farmers in more than thirty low income countries, for which is often one of the main sources of exports. The sector provides an ideal canvas to study aspects that are relevant in the financing of other export oriented sectors in developing countries (e.g., cotton, pineapple, vanilla, cocoa, cashew).

[3] The lender is well aware of the difficulties of extending loans to large firms based in rural areas of developing countries. See next section for details.

default implies that borrowers are likely to be credit constrained. The second part of the empirical section implements a regression discontinuity design to test for the presence of credit constraints. Discontinuity in the assignment of loan applications to a summary score category induces exogenous variation in loan size among otherwise identical loan applications. We find that stations use the additional funds to purchase more inputs from farmers rather than substituting other, potentially more expensive, sources of loans. We estimate mean returns to capital to be in the order of 32%, well above the interest rate charged by lenders (about 10%). These two pieces of evidence confirm that firms in the sample are severely credit constrained. We find that the relationship with the lender accounts for roughly a half of the value of informal enforcement. Furthermore, we also find evidence that larger loans lead to higher prices paid to farmers supplying the stations. This implies the existence of contractual externalities and a possibly sub-optimal level of integration along the value chain.

In sum, the study provides evidence on the sources (ex-post moral hazard) and consequences (credit constraints along the supply chain) of credit market imperfections among relatively large firms in developing countries. As further discussed below, the contractual practices adopted by our lender already mitigate sources of credit market imperfections, including those for which we find direct evidence. Therefore, our study identifies a lower bound to the cost of credit market imperfections. We discuss policy implications of all these findings in the concluding section.

Related Literature

This paper contributes to the literature on credit markets and firms in developing countries. The most closely related contribution is Banerjee and Duflo (2012) who exploit records from an Indian bank and natural experiments induced by changes in priority-lending regulations to identify credit constraints. The regression discontinuity design test for credit constraints in our paper is similar in spirit to their approach. However, in this paper we also identify sources of credit market imperfections and quantify the value of informal enforcement.[4]

The setting of our study brings this paper close to an emerging literature on the financing of export transactions (see, e.g., Paravisini et al. (2011) and Manova (2013)). The most closely related work is Antras and Foley (2012) who study contractual credit terms between a large exporter of frozen food and foreign distributors. Banerjee and

[4]The literature on testing for asymmetric information has been mostly developed in the context of insurance markets (see, e.g., Chiappori and Salanié (2002) for an early review). In the context of credit markets, Karlan and Zimman (2010) provide an experimental study of personal loans in South Africa while Adams et al. (2009) study the subprime lending in the U.S.

Duflo (2000), Macchiavello (2010) and Macchiavello and Morjaria (2012) also study contractual relationships in export markets and emphasize the importance of reputation and informal enforcement in a variety of different contexts. In contrast to these papers, we simultaneously consider relationships with both buyers and lenders and document contractual externalities along the value chain.[5,6]

The rest of the paper is organized as follows. Section 2 describes the coffee industry, its contractual practices, and the data. Section 3 introduces the model and derives testable predictions. Section 4 presents the empirical results. Sections 5 discusses policy implications. Finally, Section 6 offers some concluding remarks. Proofs, additional results and further information on the data are relegated to the Appendix.

2 Background

Coffee Washing Stations

The coffee cherry is the fruit of the coffee plant. The cherries are ripe when they change color from green to red, at which point they should be harvested. The harvest season typically lasts for three to four months. The timing of the harvest season varies by country and, within country, by region depending on altitude, soil and rainfall patterns. Most coffee-growing countries have only one major harvest a year. In most countries, the coffee cherries are picked by hand, a labor-intensive and difficult process.

The pulp of the coffee cherry is removed leaving the seed or bean which is then dried to obtain parchment coffee. There are essentially two processing methods to obtain parchment coffee: the dry method and the washed method. The dry method, also known as unwashed or natural, has the entire cherry first cleaned and then placed in the sun to dry on tables. This process is done by farmers. In the washed method, instead, farmers bring coffee cherries immediately after harvest to a washing station, the firms that are the objects of our study. The washed method requires specific equipment and substantial quantities of water. After the cherry skin and some of the pulp are removed with a pressing machine, cherries are then sorted by immersion in water. The bean is

[5] The corporate finance literature has studied several aspects that characterize our environment. For example, Klapper (2006) examines factoring while Klapper et al. (2012) examine a large sample of trade credit contracts. The paper is also related to a literature on the relationship between risk management and credit constraints. Rampini et al. (2012), for example, provide an empirical analysis for the case of airlines.

[6] Dragusano and Nunn (2013) study the impact of fair trade certification in the Costa Rica coffee sector. De Janvry et al. (2010) provide a theoretical and empirical analysis of fair trade certification using data from a secondary cooperative in Guatemala. Advaryu et al. (2013) examine the impact of international price fluctuations on farm activity in Tanzania. Casaburi and Reed (2013) study price pass-through with an experiment in the Sierra Leone cocoa sector.

then left to ferment, typically for around 30 hours, to remove the remaining skin. The fermentation process has to be carefully monitored to ensure that the coffee doesn't acquire undesirable, sour flavors. When the fermentation is complete, the coffee is thoroughly washed with clean water in tanks or in special washing machines. The beans are then dried in the sun (and sometime with the further help of machines). Coffee dried in the sun is spread out in rows on large tables or on patios where it is frequently turned by hand or raked. Drying coffee on tables improves quality but increases cost and labor significantly. After the drying process the parchment skin is easily removed in the hulling process. Essentially all coffee is hulled before shipment.

The method used to process the cherries has a significant effect on the flavor of coffee once roasted and brewed. The wet method delivers higher consistency and quality which is reflected in prices. Data from Rwanda available to the authors, for example, reveal that washed coffee is sold at two and half to three times higher price than dry coffee both as parchment in the domestic market and as green coffee at the export stage.

Despite having seasonal activities tied to the coffee harvest season, coffee washing stations are large firms by developing country standards. In our sample, stations average over 2.4 million dollars a year in sales, hold almost 1.4 million in total assets (see Table 1) and receive an average loan size of around 345,000 dollars from our lender.[7]

An important aspect of our environment is the relatively simple, and known, relationship between input and output. The quantity of output (parchment coffee) is a constant share, ranging between one fifth and one seventh, of the quantity of input (coffee cherries). That is, within the capacity limits imposed by the fixed assets invested in the station (e.g., the pulping machine, drying tables), there is a constant return relationship between coffee input and output. Disbursement to purchase coffee cherries from the farmers during the harvest season are, by far, the largest source of variable costs. These, generally, account for sixty to seventy percent of the overall costs. Other costs include labour, transport, electricity, marketing and, of course, costs of finance. Large volumes of working capital need to be mobilized over short periods of time in environments characterized by institutional underdevelopment. Furthermore, the environment is characterized by significant uncertainty, particularly with respect to fluctuations in international prices.

[7] By comparison, the firms in the sample in Banerjee and Duflo (2012) average 140,000$ in sales and 17,000$ in loan amout.

Contractual Practices I: Loans

We obtained access to the internal records of an international lender specialized in providing working capital loans to coffee washing stations. The data cover all loans ever disbursed by the lender over a period of twelve years for a total of 756 loans, of which 669 are for working capital. The one hundred ninety seven coffee washing stations are located in eighteen countries, with Peru, Mexico, Nicaragua, Rwanda and Guatemala accounting for the majority of loans.

The lender is highly aware of the difficulties in extending working capital finance to large, seasonal, business operating in rural areas of developing countries, often characterized by a relatively poor institutional environment. Consequently, the lending model is explicitly designed to cope with issues of adverse selection and moral hazard. In particular, our lender utilizes a comprehensive scoring system to rate loan applications and decide the size of the loan disbursed. The lender also disburses loans progressively and actively monitors the use of the loans. More importantly, from the point of view of the research design, lending is based on account receivables as explained in detail below.

The borrowers in the sample mostly supply the coffee specialty market. In this segment, coffee washing stations supply coffee directly to foreign buyers (which might be roasters or traders) with whom they develop informal relationships. The lending model, which is based on an account receivable system, is structured as follows. First, before the harvest begins the buyer signs a contract, or a letter of intent, with the station for the delivery of a certain amount of coffee of pre-specified quality at a later date. The lender, who has a relationship with the buyers, then advances a share of the value of the contract with the buyer to the station. The share depends on a scoring system. The scoring systems aggregates continuos sub-scores based on a large number of station and loan characteristics into discrete categories (B, A, AA). The share extended to the station typically varies between 40% and 70% of the value of the contract with the buyer. Upon delivery of the coffee, the foreign buyer notifies the lender which is then repaid (typically directly by the buyer).

This lending system is not unusual.[8] The arrangement used by our lender is essentially identical to invoice discounting in which the receivable is used as collateral

[8] Bank loans secured by accounts receivable are the primary source of SME financing for working capital in the US. Demirguc-Kunt and Maksimovic (2001) note that credit between buyers and suppliers is relatively more prevalent in countries with weak legal environments and we, therefore, conjecture that account receivables (or similar contractual arrangements) are an extremely common source of finance for SMEs in developing countries.

for the loan.[9] Because the credit provided by the lender is explicitly linked on a formula basis to the value of a supplier's accounts receivable (in addition to the supplier's overall creditworthiness), the system allows relatively high-risk exporters in developing countries to borrow against the value of their contracts with high-quality buyers in developed importing countries. By establishing direct contractual relationships with the buyers, our lender ensures that the loan is repaid if the coffee is delivered to the buyer. In other words, in order to default on the loan, the station also has to default on the sale contract with the foreign buyer. While formal enforceable contracts are typically not used, the loss in reputation and future sales from the buyer is a powerful deterrent towards this type of default.[10]

Contractual Practices II: Sale Contracts

Given the lending arrangement used by our lender, it is important to describe the basic incentives associated with sales contracts. The international trade in coffee is based upon a number of standard contractual forms. The two most frequently used are those issued by the European Coffee Federation (ECF) and by the Green Coffee Association (GCA) in the United States. The basic conditions of sale are easily covered by stipulating the applicable standard form. Parties fill the standard form with the remaining important details of the individual transaction (quantity, quality, price, ...). From the point of view of our research design, the key distinction is between trade at fixed (or 'outright') price versus trade at a 'differential' (or 'price to be fixed' (PTBF)).

Before active futures markets came into being coffee was bought and sold at fixed prices, meaning purchase and sale contracts would show a simple amount per pound or per ton. Fixed price contracts expose parties to significant price (and counterpart) risk. An importer who buys coffee that has not already been sold (bought long) hopes that the price will stay the same or go up. An exporter who sells coffee that has not already been bought (sold short) hopes that the price stays the same or goes down.

With the development of future markets coffee has increasingly been bought and sold on a 'differential basis' (or PTBF contract). In this type of sale, the seller (buyer)

[9] Invoice discounting is similar, but different from, factoring. The key distinction is that in factoring a business *sells* its accounts receivable to a third party (called the factor). The factor provides financing in the form of a cash advance (often 70-80% of the purchase price of the accounts), with the balance of the purchase price paid, net of the factor's fee and other charges, upon collection from the account client. Around the world, factoring is a growing source of external financing for small and medium-size enterprises (SMEs) (Klapper 2006).

[10] It is common practice for exporters of agricultural commodities in developing countries to enter into pre-financing arrangements with importers (see, e.g., Larson and Varangis (2006)). For example, survey data available to the authors reveal that loans from large domestic exporters represent the only source of working capital finance for 40% of Rwandese coffee washing stations (see, Macchiavello and Morjaria (2013) for details).

commits to deliver (take) a certain amount of coffee not at a fixed price but at a difference to a basis price. Theoretically the basis price can be any published price in the coffee business but, in practice, almost all differential contracts are signed against futures markets (i.e., Robusta coffee is traded against the London LIFFE Contract while Arabica coffee, the object of this study, is traded against the New York ICE 'C' Contract). The main advantage of future markets is their liquidity which allows prices to be fixed anytime these markets are open for trading. Trading on a 'differential' basis changes price risk from 'outright' price to 'differential' price risk. Although 'differential' price risk is inherently lower, it is important to note that PTBF contract does not eliminate price risk.[11]

An important aspect of the PTBF contract is the date at which the buyer and seller can fix their respective prices. In the context of our analysis, which focuses on direct exports from coffee washing stations to foreign buyers without the intermediation of traders, exporters typically do not have access to future markets. As a result, the PTBF contracts tend to stipulate a 'seller's call clause according to which the seller calls the date at which the price ought to be fixed. In principle, this allows the exporter to achieve grater insurance by fixing the price shortly after the purchase of the coffee cherries necessary to fulfill the sale contract.[12]

Descriptive Characteristics: Firms, Loan and Sale Contracts

The loans data begins in 2000 and ends in 2012, totalling 753 loans from 197 clients. The lender decides on loan terms using a scoring system. Scores are assigned to multiple sub-groups, which are aggregated into category scores, which themselves are aggregated into overall numerical scores which is the basis for the assignment of a letter score (B, A, AA). The lender has disaggregated score data starting late 2008. Prior to 2008 the numerical score data was calculated and used in the same way, but not stored systematically. As a result, there are 291 loans for which disaggregated score data exists.

Whenever a loan is given the lender assembles income sheet and balance sheet data for the client for the previous three years. From this data we constructed a panel of financial information at the station level which yields 657 station-year observations.

[11] The Coffee Export's Guide published by the International Trade Centre, for example, describes how in 2010 some Colombian coffees which had been trading at around ICE 'C' plus 15 cts/lb, went up to ICE 'C' plus 80 cts/lb. Differential price risk is relatively stronger in the specialty coffee segment of the market, where differentials are fine tuned to relatively narrower origins with less liquid markets.

[12] Stations can, however, misuse and attempt speculation by either i) fixing PTBF contracts without actually having bought the physical coffee, or ii) delaying fixing until long after the physical coffee was bought hoping for a price recovery.

The panel includes the three years prior to the closing year for all loans. For clients that received loans in later years it includes financial information for a number of years after the loan was dispersed, depending on whether the client signs loan agreements with the lender in subsequent years.

Table 1 displays descriptive statistics for both the loan level data and the client-loan panel. The average loan in the sample is just over 340,000 USD, while the average interest rate is about 9.8%, ranging from 7% to 18%. About 30% of loans in the sample are repeat clients, and default rates are low. On average only 3% of loans are written off, while about 6% are either written off, restructured or significantly late with payment. The world coffee price increased over the majority of the sample period. The price rose from about 165 USD in late 2004 to about 340 USD in late 2009. The price reaches a high of 636.54 USD in late 2011 and declines slightly in 2012. On average the price in our sample period was just under 350 USD and increased by nearly 14% over the life of the average contract.

Firms in our sample are very large by developing countries standards. Mean total assets are over 1.5 million USD, however median total assets are about half of that, so we have a few extremely large firms in the sample. Most firms receiving loans from our lenders have other loans from either other financial institutions or buyers. Income is high, over 2.5 million, but cost of goods sold is about 85% of total income. Firms employ about 135 people in a year on average, nearly three quarters of which are seasonal employees.

3 Theory

3.1 Set Up

We consider the relationship between a coffee washing station (station), a lender and a foreign buyer modeled to capture the most salient features of our environment. The station has capacity to process, and produce, Q units of coffee. We denote with q^c the quantity that the station commits to deliver to the buyer. The price, p^c, is discussed later. We assume that the only source of cost for the station is the purchase of cherries from the farmers. The price of cherries is denoted p_0 and is fixed and known to all parties. For simplicity, we set the risk-free interest rate to zero and denote by L the amount lent to the station and by D the amount the station commits to repay. The station is subject to limited liability, i.e., at all dates the payoff of the station must be positive. A delivery failure imposes an arbitrarily high penalty K on the buyer.

The timing of the game is as follows:

1. The buyer and the station agree on the sale contract: $q^c \leq Q$ and the price (to be specified later). We assume that the buyer has all the ex-ante bargaining power and makes a take-it-or-leave it offer to the station. If the station rejects the offer, the station can still produce using internal funds I and sell in the market as described below.

2. The station then negotiates the loan terms (L and D) with the lender. The station now has all the bargaining power and the lender is subject to a zero profit constraint.

3. The loan is disbursed and the station decides whether to divert the loan, or use it to purchase the cherries necessary to fulfill the sale contract.

4. Fourth, the price in the international market, p, is realized. The price in the market at the time of sale is drawn from a continuos distribution $F(p)$, with $\overline{p} = \mathbf{E}[p|p_0] = \int_0^\infty p dF(p)$.

5. The station decides whether to execute the sale and repay the loan or whether to search for an alternative buyer who pays price $p' = p$ and avoid repayment. Conditional on search, an alternative buyer is found with probability μ. If a buyer is not found, the firm can still sell to the original buyer and repay the loan with a delay.

3.2 Benchmark: First Best

We consider first the case in which all contracts are perfectly enforceable. Without loss of generality, let's focus on a fixed price contract p^c and solve the game backward. The realization of the price p has no effect on the execution of the sale.[13] Assuming the station has been able to finance the production of a quantity $Q^p \leq Q$, the revenues of the station are given by

$$\Pi\left(q^c, p^c, p\right) = \begin{cases} q^c p^c + p\left(Q^p - q^c\right) & \text{w.p. } \mu \\ q^c p^c & \text{w.p. } (1-\mu) \end{cases}. \tag{1}$$

[13] The costs incurred by the buyer for a delivery failure, K, are assumed to be larger than $\mu q^c \left(p - p^c\right)$, the expected gains of searching for an alternative buyer.

In either case, the station repays the amount D to the lender, or the entire value of the sales if this is lower. For the lender to make zero profits in expected terms, we must have

$$L \leq q^c p^c + \mu \left(Q^p - q^c\right) \overline{p}. \tag{2}$$

Given a contract q^c and p^c and internal funds I we also have

$$I + L \geq p_0 Q^p. \tag{3}$$

The station borrows to produce at full capacity if

$$\mu \overline{p} \geq p_0 \tag{4}$$

which we assume to be the case. The station, therefore, borrows $L = p_0 Q - I$. At time of contracting with the buyer, therefore, the station's outside option is given by

$$u^0 = \left(\mu \overline{p} - p_0\right) Q.$$

In order for the buyer to enter any contract, it must be that its willingness to pay, $v\left(q^c\right)$, is higher than $\mu \overline{p}$ for at least some quantity q^c. To simplify, we assume that $v\left(Q\right) \geq \mu \overline{p}$ and hence $p^c = \mu \overline{p}$ and $q^c = Q$.

3.3 Fixed Price Contract

When contracts are not enforceable, incentive compatibility considerations must be taken into account. We begin by considering the case in which a fixed price contract has been signed and, again, solve the game backward. We focus on the case in which the amount lent by the lender is lower than the face value of the contract with the buyer, i.e., $q^c p^c \geq D$. Upon observing the realized value of p, the station repays without further delays if

$$q^c p^c - D + \mu p \left(Q^p - q^c\right) + \delta \mathbf{V} \geq \mu \left[p Q^p + \delta \mathbf{U}^D\right] + \left(1 - \mu\right) \left[q^c p^c - D + \delta \mathbf{U}^L\right] \tag{5}$$

where $\mathbf{V}$ is the discounted value of future expected profits when continuing the relationship with the buyer *and* the lender, $\mathbf{U}^D$ is the discounted value of future expected profits following a default and $\mathbf{U}^L$ is the discounted value of future expected profits when paying late. We assume $\mathbf{U}^D = \mathbf{U}$ and $\mathbf{U}^L = \sigma \mathbf{V} + \left(1 - \sigma\right) \mathbf{U}$ where σ is the probability the loan is renewed following a late payment. The second assumption im-

plies that *i*) the continuation value following a late payment only depends on whether the loan is renewed or not and *ii*) conditional on no future loan, the continuation value does not depend on loan default. We leave **V** and **U** unmodeled. The incentive compatibility constraint can be rewritten as

$$\delta\left(\mathbf{V}-\mathbf{U}\right) \geq \left(\frac{\mu}{1-\sigma\left(1-\mu\right)}\right) \times \left(D+\left(p-p^{c}\right)q^{c}\right). \tag{6}$$

The station decides to search for an alternative buyer and default for *i*) lower value of the relationship with the buyer and lender, *ii*) higher values of debt D, and *iii*) higher value of the realized market price p. This positive dependence of the likelihood of default on ex-post market price realization provides the test for strategic default.[14] The probability of a default, therefore, is given by

$$\Phi^{d}\left(D,p^{c},q^{c}\right)=\mathbf{P}(p\geq p^{d})=\mu\left(1-F\left(\frac{\delta\left(\mathbf{V}-\mathbf{U}\right)-D+p^{c}q^{c}}{\mu q^{c}}\right)\right) \tag{7}$$

Loan diversion is easier to be deterred for *i*) lower debt levels D, *ii*) higher prices paid by the buyer p^{c}, and *iii*) higher values of expected future prices $\overline{p}$ (since $Q^{p}\geq q^{c}$ by definition).[15]

3.4 Summary of Predictions

The main implications we bring to the data are:

Test 1: [**Ex-ante Moral Hazard**] *Sudden increases in expected future prices at the time of contracting reduce the likelihood of default;*

Test 2: [**Ex-post Moral Hazard**] *In the presence of strategic default, sufficiently large unanticipated increases in ex-post world prices lead to higher likelihood of default;*

Test 3: [**Informal Enforcement**] *Data on the face value of debt D, sale contracts p^{c} and q^{c} and world prices μ can be used to recover lower (upper) bounds to the value of the relationship $\delta\left(\mathbf{V}-\mathbf{U}\right)$ for repaying (defaulting) borrowers using (6).*

[14] To examine the dependence of the likelihood of default on q^{c} we need to consider that D also depends on q^{c}.

[15] The contract must also satisfy the ex-ante incentive compatibility constraint: the station must prefer to invest the borrowed amount rather than diverting the loan. It is easy to show that sudden increases in the expectation of future prices immediately after contracting time increase the incentive to use the loan to produce.

4 Empirical Results

The empirical section is divided into two parts. The first section exploits the impact of international coffee price movements to test for the presence of moral hazard. The section mainly focuses on ex-post moral hazard, i.e., strategic default, and provides a simple calibration of the ex-post incentive compatibility constraint (6) to bound the value of informal enforcement in this market. The second section implements a regression discontinuity design to test for the presence of credit constraints.

4.1 Strategic Default

Cash Flows and Contract Timing

The typical cash flow profile for a station during a year is illustrated in Figure 1 (using the case of Rwanda as an example). Sales and loan contracts are typically negotiated and signed around the beginning of the harvest season (in the Rwanda case, around March). The loan is then disbursed, possibly in multiple installments, to cover the costs of purchasing cherries from the farmers. During the harvest season, stations buy cherries from farmers and process them. The contract typically matures after the end of the harvest season (i.e., after July).

An important advantage of the setting is that the timing of the harvest season is not synchronized across countries (and, to some extent, even across regions within countries). For example, most contracts in Peru (which represents 34% of the loans in the sample) are closed in the period May to June while in Nicaragua (which accounts for 11% of the loans in the sample) most contracts are closed in October to December. In Rwanda (which accounts for 8% of the loans in the sample) most contracts are closed around March to April. Figure 2 shows seasonality patterns in the closing and maturity dates of loan contracts in the sample. The closing date (blue lines) refers to the month in which the loan contract is signed. The maturity date (red line) refers to the date at which the loan is supposed to be repaid (which typically falls at or close to the delivery date in the sale contracts). The Figure illustrates the bimodal distribution of both closing and maturity dates with two peaks in each distribution driven by asynchronous coffee harvest seasons across countries. Variation in the timing of the harvest seasons and, therefore, of closing and maturity dates across countries allows us to control for time fixed effects in a flexible way in all the empirical specifications.

Baseline Test for Strategic Default

Figure 3 presents a graphical approach to test for the presence of ex-post moral hazard. Recall that the key test for strategic default is that unanticipated increases in the world price of coffee before the maturity date increase the likelihood of default. A distinctive advantage of the set up is given by the presence of liquid future markets. Futures prices quoted at the time of the closing date for the maturity date provides an unusually good proxy for parties expectations of future prices. Figure 3 shows the relationship between unanticipated increases in international coffee prices and loan defaults. The red line shows the distribution of the ratio of New York 'C' Arabica coffee price at the maturity date divided by the future price for delivery closest to the maturity date at the time the contract was closed. This is the ratio of the realized price, p, over the expected price, $\overline{p}$. During the sample periods international coffee prices have tended to increase, i.e., relatively more contracts have ratios above one. The blue line plots the density of loan defaults conditional on a given price ratio. Consistently with the presence of ex-post moral hazard, defaults are disproportionately concentrated among contracts that have witnessed sharp unanticipated price increases.

A possible objection to Figure 3 is that managers of coffee washing stations in developing countries might not form expectations based on futures market prices. Figure 4 repeats the exercise proxing unanticipated price increases as the ratio of prices at maturity over price at closing, normalized by the same ratio over the same period a year earlier. The results of the test are qualitatively very robust to this alternative formulation.

Table 2 provides an econometric investigation of the strategic default test. The econometric investigation allows us to control for a number of factors that might be driving the patterns identified in Figure 3. Specifically, Table 2 reports results from the specification

$$\Phi^d_{lst} = \alpha_0 + \alpha_1 p_{lst} + \alpha_2 \overline{p}_{lst} + \beta Z_{ls} + \mu_t + \varepsilon_{lst} \tag{8}$$

where Φ^d_{lst} is a dummy taking value equal to one if station s defaults on loan l closed at time t.[16] The main regressor of interest is p_{lst}, the realized price at the loan maturity date. To control for expectations about future prices, the specification includes $\overline{p}_{lst}$, the futures price quoted at closing for the maturity date, as a control.[17] Furthermore, we include an extensive vector of station and loan controls Z_{ls} as well as time of closing

[16] A loan is in default if it is written-off, restructured or has no payments after ninety days from its maturity dates. Alternative definitions of default yields qualitatively similar results.

[17] Specifications in which the ratio $p_{lst}/\overline{p}_{lst}$ is considered, as in Figure 3, yields identical results.

fixed effects μ_t (ε_{lst} is an error term).[18]

Table 2 reports results from different specifications. Column 1 presents OLS estimates on the full sample. The estimates show that an unanticipated ten percent increase in the world coffee price over the life of the contract is associated with a 1% increase in the default rate. Column 2 shows the same specification, but presents the probit estimates instead of the linear probability model in Column 1 and obtains qualitatively similar results. Column 3 restricts the sample to the later loans where we have data on both numerical and letter scores. Columns 4 and 5 show the same results with varying levels of controls to analyze the sensitivity of the results to various specifications. The point estimates are extremely robust across a variety of samples and specifications.

Strategic Default: an Event Study Approach

The average upward trend in world coffee prices during the sample period potentially poses a threat to the results in Table 2: loans with longer maturity might witness larger price increases and also have a higher propensity to default for reasons unrelated to strategic default.[19] On the other hand, the linear specifications in (8), might underestimate the importance of strategic default: while world price increases may increase default through ex-post moral hazard, decreases in prices might also increase default simply by limiting borrower's ability to repay the loan.

To overcome these concerns, we implement an 'event study'. The event study takes the largest 25 monthly price increases during the sample period, to examine strategic default. We compare default rates of contracts maturing just before a large price increase (when there is no opportunity for default in response to the shock) with default rates of contracts maturing just after a large price increase (when firms do have an opportunity to respond to the shock).

Table 3 presents the results of simple t-test comparisons in average default rates in the two samples of contracts. The table investigates specifications that vary with respect to the definition of default as well as with respect to the length of the time window considered for the event study. In all specifications, we find results consistent with strategic default and that are both qualitatively and quantitatively consistent with the OLS estimates in Table 2. Contracts that mature in the month after a large

[18] Controls in Z_{ls} are country fixed effects, a measure of the history of the relationship between the lender and station, and letter scores fixed effects interacted with all other controls.

[19] Since we include closing dates fixed effects, the available variation doesn't allow to flexibly control for the lenght of the loan and, at the same time, identify strategic default out of realized prices at maturity dates. This problem is similar to the well-known fact that it is not possible to flexibly identify cohort, time and age effects (see, e.g., Deaton (1997)).

price increase are 4.8%-6.3% more likely to default. Relative to the price change in the same month the year prior, the average price change is about 10%. So the appropriate interpretation of the t-test is that a price increase of 10% beyond expectations increases default by about 5% on average.

Table 4 checks the robustness of the result in Table 3 using an RD specification (see Figure A1 for the corresponding graph). The RD specification is almost the same methodology as the t-test but it controls for anything else which may vary continuously between the before and after groups. Indeed in table 4 the results are very similar to the results in table 3, ranging from about 3.8% to 9.8% for the same set of price increases. This specification also lends itself naturally to testing robustness to different bandwidths, and varying the bandwidth does little to change the estimates. As a baseline estimate we use the optimal bandwidth as described by Kalyanaraman (2012) and test robustness using 75% and 125% of this bandwidth.

Heterogeneity: Relationship's History and Contract Types

The results presented are consistent with ex-post moral hazard being an important determinant of default rates. To further investigate the logic behind strategic defaults, Table 5 explores heterogeneity in the relationship between unanticipated price increases and defaults along the lines suggested by the ex-post incentive constraints (6). Table 5 also reports results from nonparametric regression discontinuity design specifications, focusing at the discontinuity in the interaction between the distance to a large price increase and the heterogeneity dimension of interest. Each specification controls for both the price increase and the heterogeneity variable separately.

Column 1 focuses on the role played by the history of the relationships between the lender and the borrower, as a proxy for $\delta(\mathbf{V}-\mathbf{U})$. Although the model has left unspecified the determinants of continuation values $\mathbf{V}$ and $\mathbf{U}$, it is plausible that the value of the relationship increases in the age of the relationship between the borrowers and the lender.[20] The value of the relationship is likely to be increasing with the age of the relationship for two reasons. First, there are selection effects: relationships with higher value are, everything else equal, more likely to survive. Second, there might be learning effects. During the course of the relationship the lender acquires information about the borrower and, conditional on relationship survival, offers better loan terms. We proxy the age of the relationship in a rather crude way, using a dummy for whether parties have had a previous loan or not. The results confirm the intuition

[20] See Macchiavello and Morjaria (2012) for a detailed empirical exploration of this idea in the context of Kenya rose exports.

of the incentive compatibility constraint and underscore the importance of informal enforcement: stations are about 7.5% more likely to engage in strategic default when given the opportunity if no prior relationship exists with the lender.

Column 2 focuses on heterogeneity with respect to the type of contract. Although 'differential' contracts do not completely eliminate price risk, the theoretical section highlighted how fixed price contracts are significantly more vulnerable to strategic default. The results confirm that strategic default appears to be significantly more relevant in the sample of loans based on fixed price sale contracts.[21,22]

The Value of Relationships: A Quantitative Exploration of IC Constraints

The evidence reported above is consistent with the logic of the ex-post incentive compatibility constraint (6). We now use the incentive compatibility constraint to get a measure of the value of the relationship with the lender and the buyer, $\delta(\mathbf{V}-\mathbf{U})$, for each station in the sample. There are two aspects that are worthy of note. First, the right hand side of the incentive constraint (6) depends on the face value of debt, D, the sale contracts q^c and p^c, and the likelihood of finding an alternative buyer, μ. All of these variables are (directly) observable in the data. Second, in the data we observe both loan repayments as well as defaults. This implies that we can compute lower (upper) bounds to the value of the relationship for repaying (defaulting) borrowers alike.

To take full advantage of the data, we slightly extend the logic of the incentive compatibility constraint (6). Upon observing the realization of the world price p, the station has two options: *i*) to repay the loan, or *ii*) to search for a new buyer. In the second case, if the station finds a new buyer, there is default. Otherwise, we assume that the station repays the loan with a three months delay. Furthermore, the data reveal that not all relationships are continued, even conditional on loan repayment. Denote by ρ^R the probability to obtain a loan in the following season conditional on repayment and let $\mathbf{U}^R$ be the net present value of future profits conditional on repayment but not having the loan renewed. With the new formulation, the payoff

[21] The sale contract type is endogenous implying that results could be driven by selection. For example, "worse" borrower are both more likely to default and to have a higher demand for insurance (and end up with a fixed price contract). On the other hand, buyers aware of counterpart risk might be willing to award fixed price contracts only to "good" exporters which are less likely to default. If this is the case, our results are downward biased. Some preliminary evidence suggest the latter hypothesis to be more consistent with the data.

[22] It is worth noting that, due to the difficulties in coding sales contract types, this last result is very preliminary. First, it is performed on a limited sample of loan contracts. Second, measurement error is induced by having coded contracts very conservatively attributing a fixed price rather than a variable price when in doubt. We are in the process of re-coding sale contracts.

from repaying the loan is given by

$$\Pi^R(\rho^R) = p^c q^c - D + \delta \left(\rho^R \mathbf{V}^R + (1-\rho^R)\mathbf{U}^R\right). \tag{9}$$

The lender informally punishes default by limiting the probability of future loans after default. Denoting with ρ^L the probability of a loan renewal following a late payment, we can express the payoff associated with searching for an alternative buyer as

$$\Pi^S = \mu\Pi^D + (1-\mu)\Pi^R\left(\rho^L\right) \tag{10}$$

where Π^D is the payoff following default and $\Pi^R(\rho^L)$ is the payoff following a late repayment. Note that the formulation implicitly assumes that the continuation values following a repayment, $\mathbf{V}^R$ and $\mathbf{U}^R$, do not depend on whether the loan was repaid or not (i.e., all punishments come from a lower probability of loan renewal). Denoting with ρ^L the probability of a loan renewal following a default, the payoff associated with default is given by

$$\Pi^D = pq^c + \delta(\rho^D \mathbf{V}^D + (1-\rho^D)\mathbf{U}^D). \tag{11}$$

Table A2 reports estimates for the probability of loan renewal conditional on timely repayment, ρ^R, late repayment, ρ^L, and default, ρ^D.[23] The data suggest that $\rho^R \simeq 2/3$, $\rho^L \simeq 1/3$ and $\rho^D = 0$. Moreover, an estimate for μ, the probability of finding a buyer, is given by the proportion of defaults conditional on stations paying late or defaulting. The data give an estimate of $\mu \simeq 1/2$.

We assume $\mathbf{U}^0 = \mathbf{U}^D$, i.e., the continuation value conditional on the loan not being renewed does not depend on whether the loan was defaulted upon or not.[24] Recall that the value of the loan is a certain proportion, denoted λ, of the value of the contract. As an approximation, we have $D = \lambda \times q^c p^c \times (1+r)$, where r is the interest rate on the loan.[25]

[23] The table shows decreasing punishments for decreasing severity of default. Clients that have contracts written off or restructured are about 70% less likely to receive a future loan from the lender. Loans that are written off, restructured or no payment is made for 90 days after maturity are 35% less likely to receive a loan in the future from the lender, while loans written off, restructured or no payment is made for only 30 days after maturity are only 26% less likely to receive a future loan from the lender.

[24] This is a strong assumption. Unfortunately, given the nature of our data we do not observe what happens to borrowers to which loans are not renewed. Note, however, that the relationship between $\mathbf{U}^0$ and $\mathbf{U}^D$ is ambigous. If there are reputational losses associated with default, $\mathbf{U}^D < \mathbf{U}^0$. On the other hand, by defaulting, the borrower obtains higher current period monetary payoff which can help relaxing financial constraints in the next period. In this case, $\mathbf{U}^D > \mathbf{U}^0$.

[25] For loans in earlier years we do not observe λ. To maximize sample size and consistency, we proxy λ using the theoretical assignment based on the letter score, i.e., λ takes value equal to 0.4 for score

Substituting the values into the incentive constraints and normalizing the bound by the nominal value of the sale contract, $q^c p^c$, we obtain, after some manipulation, the following representation of the incentive compatibility constraint for a particular loan 'i'

$$\frac{\delta\left(\mathbf{V}^R - \mathbf{U}^R\right)}{q_i^c p_i^c} \geq \left(\frac{p_i}{p_i^c} - (1 - \lambda_i(1 + r_i))\right). \tag{12}$$

Figure 5 plots the distribution of the right hand side of (12) for both repaying and defaulting loans. Two aspects are worth of attention. First, the Figure clearly shows that the estimated (lower bound to the) value of the relationship for repaying borrowers is significantly larger than the estimated (upper bound to the) value of the relationship for defaulting borrowers: informal enforcement is an effective mechanism to deter strategic default. Second, we find the value of informal enforcement associated with the lending arrangement to be very high. On average, it amounts to 54% of the nominal value of the sale contract for which the loan is given on the sample of repaying borrowers. In other words, borrowers forego monetary gains worth a half of the sale contract to preserve a good relationship with the buyer and the lender. Conversely, defaulting borrowers must be given an additional gain worth at least 20% of the sale contract in order to trigger a default.

Are these estimate large or small? To answer this question we need a benchmark. If rents necessary to sustain these relationships are dissipated through ex-ante competition then these estimates can be compared to estimates of the fixed costs of exports. More closely to our set up, Macchiavello and Morjaria (2012) apply a similar methodology to estimate the value of informal relationships with foreign buyers in the context of Kenya rose exports. Macchiavello and Morjaria (2012) quantify the value of the relationship for Kenya rose exporters with foreign buyers to be at least 10% of sales in the relationship. In the next Section we document that borrowers are credit constrained and make relatively large profits from the loans disbursed by the lender. Taken together, these facts suggest that maintaining a good relationship with the lender, not just the buyer, is an important aspect of informal enforcement in this market.

Suppose we agree these are large numbers. What do they mean? Broadly speaking, if we think of commercial relationships as assets, all relationships with positive net present value should take place. Large estimates suggest that, due to severe contractual frictions, many valuable relationships do not emerge in equilibrium. In the narrower context of our sample, we can try to understand the source of the value from the relationship with buyers and the lender. To do so, we need to look at credit constraints

letter B, 0.6 for letter A and 0.7 above that.

and returns to capital.

4.2 Credit Constraints: Evidence from RD Design

The Test for Credit Constraints

Given the evidence above, it would be tempting to infer that borrowers in our sample are likely to be severely credit constrained. First, we have shown evidence of ex-post moral hazard. Ex-post moral hazard limits the borrower's pledgeable income and implies that profitable investment opportunities may not be undertaken for lack of funds. Second, the data show that borrowers derive significant value from preserving good relationships with the lender, suggesting that borrowers find it difficult to replace the lender with alternative sources of credit. To quantitatively assess the importance of credit constraints, however, a more rigorous analysis must nevertheless be developed. First, given relatively low default rates, evidence of ex-post moral hazard is consistent with relatively low levels of credit constraints for few borrowers. Second, the value of the relationship with the lender could stem simply from cheaper loans relative to alternative sources of finance.

Testing for credit constraints, however, poses significant empirical challenges. By definition, a firm is credit constrained if its marginal product of capital is larger than the (marginal) interest rate at which it can borrow, i.e.,

$$MPK_i > (1 + r_i)\,. \tag{13}$$

The fundamental challenge is that the marginal product of capital, MPK_i, is not directly observable and hard to estimate econometrically in the absence of exogenous variation in the amount of capital invested. (see, e.g., Keniston (2011)).

In this section we take advantage of data from the internal rating system of our lender to implement a regression discontinuity design on the effects of larger working capital loans. In an important paper, Banerjee and Duflo (2012) develop a test for credit constraints based on a natural experiment that changed the availability of credit to firms of a certain size. The logic of the test is both powerful and elegant. When offered extra credit at the same interest rate, a credit constrained firm will absorb the extra credit to increase investment, input purchase and, ultimately, production. A firm that is not credit constrained might also absorb the additional credit and, potentially, expand production if alternative sources of credit to the firm are more expensive than

the newly available one.[26] When this is the case, however, the firm will substitute existing sources of credit at least to a certain extent and completely if production increases. In other words, firms are credit constrained if in response to an exogenous increase in the supply of capital that hold constant the interest rate:

1] Production Response: *Purchases of inputs and sales increase* (**PR**),

2] No Loan Substitution: *The additional capital is not used to substitute existing, more expensive, sources of credit* (**NLS**).

The test for credit constraints is valid under two additional conditions. First, the decision influenced by the availability of credit must be 'at the margin', i.e., the availability of credit shouldn't affect the decision of whether the firm continues to operate or not. Second, the firm must be able to use the extra loan to pay-down existing loans at no additional costs. These two conditions are hard to verify in general and, ideally, their validity should be assessed on a case by case. A distinctive advantage of our setting is that both are satisfied. First, recall that we focus on working capital loans to purchase a perfectly divisible input (cherries from the farmers). That is, firms can adjust at the margin in response to an increased availability of working capital. Second, working capital loans in our environment are signed before the beginning of the harvest season and mature well within a year, i.e., before the following harvest season. The loans in our portfolio, therefore, are negotiated at a time in which the station can still costlessly adjust on other margins by borrowing less from other suppliers of funds (typically large exporters or domestic financial institutions).

Regression Discontinuity: Design and Loan Outcomes

The credit scores determine the percentage of the contract that is funded, which typically ranges from 40% to 70%. The scores are assigned based on a numerical grade based on an in depth look at the firms financial statements. Numerical grades range from 1-5. Grades below 2.7 receive a grade of C. Firms with a C score do no receive a loan, and do no show up in our sample. However we're told by the lender that there are very few of these, as firms don't apply without a letter of intent from a buyer, which would be difficult to get for poor firms. Most firms receive either a B, which is any score between a 2.7 and 3.35, or an A which is any score between 3.35 and 4.35. Some firms receive a AA, which is a score above 4.35. We use the discontinuities around both the 3.35 and the 4.35 thresholds.

[26] In which case, the firm is said to be rationed by the lender offering cheaper credit but not credit constrained, since $MPK_i = (1 + r_i)$.

Table 6 shows the impact of receiving a numerical score just above a threshold on contract terms. We run three specifications. One in which we take the distance to the nearest threshold as the running variable for each loan, and then we also run the distance to each threshold separately. We find an overall difference of about 70% in the pooled sample which may bias upwards the estimate as it compares B loans to AA loans in some cases. However this source of bias is not large, as we get estimates of about 65% when we look at each threshold individually.[27]

The average loan amount at the pooled threshold is about 300,000 USD. This means that firms just above the pooled threshold are receiving loans of about 405,000 USD while firms just below the threshold are receiving loans of about 195,000 USD for a difference of about 210,000 USD. This is a very large difference in credit access for firms of this size. However, while differences in loan amounts given are very large on either side of the threshold there is no difference in the interest rates given on either side of the threshold. On average interest rates are slightly lower for the more highly scored firms, but the difference is generally only around 1%, and is estimated very imprecisely.

Manipulation of the assignment of observations around the threshold at which the discontinuity is estimated is the main threat to the validity of the regression discontinuity design. Although conversations with the lender suggest that manipulation is unlikely, it is worth conducting more formal tests. Figure A7 reports the results from the McCrary (2008) test. The test compares the density of observations of the assignment variable around the discontinuity. If there is a discontinuity in the density of the assignment variable at the threshold, then this may suggest that the assignment of some observations might have been manipulated. The Figure clearly shows that no such discontinuity is observed in the data.

In our context, however, there might be incentive to manipulate assignment of observations in either directions: loan officers might want to 'push up' particularly worthy loan applications and 'push down' particularly unworthy ones. Table A1 takes advantage of the rich nature of our data to explore the relevance of these concerns. The numerical score is based on 30 sub-scores, each ranging between 1 and 5. Each sub-score has, therefore, little impact on the overall score. Table A1 shows that out of the thirty sub-scores, in only one case we can detect a discontinuity in the sub-score at the threshold of interest. The evidence, therefore, appears to be inconsistent with

[27] The results are fairly consistent with the description of the process as explained to us by the lender. The lender claimed that a 75% difference in loan amount between grades was normal, as they would provide around 40% of the amount needed to fill the contract for a low graded firm and about 70% for a high graded firm.

manipulation of the assignment.

Impact of Larger Loans

The evidence above suggests that the regression discontinuity design approximate an ideal experiment in which (essentially) identical loans applications are given different amounts of working capital at the same interest rate. We use this variation in access to credit to test for credit constraints.

Table 7 reports the results. Column 1 explores whether the additional loan was used to purchase more inputs. Firms indeed used the additional money to buy cherries. Spending on coffee cherries increased by about 40% if we take the average estimate at the 3 different bandwidths. The total money spent on purchases at the threshold is about 528,000 USD, meaning that if 40% of that was the additional amount spent on cherries, the difference in the additional loan amount and the difference in cherry purchases are less than 1% apart from each other (211k versus 210k). Column 2 explores the effect of the larger loans on sales and finds an increase of about 20%. Column 3 considers labour and, consistently with stations operating below capacity, fails to detect a significant impact on the amount of labour used. Taken together, therefore, Columns 1,2 and 3 show that condition (**PR**) in the test for credit constraints is satisfied: firms absorbed the additional loans to increase input purchases and expand production.

Column 4 considers other working capital loans. We find no evidence that firms used the additional loan from our lender to substitute other sources of working capital. In order to compare the effects on other working capital loans with the additional loan, we report results in level. Column 4 shows that the effect on other loans is not only imprecisely estimated, but also significantly smaller than the 200,000 USD additional loan in all the specifications. Column 4, therefore, shows that condition (**NLS**) in the test for credit constraints is also satisfied: firms did not use the additional loans to substitute other, more expensive, sources of credit. In sum, the evidence suggests that borrowers in the sample are severely credit constrained.[28]

As noted above, there is a constant return to scale technology between amount of cherries purchased by farmers and sales volumes. It is, therefore, interesting to

[28] The analysis on station level outcomes can only be performed when information on the financial results for the year in which the loan is disbursed are available. This, essentially, restrict the sample to loans for which the station had a continued relationship with the lender the following year. This introduces sample selection. It is, however, not entirely obvious how this sample selection would bias the results. The sample selects better stations that repaid the loans. These stations might be less credit constrained than defaulting stations, but might be more credit constrained than non-repeating borrowers.

decompose the effects on input purchases and output sales into volumes and prices effects. Column 5 shows that the price of cherries purchased from farmers went up by 20%, implying that the volume of purchases only increased by 20%. The increase in prices paid to farmers is large, but not surprising. At the time of harvest, the aggregate supply of cherries in a given location is inelastic. Stations, which are likely to hold some degree of market power in their local markets, compete with other buyers (mainly traders) to purchase cherries from the farmers. The increase in the price of cherries purchased means that local farmers unambiguously benefit from a station in their area receiving larger loans. This externality is a crucial consideration from a policy perspective, as further discussed below.

Column 6 explores the sale price. There is no reason why the sale price is expected to increase following a larger loan. First, the terms of the sales to the buyer for which the sale contract is used as collateral is either agreed in advance (under 'fixed price' contracts) or at a later date (under 'differential' contracts) at which point the price is determined by market movements. The stations use the additional loans also to expand sales in the market but then, again, the eventual price of the sale is not directly affected by the size of the loan. Column 6 confirms that the additional loan had no impact on the average sale price for the station.

Returns on the Additional Loans and Value of Relationship with Lender

The additional loans received by firms was largely spent to purchase cherries from farmers. The quantity of cherries purchased only went up by about 20%, because the price of cherries purchased from farmers went up by 20%. Still, a 20% increase in cherry quantity led to a large increase in profits for the stations. The additional 210,000 USD received was translated into an additional 64,000 USD in profit, representing a rate of return of about 32%. This rate of return is significantly higher than the (marginal) interest rate paid on loans.

We can also use these estimate to assess the importance of the relationship with the lender. As a benchmark, imagine that the value of the relationship with the lender is given by net present value of the future (additional) profits the station obtains from the loans. Conditional on repayment, the probability of loan renewal is around 75% and a discount factor of 0.9 (which seems reasonable given interest rates). This gives an effective discount factor equal to 0.675. An increase in loan of approximately 120K $ translates into an increase in profits of approximately. 30K $., a return of approximately. 25% on the loan. Given linear technology, it is relatively safe to extrapolate this returns to the average loan size. Since, on average, a loan is worth

60% of the value of the contract with the buyer, we have that the loan gives profits worth $0.25 \times 0.6 = 0.15$ of the value of the contract, implying an associated discounted value equal to $0.675/(1-0.675) \times 0.15 \simeq 0.3$. Recalling that for the average repaying borrower the value of the relationship with the buyer and the seller was approximately 50% of the value of the contract, we have that at least 60% of the value of informal enforcement derives from the relationship with the lender.

5 Policy Discussion

Despite the contractual arrangements set-up by our lender, the evidence shows that ex-post moral hazard is an important driver of default and, consequently, credit constraints among coffee washing stations. Strategic default is intimately connected to *i*) imperfect enforcement of international trade contracts, and *ii*) (unanticipated) fluctuations in the international price of coffee. These forces are, however, by no means specific to the environment under consideration. Waves of defaults in the international trade of commodities are often triggered by swinging international prices. For example, an unprecedented wave of broken contracts has upended the cotton marketplace following volatile price swings: the number of arbitration cases handled by the International Cotton Agreement has soared during the recent cotton price boom from an average of seventy per year to more than two hundred cases.[29] Most of the disputes end up with contracts being renegotiated. Even after winning arbitration cases, however, companies struggle to enforce awards in foreign courts especially in developing countries as it is difficult to prevent blacklisted defaulters from continuing to do business under new names or through intermediary trading houses.

Strategic default is intimately connected to the use of fixed price contracts. This raises the question as of why foreign importers agree to enter fixed price contracts with exporters at times of high price volatility. The answer most likely lies in asymmetric access to insurance and hedging markets between the contractual parties. With fixed price contracts, buyers guarantees availability of coffee and typically insure themselves through hedging on features markets. Sellers eliminate both price and quantity risk. Fixed price contracts, however, expose parties to counterpart risk: buyers renege when prices falls and sellers renege when prices raise. A natural solution would be to try to extend access to hedging markets to exporters from developing countries. This is, however, complicated by the difficulties in aggregating relatively small producers as

[29] For a recent discussion see, e.g., http://online.wsj.com/article/SB10000872396390444772804577623532167565646.html (accessed on-line November 12th 2012).

well as by the large collateral requirements necessary to undertake hedging transactions. The evidence in the paper suggests that strengthening relationships with buyers can facilitate access to working capital finance, i.e., there might be a role for export promotion and association black-listing defaulters to be played.[30]

Finally, we have documented contractual externalities along the chain: farmers benefit from larger loans given to the stations in the form of higher prices. Since stations cannot pledge farmers' surplus to obtain loans, not just the station, but the chain as a whole is credit constrained. These contractual externalities can be mitigated by fostering integration along the chain. Integration can be achieved by private processors integrating (backward) into coffee growing by acquiring an estate. In many context, however, this option is likely to be limited by the same type of credit constraints we have documented as well as by other constraints working against consolidation in land markets. Cooperatives, in which farmers own processing units, could in principle provide an alternative form of (forward) integration.

6 Conclusion

In sum, the study provides evidence on the sources (ex-post moral hazard) and consequences (credit constraints along the supply chain) of credit market imperfections among relatively large firms in developing countries. As discussed above, the contractual practices adopted by our lender already mitigate sources of credit market imperfections, including those for which we find direct evidence. Therefore, our study identifies a lower bound to the cost of credit market imperfections.

Moreover, we tie the presence of these imperfections to underlying features of the environment, particularly the lack of access to hedging instruments. Exploring in greater details the determinants of contractual choices in this environment is left for future research.

[30] Commodity price stabilization has featured prominently in development debates, though mostly from a macro point of view. Keynes (1943), Prebisch (1950) and Singer (1950) have been among the most influential supporters of unilateral and multilateral stabilization programs for commodity prices. Bauer and Parish (1952), Friedman (1954), McKinnon (1967) and Stiglitz and Newbury (1981) argued against price stabilization mechanisms and in favour of market-based solutions, which have been followed since the mid '80s in most countries.

References

[1] Adams, W., Einav, L., and Levin, J. (2009) "Liquidity Constraints and Imperfect Information in Subprime Lending." *The American Economic Review*, 99(1): 49-84.

[2] Adhvaryu, A., K. Namrata and A. Nyshadham (2013) "Booms, Busts, and Household Enterprise: Evidence from Coffee Farmers in Tanzania", mimeo

[3] Antras, P. and F. Foley (2011) "Poultry in Motion: a Study of International Trade Finance Practices", mimeo Harvard

[4] Banerjee, A. and E. Duflo (2000) "Reputation Effects and the Limits of Contracting: A Study of the Indian Software Industry", *Quarterly Journal of Economics* 115: 989-1017.

[5] Banerjee, A., and E. Duflo (2005) "Growth theory through the lens of development economics." Handbook of Economic Growth Vol. 1: 473-552.

[6] Banerjee, A., and E. Duflo (2012) "Do firms want to borrow more?" mimeo MIT

[7] Banerjee, A. and K. Munshi (2004) "How efficiently is capital allocated? Evidence from the knitted garment industry in Tirupur". *Review of Economic Studies* 71(1): 19-42.

[8] Besley, T. (1995) "Savings, credit and insurance." Handbook of development economics 3 (1995): 2123-2207.

[9] Bester, H. (1985) "Screening vs. rationing in credit markets with imperfect information." *The American Economic Review*, 75(4): 850-855.

[10] Buera, F., J. Kaboski, and Y. Shin (2011) "Finance and Development: A Tale of Two Sectors." *The American Economic Review* 101-5: 1964-2002.

[11] Burkart, M. and T. Ellingsen (2004) "In-kind finance: A theory of trade credit." *American Economic Review*: 569-590.

[12] Cameron, C., J. Gelbach and D. Miller (2008) "Robust Inference with Multi-way Clustering", mimeo, University of California-Davis.

[13] Casaburi, L. and T. Reed (2013) "Interlinked Transactions and Pass-Through: Experimental Evidence from Sierra Leone" mimeo

[14] Chiappori, P.A. and B. Salanié (2002) "Testing Contract Theory: a Survey of Some Recent Work" in *Advances in Economics and Econometrics*, vol. 1, M. Dewatripon et al. eds, Cambridge University Press.

[15] De Janvry, A., McIntosh, C., and Sadoulet, E. (2010) "Fair Trade and free entry: Generating benefits in a disequilibrium market." mimeo Berkeley ARE

[16] De Mel, S., D. McKenzie, and C. Woodruff (2008) "Returns to capital in microenterprises: evidence from a field experiment" *The Quarterly Journal of Economics* 123-4: 1329-1372.

[17] De Mel, S., D. McKenzie, and C. Woodruff (2009) "Are women more credit constrained? Experimental evidence on gender and microenterprise returns", *American Economic Journal*: *Applied Economics*: 1-32.

[18] Ellingsen, T., and E. Kristiansen (2011) "Financial Contracting Under Imperfect Enforcement." *The Quarterly Journal of Economics* 126.1: 323-371.

[19] Fafchamps, M., D. McKenzie, S. Quinn, and C. Woodruff (2011) "When is capital enough to get female microenterprises growing? Evidence from a randomized experiment in Ghana" National Bureau of Economic Research WP 17207.

[20] Ghosh, P., D. Mookherjee, and D. Ray (2000) "Credit rationing in developing countries: an overview of the theory." Readings in the Theory of Economic Development: 383-401.

[21] Ghosh, P. and D. Ray (1996) "Cooperation in Community Interactions without Information Flows", *Review of Economic Studies*, 63: 491-519.

[22] Hsieh, C. and P. Klenow (2009) "Misallocation and manufacturing TFP in China and India." *The Quarterly Journal of Economics* 124-4: 1403-1448.

[23] ITC (2012) *The Coffee Exporter's Guide*, 3rd Edition, International Trade Centre, Geneva.

[24] Karlan, D., R. Knight, and C. Udry (2012) "Hoping to win, expected to lose: Theory and lessons on micro enterprise development". National Bureau of Economic Research, WP 18325.

[25] Karlan, D., and J. Zinman (2009) "Observing unobservables: Identifying information asymmetries with a consumer credit field experiment." *Econometrica* 77-6: 1993-2008.

[26] Keniston, D. (2011) "Experimental vs. Structural Estimates of the Return to Capital in Microenterprises", mimeo Yale.

[27] Klapper, L., Laeven, L., and Rajan, R. (2012) "Trade credit contracts." *Review of Financial Studies*, 25(3): 838-867.

[28] Kremer, M., Lee, J. N., Robinson, J. M., and Rostapshova, O. (2011) The return to capital for small retailers in Kenya: evidence from inventories. Mimeo, Harvard University.

[29] Lacker, J., and J. Weinberg (1989) "Optimal contracts under costly state falsification." *The Journal of Political Economy*: 1345-1363.

[30] Macchiavello, R. (2010) "Development Uncorked: Reputation Acquisition in the New Market for Chilean Wines in the UK", CEPR DP 7698

[31] Macchiavello, R. and A. Morjaria (2012) "The Value of Relationships: Evidence from a Supply Shock to Kenyan Rose Exports", CEPR DP 9531.

[32] Manova, K. (2013) "Credit constraints, heterogeneous firms, and international trade." *The Review of Economic Studies*, 80(2): 711-744.

[33] Paravisini, D., Rappoport, V., Schnabl, P., and Wolfenzon, D. (2011) "Dissecting the effect of credit supply on trade: Evidence from matched credit-export data" NBER 16975.

[34] Paulson, A., R. Townsend, and A. Karaivanov (2006) "Distinguishing limited liability from moral hazard in a model of entrepreneurship." *Journal of Political Economy* 114-1: 100-144.

[35] Rampini, A., Sufi, A., and Viswanathan, S. (2012) "Dynamic risk management." mimeo Duke

[36] Stiglitz, J., and A. Weiss (1981) "Credit rationing in markets with imperfect information." *The American Economic Review* 71-3 : 393-410.

[37] Varangis, P., and Lewin, B. (2006) "Approaches to managing coffee price risks" in Agricultural Commodity Markets And Trade: New Approaches to Analyzing Market Structure And Instability, 282.

Table 1: Descriptive Statistics, Stations and Loans

Variable	Observations	Median	Mean
Panel A: Washing Station Descriptive			
Total Sales ('000 $)	143	1150	2430
Number of Employees (Permanent)	143	8	32
Number of Employees (Seasonal)	143	99	138
Total Assets ('000 $)	143	607.8	1383
Costs of Goods Sold / Total Sales	143	0.84	0.82
Number of Loans with Lender	197	3	3.39
Panel B: Loan Descriptive			
Loan Amount ('000 $)	669	221.1	346.7
Interest Rate	669	0.091	0.098
Previous Loan with Lender	669	--	0.29
Numerical Score	669	3.57	3.61
Length of Loan	669	245	302
Write - off	669	--	0.027
Write - off or Restructured	669	--	0.03
Write - off, Restructured, or Delay	669	--	0.061
World Price at Closing	669	315.8	346.45
World Price at Maturity	669	322.6	378.85

Notes: The sample of station is constructed from a panel based on financial statements for the 3 years prior to a loan being given. For firms with loans in multiple years, the panel includes financials for both before and after loans were given. The sample of contracts is all coffee contracts from our lender. We have a letter score for all contracts, but a numerical score for only a subset of contracts, as the numerical score system was introduced by the lender partway through the sample. The sample also only includes contracts that were closed at the time of receiving the data. Open loans were omitted as they did not have the same opportunity for default.

Table 2: International Prices and Default, Robustness

	Dependant Variable: Write-off, restructured or no payment after 90 days late				
	(1)	(2)	(3)	(4)	(5)
Price Ratio	0.114***	1.459**	0.429***	0.0794**	0.111***
	(0.0406)	(0.618)	(0.0811)	(0.0376)	(0.0410)
Model	OLS	Probit	OLS	OLS	OLS
Sample	Full	Full	Numerical Score Only	Full	Full
Futures Price (maturity) at Closing Date	Y	Y	Y	N	Y
Letter Score Fixed Effects	Y	Y	Y	Y	Y
Country Fixed Effects	Y	Y	Y	Y	Y
Closing Month Fixed Effects	Y	Y	Y	Y	Y
Previous Relationship	Y	Y	Y	N	N
Number of Loans to Client Fixed Effects	Y	Y	Y	N	N
Observations	699	588	289	704	699
R-squared	0.280	N/A	0.351	0.273	0.279

Notes: ***, **, * denote statistical signi cance at the 1%, 5% and 10% level respectively. Description: The table reports the estimated difference in mean rates of default when the world price of coffee doubles during the life of the contract. The price ratio here is defined as the price at maturity over the price at closing. Robust standard errors clustered by country are reported in parentheses.

Table 3: International Prices and Default, an Event Study

	(1) Write-Off, Restructured no payment after 30 days	(2) Write-Off, Restructured no payment after 60 days	(3) Write-Off, Restructured no payment after 90 days
t-test: 2 Month Window	0.0636**	0.0559**	0.0486**
	(0.0259)	(0.0237)	(0.0228)
Observations	419	419	419
t-test: 3 Month Window	0.0458**	0.0403**	0.0343*
	(0.0214)	(0.0194)	(0.0187)
Observations	552	552	552
t-test: 4 Month Window	0.0497**	0.0419**	0.0366**
	(.0199)	(.0179)	(.0174)
Observations	616	616	616

Notes: ***, **, * denote statistical significance at the 1%, 5% and 10% level respectively. The number of months from one of the top 25 monthly price increases is the grouping variable, and we restrict the sample to contracts 1 month before and one month after to be sure results above are driven by contracts around the threshold. For contracts that end in the month of an event, we assign the contract to the `before' group if the contract matures in the first half of the month and the `after' group if the contract matures in the second half of the month. Description: Estimates show that out-of season price increases have a positive impact on default through the strategic default mechanism. When the price of coffee increases but the price of inputs does not, strategic default is most likely. The results are almost identical to the results using the discontinuity methodology

Table 4: International Prices and Default, an Event Study

	(1) Write-Off	(2) Write or Restructured	(3) Write-Off, Restructured or no pmt after 30 days	(4) Write-Off, Restructured or no pmt after 90 days
Optimal Bandwidth	0.0385*	0.0448*	0.0986**	0.0500***
	(0.0223)	(0.0231)	(0.0485)	(0.0173)
75% Optimal Bandwidth	0.0187*	0.0250**	0.0540**	0.0500***
	(0.0108)	(0.0124)	(0.0249)	(0.0173)
125% Optimal Bandwidth	0.0395*	0.0462**	0.1000**	0.0919***
	(0.0221)	(0.0229)	(0.0483)	(0.0321)

Notes: ***, **, * denote statistical signi cance at the 1%, 5% and 10% level respectively. The estimates are calculated using a regression discontinuity design using the kernel density method. A triangle kernel was used and the optimal bandwidth was calculated as in Kalyanaraman (2012). The number of months from one of the top 25 monthly price increases is the running variable. Description: The table reports the estimated difference in mean rates of default when the world price of co ee increases immediately before the contract matures as opposed to immediately after. It shows that in-season world price increases do not have a significant impact on default, and if anything reduce default by reducing credit constraints. Out of season price increases have a positive impact on default through the strategic default mechanism. When the price of coffee increases but the price of inputs does not, strategic default is most likely.

Table 5: Heterogeneity (Ex-Post ICC Constraint)

Dependent Variable: Default	[1] Mature After P Jump X First Loan	[2] Mature After P Jump X Fixed Price Contract
Optimal Bandwith	0.0754**	0.0516***
	[0.0371]	[0.0179]
75% Optimal Bandwith	0.0758**	0.0521**
	[0.0377]	[0.0182]
125% Optimal Bandiwth	0.0631*	0.0739*
	[0.0311]	[0.0371]
Number of observations	669	669

Notes: ***, **, * denote statistical significance at the 1%, 5% and 10% level respectively. We define a fixed price contract as a contract where a percentage of the contract is not tied to the world coffee price. The estimates are calculated using a regression discontinuity design using the kernel density method. A triangle kernel was used and the optimal bandwidth was calculated as in Kalyanaraman (2012). Each specification controls individually for each element of the interaction. Description: This table shows heterogeneity in strategic default, showing that default is driven by firms without a prior history with the lender and firms with fixed prices.

Table 6: Regression Discontinuity Results, Loan Outcomes

	(1)	(2)	(3)	(4)	(5)	(6)
	log(Loan Amount)			log(Interest Rate)		
	Pooled	B to A	A to AA	Pooled	B to A	A to AA
Optimal Bandwidth	0.713**	0.675**	0.659*	-0.0140	-0.00610	-0.0147
	(0.287)	(0.303)	(0.364)	(0.0167)	(0.0240)	(0.0142)
75% Optimal Bandwidth	0.764**	0.770**	0.751*	-0.0153	0.0128	-0.0190
	(0.324)	(0.365)	(0.394)	(0.0184)	(0.0257)	(0.0162)
125% Optimal Bandwidth	0.616**	0.623**	0.563	-0.00990	-0.0135	-0.0144
	(0.265)	(0.284)	(0.347)	(0.0158)	(0.0223)	(0.0136)
Observations	197	197	197	189	189	191

Notes: ***, **, * denote statistical significance at the 1%, 5% and 10% level respectively.The estimates are calculated using a regression discontinuity design using the kernel density method. A triangle kernel was used and the optimal bandwidth was calculated as in Kalyanaraman (2012). The distance in numerical score points to the threshold is the running variable in each specification. Controls include the amount requested, and renewals. Description: The table shows that getting a score just above the threshold results in a 65% higher loan at each threshold. This is consistent with what was told to us by the lender. The lender typically lends between 40%-70% of the working capital deficit, depending on the letter score and loan size. If the 40% - 70% difference was a hard rule this would result in an estimate of 0.75. While there is a very sharp increase in the loan amount at the threshold, there is no difference in the interest rate given to the client.

Table 7: Regression Discontinuity Results, Firm Outcomes

	(1)	(2)	(3)	(4)	(5)	(6)
		Spent/Earned			Prices	
	log(Purchases)	Sales	log(Labour)	Other Loans	log(Purch. P)	log(Sales P)
Optimal Bandwidth	0.477*	1,587,345**	0.218	21.86	0.221**	0.254
	(0.263)	(730,861)	(0.441)	(280.3)	(0.102)	(0.227)
75% Optimal Bandwidth	0.300*	1,872,649**	0.218	-68.90	0.264**	0.420
	(0.512)	(818,399)	(0.509)	(312.0)	(0.115)	(0.295)
125% Optimal Bandwidth	0.429*	1,312,218*	0.219	67.65	0.212**	0.103
	(0.256)	(681,457)	(0.415)	(267.2)	(0.0974)	(0.209)
Observations	167	189	180	112	189	189

Notes: ***, **, * denote statistical significance at the 1%, 5% and 10% level respectively.The estimates are calculated using a regression discontinuity design using the kernel density method. A triangle kernel was used and the optimal bandwidth was calculated as in Kalyanaraman (2012). The distance in numerical score points to the threshold is the running variable in each specification. In some cases, due to many missing values, similar variables are used to predict missing observations. For example, cost of goods sold is sometimes used to predict spending on cherries, when observations are missing. In these cases the variables used to predict the missing observations (e.g. cost of goods sold) are included as controls. Description: The table shows that firms are credit constrained. Getting a score just above the threshold results in a 40% more money spent purchases, almost 20% of which is from increased quantity purchased. The additional purchases in cherries results in almost 65,000 higher profit, strong evidence of credit constraints. The additional money helps farmers, as prices for cherries increase by over 20%.

Table A1: Regression Discontinuity Robustness: Test for Manipulation of Sub-scores

Running Variable: Distance to Threshold (Overall Score)			
Dependent Variable	Estimate	Standard Error	Observations
Entity Score	0.108	(0.109)	315
Accounting Quality	0.221	(0.226)	315
Planning Systems	0.250	(0.156)	315
Liquidity Risk	-0.0561	(0.206)	315
Leverage	0.156	(0.178)	315
Profitability	0.0934	(0.189)	315
Credit History (RC)	0.155	(0.203)	312
Asset Quality	0.205	(0.168)	303
Product Score	0.0407	(0.0960)	315
Processing	0.156	(0.131)	315
Supply Security	-0.0630	(0.103)	315
Management Score	0.0176	(0.114)	315
General Manager	-0.0649	(0.168)	315
Finance Accounting	0.0795	(0.190)	315
Internal Controls	0.156	(0.169)	314
Marketing Sales	-0.132	(0.162)	315
Staff Retention	0.142	(0.170)	303
Report Quality	0.00691	(0.142)	314
Report Punctuality	0.00318	(0.151)	302
Email Promptness	0.130	(0.168)	314
Email Quality	0.0682	(0.158)	302
Buyer Score	0.116	(0.0901)	315
Buyer Quality	0.158	(0.119)	315
Buyer Relationship	0.170	(0.165)	315
Buyer Mix	0.607**	(0.288)	315
Type of Contract	0.114	(0.160)	300
Context Score	-0.0328	(0.0473)	315
Weather	-0.0422	(0.146)	315
Country Stability	0.0621	(0.128)	314
Sales Price Volatility	0.0897	(0.222)	300

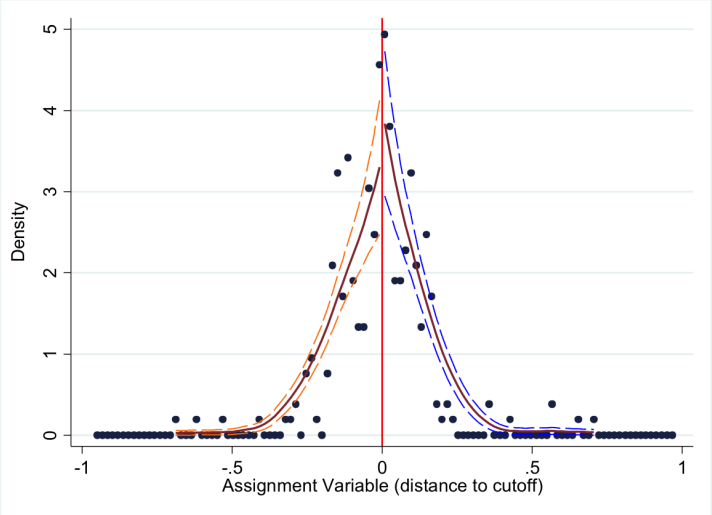
***, **, * denote statistical significance at the 1%, 5% and 10% level respectively. This table shows the placebo for the manipulation of the sub-scores which make-up the numerical score that is used in the RD estimates. Only one out thirty sub-scores shows any difference on either side of the overall score threshold, but at least one of thirty would is expected as a false positive. We interpret this as evidence supporting the assumption that there was no manipulation or sorting of scores in order to give preferred clients better contractual terms.

Table A2: Informal Punishment for Default by the Lender

	(1)	(2)	(3)	(4)
	Dependent Variable: Future Contracts From Lender			
Write-off	-0.698***			
	(0.0696)			
Write-off or restructured		-0.702***		
		(0.0690)		
Write-off, restructured or no payments for 90 days			-0.352***	
			(0.122)	
Write-off, restructured or no payments for 30 days				-0.265**
				(0.103)
World Price and Futures	Y	Y	Y	Y
Letter Score Fixed Effects	Y	Y	Y	Y
Country Fixed Effects	Y	Y	Y	Y
Closing Month Fixed Effects	Y	Y	Y	Y
New Client Dummy	Y	Y	Y	Y
Number of Loans to Client Fixed Effects	Y	Y	Y	Y
Observations	702	702	702	702
R-squared	0.661	0.663	0.638	0.632

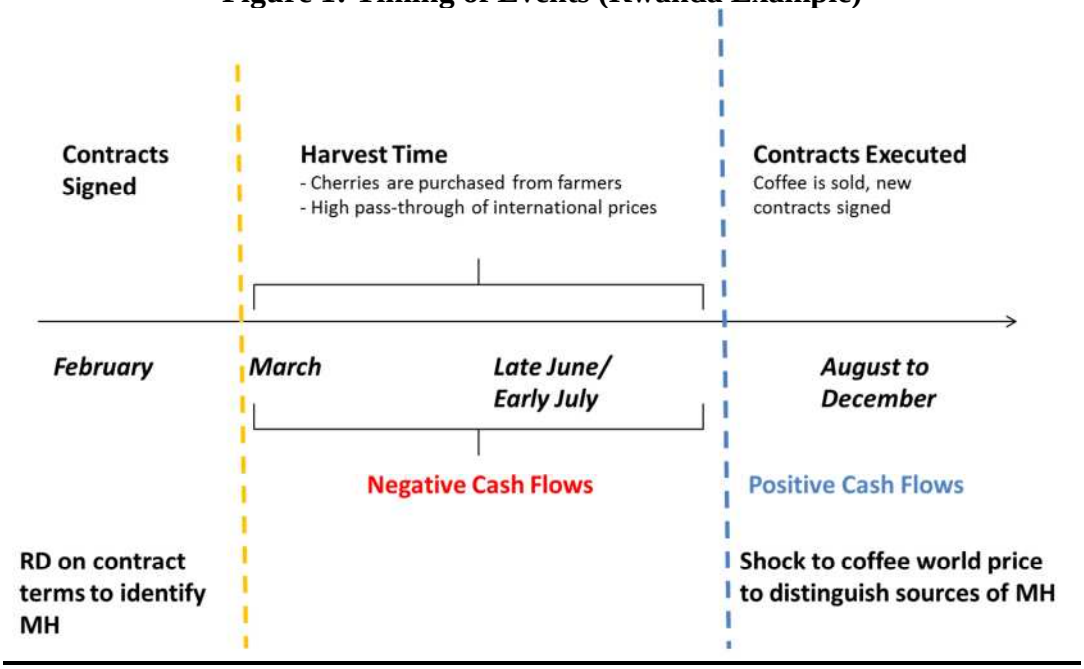
*** p<0.01, ** p<0.05, * p<0.1. Standard errors are clustered by Country. The table shows that stations are punished for defaulting on contracts. If a station has a contract written off, they are about 70% less likely to receive a loan from the lender in the future.

Figure A7: Regression Discontinuity Graph - Sorting Around the Threshold



The figure shows that he lender did not manipulate scores around the threshold to give larger loans to preferred clients.

Figure 1: Timing of Events (Rwanda Example)

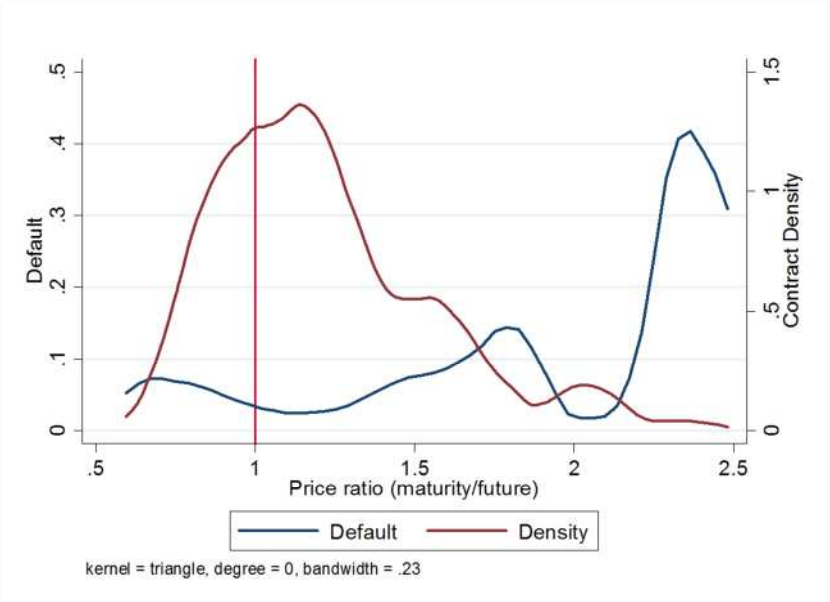


The Figure depicts the typical timing of events in the case of Rwandan contracts.

Figure 2: Seasonal Distribution of Contract Timing

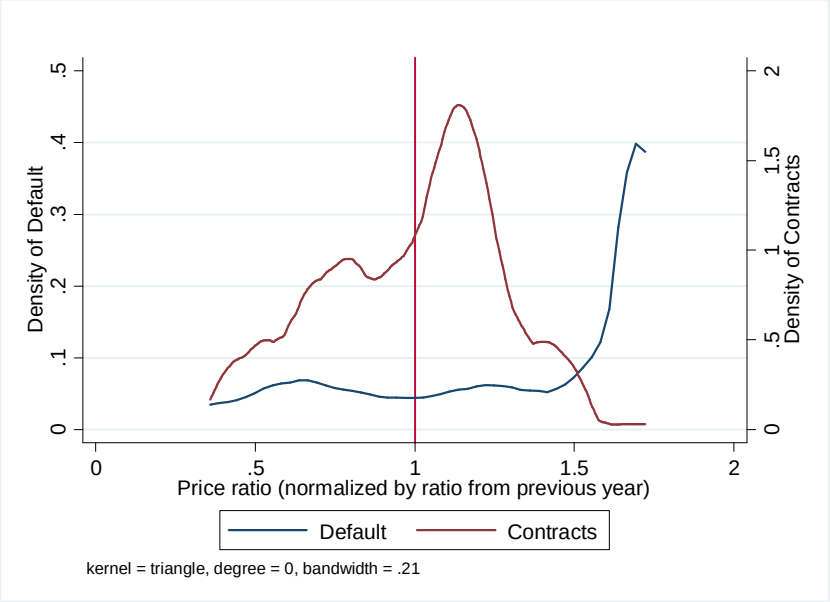
The Figure shows seasonality patterns in the closing and maturity dates of loan contracts in the sample. The closing date (blue lines) refers to the month in which the loan contract is signed. The maturity date (red line) refers to the date at which the loan is supposed to be repaid. The Figure illustrates the bi-modal distribution in the distributions of both closing and maturity dates. The two picks in each distribution are driven by asynchronous coffee harvest seasons across countries and altitude ranges. Contracts tend to be closed just ahead of, or in the early phases, of the harvest season. For example, most contracts in Peru (which represents 34% of the loans in the sample) are closed in May – June, in Nicaragua (which accounts for 11% of the loans in the sample) most contracts are closed in October – December, in Rwanda (which accounts for 8% of the loans in the sample) most contracts are closed in March – April.

Figure 3: Unanticipated Price Increases and Defaults (Part I)



The Figure shows the relationship between unanticipated increases in international coffee prices and loan defaults. The red line shows the distribution of the ratio of New York C Arabica coffee price at the maturity date divided by the future price for delivery closest to the maturity date at the time the contract was closed. During the sample periods international coffee prices have tended to increase, i.e., relatively more contracts have ratios above one. The blue line plots the density of loan defaults conditional on a given price ratio. Defaults, measured as [***insert details***] are disproportionately concentrated among contracts that have witnessed sharp unanticipated price increases.

Figure 4: Unanticipated Price Increases and Defaults (Part II)



The Figure shows the relationship between unanticipated increases in international coffee prices and loan defaults. The red line shows the distribution of the ratio of New York C Arabica coffee price at maturity date divided by the same price at closing date, normalized by the same ratio for the previous year. During the sample periods international coffee prices have tended to increase, i.e., relatively more contracts have ratios above one. The blue line plots the density of loan defaults conditional on a given price ratio. Defaults, measured as [***insert details***] are disproportionately concentrated among contracts that have witnessed sharp unanticipated price increases.

Figure 5: The Value of Informal Enforcement for Defaulters and Non-Defaulters