# Acquisitions, Management, and Efficiency in Rwanda's Coffee Industry*

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**Abstract**

Markets in low-income countries often display long tails of inefficient firms and significant misallocation. This paper studies Rwandan coffee mills, an industry initially characterized by widespread inefficiencies that has recently seen a process of consolidation in which exporters have acquired control of a significant number of mills giving rise to multi-plant groups. We combine administrative data with original surveys of both mills and acquirers to understand the consequences of this consolidation. Difference-in-difference results suggest that, controlling for mill and year fixed effects, a mill acquired by a foreign group, but not by a domestic group, improves both productivity and product quality. The difference in performance is not accompanied by changes in mill technology or differential access to finance. Upon acquisition, both foreign and domestic group change mills' managers. Foreign groups, however, recruit younger, more educated and higher ability managers, pay these managers a higher salary (even conditional on manager and mill characteristics) and grant them more autonomy. These "better" managers explain about half of the better performance associated with foreign ownership. The difference in performance reflects superior implementation, rather than management knowledge: following an acquisition, managers in domestic and foreign groups try to implement the same management changes but managers in domestic groups report significantly higher resistance from both workers and farmers and fail to implement the changes. The results have implications for our understanding of organizational change and for fostering market development in emerging markets.

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# 1 Introduction

Performance varies widely between firms even within narrowly defined sectors (Syverson (2011)) and particularly so in low-income countries (Hsieh and Klenow (2009); Hsieh and Olken (2014)). These differences in performance reflect, to a large extent, the lack of adoption of appropriate management practices, particularly in developing countries (Bloom et al. (2012)).

To the extent that we think that performance differences are related in part to differences in management practices, how can we improve management practices? A rich literature has focused on evaluating the impact of delivering training programs and consulting services, finding rather mixed evidence (see McKenzie (2020) for a survey).[1] Stronger product market competition can give firms incentives to improve performance (see, e.g., Schmitz Jr. (2005)) and reduce dispersion in performance (Syverson (2011)) promoting the adoption of better management practices. In environments with weak contracting institutions, however, competition might however destroy rents that are necessary for firms to sustain well-functioning relationships with workers and suppliers and might thus hinder performance and inhibit better management (Macchiavello and Morjaria (2021)).

This paper explores a third channel: acquisitions, i.e., the market for firms, the process through which productive assets are allocated to better owners. Despite the potential relevance, studies of acquisitions in low income countries are relatively scarce and the evidence quite scant. Besides data availability and the small number of firms within narrowly defined sectors, an additional challenge in low-income countries is that family firms and SOEs dominate the ownership landscape (McKinsey Quarterly (2014)) making turnovers in ownership rare events.[2]

This paper studies ownership changes among coffee mills in Rwanda a context that, besides its intrinsic relevance, also allows us to overcome the main measurement challenges.[3] The industry, which counted only a handful of mills in the early 2000s when the country was recovering from civil conflict and genocide, counts around 300 mills today. In more recent years, the industry has witnessed a process of consolidation in which exporters, both domestic and foreign owned, started acquiring control over mills. Combining a panel of both administrative and original survey data we collected in the industry we are thus able to study in detail the process of acquisition, its drivers and consequences, in the industry. Within a difference-in-difference framework that controls for both mill and year fixed effects, we find that acquisition by a foreign owner, but not by a domestic owner, is accompanied by improvements in mills' performance (higher capacity utilization, lower operational costs) and product quality. Taking advantage of our uniquely detailed *acquirer* survey, we are able to assuage several identification concerns, e.g., by focusing on event-study specifications that compare the acquired mills only

[1] With few exceptions, most notably Bloom et al. (2012), the literature has evaluated interventions for micro- and small- firms. In most countries, however, the majority of capital is invested in larger firms (see, e.g., Banerjee et al. (2015), Hsieh and Olken (2014)).

[2] For instance, consider the MSCI Emerging Market Index, SOEs are 26.3% of the Index (2018) and the number of SOEs has been increasing as a percentage of the world's largest companies as measured by the Fortune Global 500.

[3] Coffee is the main source of livelihood for about 25 million farmers worldwide and features many aspects common to other agricultural chains in developing countries.

against other acquisition targets reported by the same *acquirer*. If anything, rather than selecting mills on better trajectories or likely to receive positive shocks, *foreign* groups appear to target poorly managed mills that can be turned around.[4] We perform additional checks to our identification strategy by changing the sample of counterfactual mills used to evaluate the impact of the acquisition. While we follow the standard in the literature, we also take advantage of the survey conducted with all the groups in the country in which we elicited – for each mill that the group had acquired – a set of mills that were existing at the time of the acquisition and that the acquirer would have considered as alternative targets. This allows us to construct pairs of mills (acquired and its target) and include interactions of pair and year fixed effects as controls. In this exercise we find results that are qualitatively in line with, and economically larger then, the baseline results. Taken together, these checks assuage concerns that unobservable differences in trajectories across acquired and non-acquired mills drive the results. Thus we are reasonably confident of having identified a positive impact on operational efficiency (utilization and costs) of being acquired by a foreign group.

What explains the superior performance of mills acquired by foreign investors? A large literature has argued that foreign firms might possess better technology (see, e.g., Guadalupe et al. (2012)), access to finance (see, e.g., Antras et al. (2009) and Manova et al. (2015)) and/or management practices (Bloom et al. (2009)).[5] In our context, we find that differences in management are the most important driver of the difference in performance between foreign and domestic groups. We explicitly rule out differences in technology (domestic and foreign groups deploy similar type of mill processing technology) and access to working capital finance. We thus focus on *managers* and *management* as candidate explanations for the difference in performance. We show that, following an acquisition, both foreign and domestic groups change the manager of the mill. Foreign groups hire what appears to be better managers on observable characteristics: managers with higher education and cognitive skills. These foreign groups also pay these managers more and grant them more autonomy. We also show that these manager characteristics, however, only account for a share of the post-acquisition performance difference between *foreign* and *domestic* groups.

The remaining share, appears to be accounted for by differences in *management*. Differences in management could lead to differences in performances because of differences in *knowledge* ("what to do") vs *implementation* ("how to do it"). We elicit detailed measures of the number and type of management changes that managers tried to implement post-acquisitions. We find no difference in the amount and type of changes that managers in domestic and foreign groups attempted, suggesting that differences in *knowledge* are unlikely to drive results. We show, however, that managers in foreign groups face less resistance to these changes from both workers and farmers and report to have been more successful at implementing changes

[4] Foreign group expansion is thus through mainly acquisitions (brownfield), whilst domestic group expand both by acquiring mills and by setting up new mills (greenfield).

[5] While the evidence in Bloom et al. (2009) speaks against a purely contingent view of management practices, it could still be the case that MNCs bring different technology and that requires them to adopt different management practices relative to domestic firms.

overall.[6] Differences in performance appear thus to be driven, at least in part, by differences in management *implementation*.

**Related Literature** This article contributes to four strands of literature. The most closely related work, and the inspiration for our exercise, is the paper by Braguinsky et al. (2015) on the consequences of acquisitions of cotton mills in early twentieth century Japan. Like Braguinsky et al. (2015) we are also able to explore, within a difference in difference framework, differences in physical productivity and profitability. We take advantage of our survey of both mills and acquirers to explore in detail the changes, and the corresponding challenges, through which acquisitions lead to changes in performance.[7]

Second, we contribute to the literature on firm performance and productivity dispersion in low-income economies (Hsieh and Klenow (2009); Hsieh and Olken (2014)) by considering the role of acquisitions and consolidation, an important channel that might have been under studied duo to data limitations.

Third, the article relates to the literature on management practices and managers.[8] One view of management emphasizes how the root differences in firm performance is due to CEO/ managers skills, rather than management practices, which are simply an outcome reflecting the skills of the managers at the top.[9] In seminal work, Bloom et al. (2012 and 2018) implement a eight years follow-up to the textile mill experiment in India. They find some persistence in management practices. About half of the practices once adopted however are "forgotten". The loss in practices is related to managerial turnover and limited attention of current managers. Our evidence complements their results in pointing out how management appears to be embedded both in managers and in the organization as a whole.[10]

Fourth, we also make progress on the literature of organizational changes, in particular challenges of implementing changes in organizations. Gibbons and Henderson (2012) highlight the role of managers in setting up relational contracts that, once in place, are very hard to change. Atkin et al. (2017) experimentally study the introduction of a better cutting technology that can potentially reduce material waste. They find that cutters resisted change because they were not compensated for having to learn the new technology within a traditional system that relied mostly on piece rates. The paper highlights the importance of communication frictions within the firm in slowing down technology adoption. Macchiavello et al (2020) evaluated

[6] The higher success in implementation reported by foreign managers corresponds to better performance, e.g., in practices aimed at increasing quality and implementing certification programs.

[7] We follow the same DID and event-study like methodology as in Braguinsky et al. (2015). Our original acquirer survey, however, allows us to explore in greater details drivers of acquisitions and explore robustness of the main results to narrower counterfactuals that only exploit targeted, but not realized, acquisitions.

[8] On MNC ownership and management practices see also e.g. Bloom et al. (2012).

[9] For example, Bandiera et al (forthcoming) measure "CEO style" using text-analysis techniques on CEOs diaries and show, through a DID framework, that a certain CEO style appears to be associated with better firm performance.

[10] The distinction has potentially important policy implications: if good management can be taught and transferred, there should be emphasis on expanding access to training and consulting services. If, instead, better management practices are embedded into better managers that are able to overcome implementation challenges, then making sure that markets allocate assets to good managers becomes crucial.

a program that tries to promote more female to managerial roles inside Bangladeshi garment factories. One aspect that made the transition challenging is that current potential supervisors (all males) might resist such a program since if the factory switches to an equilibrium in which women are considered for managerial roles then they are made worse off. We complement this work by directly measuring attempted changes, implementation challenges and sources of resistance.

The rest of the paper proceeds as follows. Section 2 provides industry background and presents our surveys and administrative datasets. Section 3 presents a theoretical framework that captures the key aspects of our setting. The empirical analysis proceeds in two steps. Section 4 investigates the impact of acquisitions on mills performance. We distinguish between foreign and domestic owners and present a battery of robustness checks, focusing particularly on the original *acquirer* survey which allows us to explore target selection and evaluate the impact using attempted acquisitions as a control. Section 5 investigates the mechanisms. After ruling out differences in mill technology and access to capital as key explanations, we focus on the role of both managers and management, on knowledge versus implementation and challenges to change. Concluding remarks are discussed in Section 6.

# 2 Industry Background

This Section provides background information on the industry. We first describe the coffee sector in Rwanda focusing in particular on the industry evolution in recent years. We then describe both the original administrative and survey data we have collected and compiled for the industry.

## 2.1 Coffee in Rwanda

*Sector Overview:* Coffee is produced in about 50 countries around the world. Certain aspects of coffee cultivation, harvesting, processing and commercialization differ across countries. This section focuses on Rwanda's industry. In 2017 there were around 355,000 smallholder farmers growing coffee and coffee accounted for almost 7% of the country's export earnings.[11]

*Harvest, processing and exporting:* The coffee cherry is the fruit of the coffee tree. Cherries are ripe when they change color from green to red, at which point they should be harvested. The harvest period typically lasts three to four months and its timing varies across regions depending on altitude and rainfall patterns. Coffee cherries are harvested by hand, a labor intensive process requiring both care and effort. Coffee cherries, even from the same tree, do not ripen for harvest all at once. While less laborious, harvesting cherries all at once compromises quality.

Upon harvest, the pulp of the coffee cherry is removed, leaving the bean which is then dried to obtain parchment coffee. There are two processing methods to obtain parchment coffee: the

[11] Source: NISR Statistical Year Book, 2017 and BNR-National Bank of Rwanda, 2018.

sun-dry method and the wet method. In the sun-dry method, farmers de-pulp cherries at home using rocks before drying them on mats. This process produces coffee cherries of lower and less consistent quality. By contrast, cherries processed through the wet method are taken to a mill (often referred to as coffee washing stations or wet mills) within 6-12 hours of harvest. If not taken immediately, the cherries will start to ferment and rot. Mills are therefore scattered around the countryside; farmers closest to the mill often take cherries to the mill's gate directly. Those who are further afield bring cherries to collection sites in which coffee collectors buy coffee.

The wet method requires specific equipment and substantial quantities of clean water.[12] After the cherry skin and pulp are removed with a pressing machine, cherries are sorted by immersion in water. The bean is then left to ferment for around 30 hours to remove the remaining skin. When fermentation is complete, the coffee is thoroughly washed with clean water in water tanks. The beans are then laid out on drying tables and frequently and carefully turned by hand until completely and uniformly dry over a 15 day period. This process is necessary to bring the moisture down of the beans. After the drying process is completed the coffee (at this stage referred to as "parchment") is bagged and taken to the warehouse of an exporter in the capital city.

The export company will dry the parchment again to ensure a consistent moisture is attained, hull the coffee using a dry mill (usually their own or will obtain service from one of the dry millers), will clean and polish the hulled coffee before grading and color sorting by size and weight.[13] The output of the hulled coffee is referred to as "green coffee" and this will then be bagged again, typically sent to the Port of Mombasa in Kenya, loaded onto a ship, and transported to a roaster in the country consuming the coffee (see Figure I for an illustration of the supply chain).

*Coffee Mills in Rwanda*

We begin by describing coffee mills in Rwanda in 2012, the first year in which we conducted a survey of mills in the industry. There were 214 processing mills in the country in 2012. Summary statistics for mills in Rwanda in 2012 are reported Appendix Table B1. The survey covered nearly all operating mills in the 2012 harvest year. The response rate was close to 100%.

The average mill employed around 35 seasonal employees and sources from close to 400 smallholder farmers. Coffee mills are thus large firms by developing countries' standards (see, e.g., Hsieh and Olken (2014)). There is dispersion in installed capacity, measured in tons of

[12] In terms of value the wet method yields significantly higher value addition for the Rwandan coffee chain as a whole. At the time of our surveys, export gate prices for wet-processed coffee (known as fully washed coffee) were around 40% higher than for dry-processed coffee (see Macchiavello and Morjaria (2015)) for details). Selling cherries to mills also yields higher revenues at the farm gate. The average price of cherries sold to mill was about 200 Rwandan Francs (RWF) per kilogram. In contrast, home processed parchment coffee fetched an average price of 760 RWF per kilogram. Since it takes approximately 5.5 to 6.0 kilograms of cherries to produce one kilogram of home-processed parchment irrespective of the processing method, the price of cherries under home processing is approximately 140 RWF per kilogram, substantially lower than the corresponding figure for cherries sold to mills.

[13] At the time of our 2017 survey there were 12 dry mills owned by exporters located around the capital.

cherry processing per year. Small mills have capacity up to 250 tons; medium-sized mills, which constitute the majority, typically have a capacity of 500 tons; and a handful of large mills have a capacity in excess of 1000 tons.

*Industry Evolution and Organizational Forms*

Figure II depicts the evolution of the industry. In the early 2002, there were only a handful of coffee mills operating in the country. In the past 15 to 20 years, the number of coffee mills in the country has continuously increased to 297 in 2017, the last year for which we have data available.

Besides the remarkable expansion in the number of mills and, consequently, in installed capacity, the ownership of coffee mills in the country has also changed dramatically over time. Shortly after the beginning of the industry, an increasing share of coffee mills begun to be owned by *domestic groups*, defined as companies that own at least two coffee mills in the country. By 2011, domestic groups owned 35% of the 200 mills constructed in the country.

Starting in 2011, and throughout the last decade, the industry has witnessed the entry of *foreign groups*, defined as companies controlled by foreign multinationals (MNCs) that own more than one mill in the country. By 2017, foreign firms control approximately 17% of the 297 mills operating in the country. However, domestic and foreign groups appear to be quite different in their entry strategy into the industry. Relative to domestic groups, foreign groups predominantly enter through acquisitions of existing mills (brownfield assets). Close to 82% of the foreign groups portfolio consists of mills that were already constructed. In contrast, domestic groups use both acquisitions and building new mills to enter the industry, with a larger share being mills that are greenfield investments (70%).

Both domestic and foreign groups have been involved in the exporting of coffee as their core activity, in most cases before they started acquiring control over mills. The emergence of groups is thus closely associated with backward integration strategies pursued by these companies. In between ownership and just providing milling and marketing services, there is a continuous of organizational forms that govern the relationship between mills and exporting companies. In increasing order of integration (i.e. more forward integration to complete backward integration), we can distinguish between the following:[14]

1. Coffee service provider (referred to often as CSP), in which the exporting company acts as an agent and provides only dry milling and marketing services to the mills;

2. Arm's length sourcing of coffee (independent);

3. Relational sourcing, in which the exporting company and the mills repeatedly interact over the course of several seasons, often with forward contracts and pre-financing arrangements;

[14]Note, by design, full forward integration in which the mill directly exports to a global buyer is not in our survey as the sample is only of exporters. However direct exporting in 2017 by mills is extremely rare in Rwanda, as only a handful of mills are engaged in direct trading. These mills are mainly NGO-supported mills and by volume account for less than 5% of coffee export volumes.

4. Renting, in which the exporting company fully operates the mill, without owning its assets;

5. (Backward) integration, in which the exporting company owns the assets invested in the mill and fully controls all its activities

A full breakdown of the different organizational forms that groups have in 2017 is provided in the Appendix Table B2. There are differences between domestic and foreign exporting companies in the organizational forms they operate. Foreign groups are more likely to have more interactions with mills than domestic groups – the average foreign group has 21 mills they interact with versus a domestic group which typically has 4 mills. Further foreign groups are more likely to relational source, own and be in some form of partnership with a mill then a domestic group.

In many cases, then, the acquiring company already had a relationship with the acquired washing station. For example, the acquired washing station might have previously supplied coffee to the exporting company. From now onward, we bundle ownership and rental agreements into a unique category and label it as ownership.[15]

## 2.2 Data

*Surveys of mills:* to understand performances of mills, we designed and implemented a survey in collaboration with the National Agricultural Exporting Board (NAEB) − the government institution in charge of the coffee sector. The training of all the survey modules was done by one of the author's. The survey was implemented towards the end of the harvest season (May through July) in 2012, 2015 and 2017 by four survey teams led by a qualified NAEB staff member. Interviews were pre-arranged and mill manager's participated for 3 to 6 hours to complete the survey. Our survey modules covered manager characteristics and their career history in the coffee industry, mill operations, finance and labor management. We also collected random samples of the mills output (parchment coffee) and assessed its quality attributes at a coffee laboratory for all three rounds of the survey.

The three rounds of surveys enable us to construct a panel dataset of highly detailed information of mill operations. In late 2015 we noted the increase in consolidation and entry of foreign groups in the industry, hence in order to understand and capture *management changes* in light of this, in the 2017 survey round an additional module on *changes at mill* was introduced.[16] This *change at mill* module asks questions with regards to management in five key areas of running successfully mill operations: (i) processes with regards to managing coffee cherry quality (the mill input), (ii) management of farmer incentives and training (suppliers), (iii) management of coffee collectors (intermediaries), (iv) operations of the mill with regards to

[15] Our empirical results are robust to only keeping owned mills, and dropping rented mills.

[16] This *change* at the mill module is inspired from first generation of management studies e.g. Black and Lynch (2001) and second generation of management studies, pioneered by Bloom and Van Reenen (2007). While we focus on a single-country approach and ask direct questions about management practices, we also embed like in the second generation studies a systematic codified management practices module.

capex, and IT investments and lastly (v) worker management. In total across these five areas we can investigate 12 important management practices that can be introduced and modified at the mill (see Table B3 for the complete list). For each management practice we obtain information on whether the practice was *attempted* (and if so, when), how *difficult* it was to implement the practice, if there was any *resistance* in implementing the practise (and if so, from whom) and lastly how much *autonomy* the mill manager has in changing the management practise.

*Survey of Exporters/Acquirers:* to understand the relationships and motives of exporters (acquirers) we directly collected in 2017 information from these buyers of mills on the processes through which they select target mills. One of the authors interviewed face-to-face all downstream buyers over 2-7 hour interviews. Our sample consists of 41 group owners, representing 91% of the export market. We collected systematically information on the reasons why they integrated specific mills, whether they considered other mills and – if yes – why they did not proceed. Besides its intrinsic value to understand the process of acquisitions by directly asking acquirers, this additional information informs us about the possibility of constructing better counterfactuals for acquisition. Essentially by constructing better control groups we implement a strategy akin to Greenstone et al. (2012)). Acquirers were also asked about management practises deployed at each mill they own or rent, i.e. the *changes at mill* module described above is also asked, partly to undertake a double-blind methodology validation but also to understand the differences in understanding between the mill operators and headquarters.

*Administrative & Other Data:* to understand the evolution of the industry we construct a mill-year panel data set from 2002 (when there were only 3 mills in the country) up to 2017. Given the industry's importance as a foreign exchange earner, mills are required since 2012 to report various performance measures in each year they operate. These include their operating capacity to process cherries for the season, and how many tons of cherries they processed. Using archival sources of company reports and interviewing industry veterans we are able to construct backward up to 2002 a panel of performance measures. Further by obtaining a list of owner names from the *Rwanda Commercial Registration Agency* and using our interviews we are able to designate type of owners to each mill. The industry is small enough that we can obtain the universe of owners and cross-check responses with multiple stakeholders. This information assists us to categorize which groups the mills belong too, foreign or domestic.

# 3 Theory [incomplete]

This section lays out a theoretical framework that guides the empirical analysis.

Imagine a world in which: (a) managerial talent and autonomy are complement and (b) autonomy requires higher (efficiency) wages.

- *Original sin* world: domestic groups either because of local politics or financing con-

straints buy/build mills only where they have personal relationships and end up hiring local managers → worse managers, who face more resistance and to whom they give less autonomy.

- *Capabilities* world: foreign groups have other capabilities (management systems, different demand channels...) that are complementary to managerial talent → because of these capabilities they are willing to pay more for better mills (whether it really matters to have a good manager) and end up acquiring those mills and placing the "right" manager (who face less resistance).

# 4 Foreign Group Ownership and Performance

The main results of the empirical analysis are split between this section and the next. This section investigates the effect of group ownership on performance. We distinguish between ownership of mills between foreign and domestic groups. Before turning to our regression analysis, descriptive statistics of performance measures already provide signs of performance differences across groups. In Table I, Panel A we note that foreign groups have larger mills, process more of the input material (cherries), produce more of the output material (parchment), in general it is of higher quality (Grade A) and with better efficiency (conversion rate), with lower operational cost to convert the input into 1 kg of output. Foreign groups hire more seasonal workers to help at the mill to manage cherries at the mill gate as well as to sort and dry the parchment. In terms of manager characteristics, foreign groups pay more to their managers (this per se might not be surprising as these managers are supervising larger mills), deploy higher educated and ability (as measured by raven tests) managers.

We report results using both difference-in-difference specifications, event-study designs and leveraging unique features of the "acquirer" survey we conducted in 2017 to explore the robustness of the main results when constructing alternative counterfactual and comparison groups for acquired mills.

Taken together, the results point at the fact that, following acquisition by a *foreign* group, the performance of the mill significantly improves. In contrast, we find that acquisition by *domestic* groups is not associated with systematic improvements in performance. This results raise the question of what might account for the difference between the performance of *foreign* and *domestic* groups. We explore those further in Section 5.

## 4.1 Operations

We start by considering difference-in-differences specifications on operational outcomes at the mill level. Table II reports results from a specification of the form

$$y_{it} = \phi_i + \eta_t + \beta^g \times \mathbf{I}^g_{it} + \epsilon_{it}$$

where $y_{it}$ is an outcome of interest for mill $i$ in year $t$, $\phi_i$ are mill fixed effects, $\eta_t$ are year fixed effects and $\epsilon_{it}$ is an error term. The independent variables of interest are dummies $\mathbf{I}^g_{it}$

taking value equal to 1 when the mill is owned by a group of type $g \in \{d, f\}$. Standard errors are clustered at the mill level.[17]

Panel A reports results simply comparing mills belonging to groups versus not, while Panel B splits the group dummy between *domestic* and *foreign* groups (and reports p-values for the joint test of equality $\beta^d = \beta^f$).

Columns 1 to 4 consider outcomes from the administrative records, and thus available for all mill-year. Columns 2 to 4 are conditional on the mill being operational in that year, hence the different number of observations. Columns 5 to 7, instead, focuses on outcomes that we could measure only during the surveys conducted in the years of 2012, 2015 and 2017. Note in the surveys we also solicit responses for the interim years to create a full panel between 2012-2017.

Column 1 shows that mills that belong to *foreign*, but not to *domestic*, groups are more likely to be operating in any given year. The dependent variable $y_{it}$is a dummy taking value equal to 1 if the mills is operating and equal to 0 otherwise. On average, in any given year, 89% of the mills operates. It is thus not unusual for mills to undergo operational difficulties so severe as to shut down the mill. Panel A shows that ownership to a group is associated with a much higher (5%) higher likelihood that the mill operates relative to stand alone mills. Panel B shows that this difference is entirely driven by foreign group ownership. Ownership by a domestic group is associated with a 0.03 coefficient, not statistically significant at conventional levels. Ownership of mills by foreign groups is instead associated with a very large 0.15 coefficient highly statistically significant. The two estimates are significantly different from each other (p-value$<$ 0.01). We will later document when exploring in greater detail selection into group ownership, that foreign groups if anything target particularly under-performing mills for acquisition, including those that are not operating at all.

Column 2 shows that mills that belong to *foreign* and *domestic* groups are both likely to increase installed capacity in any given year conditional on being operational. The dependent variable $y_{it}$ is the installed capacity (ln) of how many tons of cherries the pulping machine can process in a given year. Panel A shows that ownership to a group is associated with a much higher (8%-age points) likelihood that the mill increases installed capacity. Panel B shows that this difference is equally driven by both types of group ownership. The group dummy estimates for the domestic and foreign groups are not statistically different from each other.

Column 3 shows that mills that belong to *foreign*, but not to *domestic*, groups are more likely to process more cherries in any given year conditional on being operational. The dependent variable $y_{it}$ is the amount of cherries that the mill has processed in a given year (tons). Panel A shows that ownership to a group is associated with a 3%-age points, higher but not statistically significant at conventional levels. Panel B shows that this difference is entirely driven by foreign group ownership. Ownership by a domestic group is associated in fact with a negative 11.4%-age points when it comes to bringing in more coffee cherries to the mill, albeit not statistically significant at conventional levels. Ownership of mills by foreign groups is instead associated

[17]Results are also robust to two-way clustering [mill, group-year].

with a very large 54.3%-age points increase in procuring coffee cherries and this is highly statistically significant. The two estimates are significantly different from each other (p-value $< 0.01$).

The findings so far reveal that there is an increase in both installed capacity and procurement in mills belonging to *foreign* groups. Column 4, brings together both these results and shows that mills that belong to *foreign*, but not to *domestic*, groups are more likely to increase utilization of the mill. The dependent variable $y_{it}$ is the log of utilization of the mill which is defined as the ratio of the amount of cherries processed in a given year divided by the total capacity of the mill in the year. Panel A shows that ownership to a group is associated with lower utilization (7.3%-age points) but it is not statistically significant. Panel B shows that this difference is equally driven by both types of group ownership but in opposite directions. Ownership by a domestic group is associated with a reduction in utilization (21.6%-age points) whereas ownership of mills by foreign groups is instead associated with a very large increase in utilization (44.5%-age). The two estimates are significantly different from each other (p-value $< 0.01$).

Columns 5 to 7 now explores performance measures from the survey. Column 5 shows that mills belonging to *foreign*, but not to *domestic* groups are likely to increase the number of seasonal workers. In column 5 the dependent variable $y_{it}$ is the number of seasonal labor (ln) the mill deploys in the season. Seasonal laborers are essential for managing the process of turning the coffee cherries into parchment. Panel A shows that ownership to a group is not associated the number of seasonal workers. However, Panel B shows that there is difference between the two types of groups. Ownership by a domestic group is associated with a 0.02 coefficient, but not statistically significant at conventional levels. Ownership of mills by foreign groups is instead associated with a very large 0.29 coefficient and highly statistically significant. The two estimates are significantly different from each other (p-value = 0.03).

Aside utilization of the mill another key metric of mill performance is the capital to labour utilization. In column 6, we find that mills belonging to *foreign*, but not to *domestic*, groups are less capital intensive when it comes to the capital to labor ratio. The dependent variable $y_{it}$is the installed capacity as a proportion of seasonal labor deployed at the mill. Panel A shows that ownership to a group is not associated with a different capital to labor ratio. Panel B however shows mills under *foreign* group ownership have lower capital to labor ratio i.e. the foreign group mill utilizes capacity fully by bringing in the amount of labour required to fully exploit the capacity of the mill. Ownership by a domestic group is associated with a 0.06 coefficient, not statistically significant at conventional levels. Ownership of mills by foreign groups is instead associated with a very large negative 0.275 coefficient and highly statistically significant. The two estimates are significantly different from each other (p-value = 0.01).

Column 7 shows that mills that belong to *domestic*, but not to *foreign*, groups are likely to have a lower output to labor ratio. Not surprising, given *domestic* groups are unable to procure more cherries despite increasing installed capacity at the mill. This further demonstrates a challenge for the domestic mills, they have increased capacity but have not been able to procure

enough cherries yet their labor requirements have not been adjusted. This result points to the fact that the labor foreign groups deploy does not have decreasing marginal returns, the new seasonal workers are as productive as the older workers at the foreign mill.

In sum, Table II finds that mills acquired by foreign groups, but not by domestic groups, tend to perform better after acquisition: they are more likely to operate; have higher capacity utilization; they are *less* capital intensive and they produce more output per worker. Domestic groups on the other hand are mismanaging on both the procurement side as well as on the labor management side at the mill.

## 4.2 Costs

Table IV explores differences in performance in greater detail looking at unit costs, which considers the cost of converting the coffee cherries (the input to mills) into parchment coffee (the output of the mill). Data on unit costs of operations are only available from the survey data, i.e. for years of 2012-2017. Note in our 2012, 2015 and 2017 surveys we ask for data in the interim non-survey years to create a panel dataset between 2012 and 2017.

Column 1 considers first an overall measure of cost as reported by the mill manager. Specifically, we ask the mill manager to report the overall operating costs of the mill for the most recent completed harvest season. We divide the reported costs by the total output of the mill for that season. This provides us a summary measure that includes both variable and fixed production costs to produce 1 kg of the output material (parchment coffee). We specifically ask the manager to focus on cash flow outlays, rather than more complex accounting considerations. The seasonal nature of the industry facilitates this approach.

The estimate in Panel A reveals that mills that are owned by groups do not have different unit costs relative to stand alone mills. However, in Panel B, we find that mills owned by *foreign* groups report 9% lower unit costs than stand alone mills and 11.5% lower unit costs than mills belonging to *domestic* groups. The difference between domestic and foreign groups is statistically significant (p-value <0.01).

Columns 2 through 6 takes advantage of the relative simplicity of the production process to ask managers directly about the structure of variable costs specifically. Mills are characterized by a relatively simple technology that facilitates the calculation of unit costs of production. It takes approximately 5.5 to 6.0 kilograms of coffee cherries to produce 1 kg of mill parchment coffee, the mill output. Under a Leontieff technology approximation, the cost of producing 1 kg of parchment coffee is the sum of (i) the price paid to farmers for cherries, and (ii) other operating costs, including labor, capital, procurement, transport, marketing and overheads. The former accounts 60-70% of the total cost of processing.

Despite the radically different approach in measuring costs, column 2 finds a pattern qualitatively similar to the one found in Column 1. If anything, we find that mills owned by groups have variable unit costs that are 6% higher than stand alone mills, albeit the difference is not statistically significant at conventional level. The group affiliation, however, masks significant heterogeneity. We find that mills owned by domestic groups have 7% higher costs than both

stand alone mills and mills owned by foreign groups (p-value<0.10).

Columns 3 to 6 considers the main components of the variable unit costs separately: the costs of procuring coffee cherries (Columns 3, 4a and 4b), the costs of labour (Column 5) and other costs for processing material and procurement (Column 6). On average these costs account for approximately 65-70%, 15-20% and 5-10% of the variable costs of production for the typical mill. In this exercise, we exclude the costs of financing the working capital necessary to purchase cherries from the farmers. This is because, typically, the managers of mills owned by groups are not able to report figures regarding the sources of funds (e.g., working capital loans, advances from buyers, internal funds) used by the firm to pay farmers. We consider costs of working capital in further detail in the next section using the exporter survey.

Column 3 shows that, relative to stand alone mills and to foreign groups, mills owned by domestic group tend to have 6% higher costs for cherry procurement per kilo of output. The costs of cherries per kilo of output depends on two factors: the unit price paid to farmers for the cherries and the conversation ratio of converting cherries to parchment coffee (i.e. how many kgs of cherries are needed to obtain one kg of parchment). Columns 4a and 4b considers those two elements separately and finds that most of the difference is driven by a worse conversation ratio. The conversion is a parameter of the production function and should be not different across groups and stand alone mills because it is mechanical aspect of the machines. However we do find in Panel B that *domestic* groups have a higher conversion ratio ( 3.10%-age points) and the difference between domestic and foreign groups is marginally statistically significant (p-value =0.14). This potentially indicates a lower efficiency in domestic groups, i.e. more coffee cherries are needed to get to 1 kg of the output. Indications of poor storage and handling as well as concerns of mismanagement at the mill-gate (including theft).

Looking at the other sources of costs, Column 5 and 6 confirm that mills owned by foreign groups tend to have lower unit costs than firms owned by domestic groups. Column 5 shows that they have nearly 20% lower labour costs (p-value <0.10), a figure that matches closely the difference in output per worker in Column 7 of Table II. Column 6 encompasses a number of different costs, including procurement, transport and commissions to coffee collectors. The results indicate these costs to be lower in foreign groups, but not statistically significant given the noisy measures.

### 4.3 Threats to Identification Strategy

We now discuss various threats to the identification strategy and our robustness checks.

*Checking for Pre-trends.* The baseline specification has focused on a difference-in-difference (DID) specification with mill and year fixed effects. As in standard DID specifications, we have checked for pre-trends. We ran event study analysis for mill outcome measures available from the administrative panel dataset and repeat the prior analysis but this time we look at the effect by year relative to year of acquisition. Figures III show that, if anything, mills acquired by foreign groups were on negative pre-trends, at least for capacity utilization (Panel B) and

operational status (Panel C), consistent with the idea that foreign groups acquired and turned around poorly performing mills. Zero on the x-axis indicate the year in which the mill gets acquired (the year of purchase) and 1 is the first "birthday" of the mill in the groups portfolio and hence -1 indicates the year before the purchase. We further see that upon acquiring the foreign group utilizes the asset and the effect persists.

*Robustness to Counterfactual Exercises.* Table IV performs additional checks to our identification strategy by changing the sample of counterfactual mills used to evaluate the impact of the acquisition. While some of the reported specifications are standard in the literature, we also take advantage of the survey conducted with all the groups in the country in which we elicited – for each mill that the group had acquired – a set of mills that were existing at the time of the acquisition and that the acquirer would have considered as alternative targets. Reported reasons for choosing the particular targets was the mill was available for sale and the price point was appropriate. Reasons for failed acquisitions were predominately the price of the asset and often the asset seller had changed their mind.[18] For exposition simplicity, Table IV focuses on the three main mill performance outcomes discussed before: whether the mill is in operation (panel A), capacity utilization (panel B) and processing costs per kilo of output (Panel C).

For ease of comparison, column 1 repeats the reported estimates from the baseline specification. Column 2 restrict the sample to mills that have switched ownership at some point during their existence, thereby excluding from the control group mills that might have different trends influenced by unobservable characteristics that makes them unsuitable targets for acquisition. Note that since many mills are recent and/or have never been acquired the number of observations drops to approximately 40% of the original sample size. Despite this significant change in the sample, results are virtually unchanged and we still find economic and statistically significant differences in the performance of mills acquired by foreign groups versus domestic groups post-acquisition. Column 3 restricts the sample to only include mills that have belonged to a group at some point in time, and finds nearly identical results. Column 4 restricts the sample to only include mills that have changed ownership and whose new owner is a group.

We now take a different approach. In 2017, during our last survey, we conducted detailed interviews with CEOs and managing directors of the groups. During these interviews a series of detailed questions about the group acquisition strategy and processes was solicited. Among those, we elicited, for each separate mill in the groups portfolio, a set of comparable targets that the groups had considered acquiring at the time the mill had been acquired. We have 61 total target mills as being identified by the acquirer as equivalent mills to their acquisition. Note that a mill could be named as target for more than one mill and by more than one

[18] Failed acquisitions accounted for around 10% of the targets from our acquirer survey.

group.[19] Of these 61 counterfactual mills, 75% of them at some point belonged to a group.[20]

We now use this information from the acquirers directly to aid us in identifying appropriate counterfactuals. Column 5 runs the same specification as our baseline (column 1) but the sample includes all the mills the acquirer owns and provided a counterfactual mill. Note if a mill is mentioned as a target more than once it will appear in the sample the equivalent number of times. Results are qualitatively and economically similar to column 1, despite the sample size dropping by nearly half.

Column 6 further restricts the comparison to be within the pair-year of acquired and target mill. Specifically, we construct pairs of mills (acquired and its target) and include interactions of pair and year fixed effects as controls. Effectively, we are thus comparing the trajectory of acquired mills relative to the target mill allowing for common year effects across the two mills. Despite the significant drop in sample size (because of the fixed effects) and in degrees of freedom due to the inclusion of pair-year fixed effects, we find results that are qualitatively in line with, and economically larger then, the baseline results.

In column 7 we continue using the acquirer survey. As we asked the acquirer to provide a list of all the mills they source coffee from - we can use all the non-owned and non-rented mills as potential counterfactuals.[21] Results are strikingly equivalent to our baseline. Note the number of observations increases vis-a-vis our baseline sample because the same mill can be mentioned by more than one exporter and hence it appears in the sample equivalent times it is mentioned. Column 8 restricts the sample to only those mills the exporter is in relational sourcing (repeated sourcing with forward contracts and pre-financing arrangements). Results are further robust to this narrowing of the sample. Columns 9 and 10 repeat the analysis of columns 7 and 8 including acquirer-year fixed effects. Finally in column 11 we obtain from the acquirer all failed mill acquisitions, these mills are now included in the sample. The intuition being that those failed mills would have been desired mills to own but could not be owned. Results broadly remain in line with our baseline.

In sum, taken together, these checks assuage concerns that unobservable differences in trajectories across acquired and non-acquired mills drive the results. We are reasonably confident of having identified a positive impact on operational efficiency (utilization and costs) of being acquired by a foreign group.

*Two-way fixed estimation with heterogeneous treatment effects.* In a recent DID methodology paper, de Chaisemartin and D'Haultfoeuille (2020) note that in difference-in-difference designs with period and group fixed effects identifies weighted sums of average treatment effects

[19] In the early days of the industry, acquirers had limited options to consider other targets as there were relatively few mills - this prompted us to ask the acquirers, which other mill *today* (i.e. in 2017) would be an equivalent acquisition? We have 81 mills in this category. In unreported results, using these mills as another potential counterfactual findings are similar in terms of magnitude and statistical significance in line with the baseline.

[20] A breakdown of these transitions is as follows: 4 became part of a group the same year, 25 were part of a group before, and 13 became part of a group later.

[21] As outlined in Section 2.1, exporters can not only own or rent a mill, but can source from an independent mill, the exporter can be an agent for the mill ("coffee service provider"), they can also be in relational sourcing (providing pre-financing arrangements) and a mill could also have been a failed acquisition for the exporter.

(ATEs) in each group and period with weights that may be negative and propose a correction. In our case the coefficient for foreign is a weighted sum of 135 ATEs of which 3 receive a negative weight and the coefficient for domestic is a weighted sum of 802 ATEs, of which 341 receive a negative weight. In light of this we re-run our main analysis using Stata command *did _multiplegt* and our results are consistent with our main Table II and Table IV. Results are reported in Appendix Table –

# 5 Mechanisms

The results so far point at the fact that, following acquisition by a foreign group, the performance of the mill significantly improves. In contrast, we find that acquisition by domestic groups is not associated with systematic improvements in performance. This raises the natural question of what might account for the difference between the performance of foreign and domestic groups. This section investigates this further.

We first document that the superior post-acquisition performance of *foreign* relative to *domestic* groups *cannot* be explained by differences in mill technology and access to finance, two important factors highlighted by the previous literature.[22] In particular, we show that the exact type of equipment invested in mills owned by foreign and domestic groups is nearly identical. Appendix Table B5 documents that in fact domestic groups have *more* discs per pulping machine (column 1) but the type of pulping machine used (column 2 to 4) as well as other key mill infrastructure such as generators and the ratio of water tank capacity to drying tables (columns 5 to 9) is similar across domestic and foreign groups.[23] In our acquirer survey we ask the owners on their source of finance for working capital (which is required to purchase coffee cherries during the season).[24] We note in Appendix Table B4 that across domestic and foreign groups there is no statistical difference when it comes to sourcing working capital from financial institutions, using internal funds, borrowing from coffee suppliers (i.e. farmers) and obtaining loans from friends and partners (column 1 to 4).[25] These findings resonate with our earlier finding, that *domestic* groups, if anything, expand capital invested in the mills (Table II, column 2) thus suggesting that differences in access to finance are unlikely to be a driving factor in explaining performance differences.

We thus focus the reminder of Section 5 tests on two complementary sets of mechanisms. First, we distinguish *managers* versus *management*. We show that *foreign* groups hire what

[22] On differences in technology between domestic and foreign firms see, e.g., Guadalupe et al. (2012). On access to finance, Antras et al. (2009) and Manova et al. (2015) among others document how MNCs typically have better access to finance than domestic firms.

[23] There is a large difference in IT deployment between the foreign and domestic groups, but it does not help to explain much of performance difference (partly because we can only check in 2017 cross-section survey and there the difference in performance is not as stark.

[24] Out of the 6 foreign groups that report having only one funding source for their working capital: 4 source from internal funds and 2 from banks.Out of the 13 domestic groups that have only one funding source: 5 source from banks, 6 from their own funds, and 2 from friend and partners.

[25] In column 5, we do see a difference (p-value<0.10) when it comes to advances from foreign buyers. Domestic groups are more likely to obtain advance purchase finances from global buyers. This is not surprising compared to foreign groups, as these groups obtain finances from their parent companies and hence are less likely to report sourcing finance from foreign buyers.

appear to be better managers on observable characteristics: managers with higher education and cognitive skills. These groups also pay these managers more and grant them more autonomy. We also show that these manager characteristics, however, only account for a share of the post-acquisition performance difference between *foreign* and *domestic* groups.

The remaining share, appears to be accounted for by differences in *management*. Differences in management could lead to differences in performances because of differences in *knowledge* ("what to do") vs *implementation* ("how to do it"). We elicit detailed measures of the number of changes that managers tried to implement post-acquisitions. We find no difference in the amount and type of changes that managers in domestic and foreign groups attempted, suggesting that differences in *knowledge* are unlikely to drive results. We show, however, that managers in foreign groups face less resistance to these changes from both workers and farmers and report to have been more successful at implementing changes overall.[26] Differences in performance appear thus to be driven, at least in part, by differences in management *implementation*.

## 5.1 Managers vs Management [incomplete]

We begin our mechanism discussion by first looking at the managers deployed at the mills. Table V documents that both domestic and foreign groups change the mill manager soon after acquiring a new mill (column 1). In general a manager is changed every five years (mean 0.17), acquisitions nearly doubles the probability of a manager switch to 2-3 years. Foreign groups pay higher salaries (column 2). Both domestic and foreign groups hire younger managers with secondary education at least, however foreign groups prefer to hire university graduates and managers with higher ability as measured by a raven test. In sum, the evidence supports that there is manager selection across the two types of groups.

We note that foreign group managers are getting paid more when running a mill. Why is that? We run mincer regressions in Table VI and find that foreign group managers earn a premium even after controlling for manager characteristics from V (column 2) and also after controlling for the type of mill they are managing (column 3). In column 4 we additionally control for the manager's district of birth, we find conditional on the manager's birth place there is still a wage premium offered by foreign groups to their managers. In column 5 we exploit the panel nature of the sample and now instead control for manager fixed effects, results are qualitatively similar to our baseline. As this specification is more demanding in terms of including managers fixed effects, we lose close to 25% of our observations. In column 6 we include in addition to manager fixed effects, mill fixed effects, again we find results qualitatively similar to our baseline. Lastly, in column 7 we repeat the column 6 specification including this time the manager's district of birth. In essence, foreign groups hire better managers, pay them more even relative to their skills, ability, experience, birthplace and type of mill they run.

In light of the mincer manager salary regressions, we next investigate how much of the firm performance we observed in Section 4 can be explained by foreign groups having "better"

[26] The higher success in implementation reported by foreign managers corresponds to better performance, e.g., in practices aimed at increasing quality and implementing certification programs.

managers running the mill? Table VII makes an attempt to tease out the role of observable surveyed manager characteristics in explaining firm performance. Dependent variables in this table are key mill performance measures. Odd columns are baseline specifications akin to Tables II and IV and even columns include our standard managerial characteristics. Across all the key mill performance measures we find that having a "better" explains 25-50% of firm performance. Column 7 and 8 provide a placebo check - managers in the field cannot adjust the installed capacity of the pulping machine at the mill. The purchasing of pulping machine is headquarters decision.

### 5.2 Management: Knowledge vs Implementation [incomplete]

Both group managers know what to do, see Figure IV. Taking Figure IV to regression analysis provides Table VIII – total attempts and total resistance are dependant variables, and are provided with no controls and as well as with manager and mill controls.

### 5.3 Resistance to Change [incomplete]

### 5.4 Selection for Acquisitions [incomplete]

Table X provides the different ranking criteria for acq by the groups.

## 6 Conclusion

Markets in low-income countries often harbours (too) many unproductive firms. In this paper we study the Rwandan coffee industry that was initially characterized by widespread inefficiencies that has recently seen a process of consolidation in which exporters have acquired control of a significant number of mills giving rise to multi-plant groups. We combine administrative data with original surveys of both mills and acquirers to understand the consequences of this consolidation.

We learn that acquisition is potentially an important mechanism to improve market efficiency in low-income countries. But not all acquisitions are the same, foreign groups improve productivity and product quality. The difference in performance is not accompanied by changes in technology or differential access to capital but instead management capabilities. We learn that foreign groups target less well performing mills with higher potential for quality. They appoint better managers (younger, more educated and higher ability) and bring them from outside the district, pay them more and give them more autonomy. These "better" managers in foreign groups explain about half of the better performance associated with foreign ownership. The difference in performance reflects superior implementation, rather than management knowledge: following an acquisition, managers in domestic and foreign groups try to implement the same management changes but managers in domestic groups report significantly

higher resistance from both workers and farmers and fail to implement the changes. Foreign groups implement changes related to quality and succeed in implementing those quality related changes. The results have implications for our understanding of organizational change and for fostering market development in emerging markets.

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Table I: **DESCRIPTIVE STATISTICS**

| | Foreign Group | Domestic Group | Standalone Mills |
|---|---|---|---|
| **Panel A: Mill Characteristics** | | | |
| Mill Capacity (tons) | 600 | 513 | 339 |
| Cherries Processed (total, tons) | 478 | 369 | 195 |
| Total Production of Parchment (tons) | 103 | 83 | 45 |
| Grade A Parchment (%) | 77 | 76 | 75 |
| Conversion rate (kgs) | 5.08 | 5.13 | 5.26 |
| Cost of 1 kg output (parchment, RWF) | 1668 | 1919 | 1772 |
| Number of permanent workers | 6 | 6 | 5 |
| Number of seasonal workers | 71 | 55 | 41 |
| **Panel B: Manager Characteristics** | | | |
| Manager experience (years) | 6.31 | 6.45 | 5.18 |
| Manager with secondary education | 1.00 | 0.95 | 0.89 |
| Manager with college/university education | 0.77 | 0.48 | 0.36 |
| Manager raven score (z-score) | 0.14 | -0.13 | -0.27 |
| Manager monthly salary, USD | 340 | 245 | 210 |

*Note:* This table presents average key performance measures of mills from our last survey in 2017 across the three organizational forms in the industry: foreign groups of which they are 8, domestic groups of which there are 45, and standalone mills (domestic entrepreneurs who own a single mill) of which there are 150. Mills procure cherries and convert them into output (known as parchment). The mill output can be graded into 4 categories: A (the highest), B, C and triage. Conversion rate is a measure of physical efficiency, it the number of kgs of cherries required to produce 1 kg of parchment. Responses are by mill managers.

Table II: **OPERATIONS**

| Dependent Variable | (1) Operating = 1 | (2) Installed Capacity (tons, ln) | (3) Cherries Processed (tons, ln) | (4) Utilization (ln) | (5) Labor (# workers, ln) | (6) Capital to Labor (ln) | (7) Output to Labor (ln) |
|---|---|---|---|---|---|---|---|
| **Panel A: Group Ownership** | | | | | | | |
| Mill belongs to group | 0.056** | 0.080** | 0.029 | -0.073 | 0.075 | -0.013 | -0.098 |
| | (0.026) | (0.032) | (0.078) | (0.080) | (0.056) | (0.067) | (0.073) |
| **Panel B: Foreign vs. Domestic Group Ownership** | | | | | | | |
| Mill belongs to a foreign group | 0.146*** | 0.080** | 0.543*** | 0.445*** | 0.285** | -0.275** | 0.068 |
| | (0.039) | (0.040) | (0.121) | (0.121) | (0.114) | (0.119) | (0.117) |
| Mill belongs to a domestic group | 0.031 | 0.080** | -0.114 | -0.216*** | 0.020 | 0.056 | -0.141* |
| | (0.027) | (0.036) | (0.083) | (0.080) | (0.060) | (0.069) | (0.079) |
| Observations | 2,391 | 2,127 | 2,127 | 2,127 | 964 | 964 | 964 |
| Data Source | | Administrative (annual) | | | | Survey (2012, 15, 17) | |
| Mill and Year FE | Y | Y | Y | Y | Y | Y | Y |
| Mean dependent variable | 0.89 | 12.86 | 11.96 | 6.00 | 11.11 | 8.62 | 8.11 |
| P-value [Foreign = Domestic] | 0.00 | 0.99 | 0.00 | 0.00 | 0.03 | 0.01 | 0.08 |

*Note:* Standard errors are clustered at the mill-level. $***$ (**) [*] indicates significance at the 0.01 (0.05) [0.1] level. Panel A reports results simply comparing mills belonging to groups versus not, while Panel B splits the group dummy between *domestic* and *foreign* groups and reports p-values for the joint test of equality. Dependent variables in columns 1 to 4 are outcomes from administrative records, and thus available for all mill-year between 2002 and 2017. Columns 2 to 4 are conditional on the mill being operational in that season, hence the reduced number of observations. Column 1 is is a dummy variable taking value equal to 1 if the mills is operating and equal to 0 otherwise in that season. Column 2 is the installed capacity (ln) of the mill, i.e. how many tons of cherries the pulping machine can process in a given season. Column 3 is the amount of cherries that the mill has processed in a given season (ln, tons). Column 4, brings together dependent variables from columns 2 and 3 and creates a measure of utilization of the mill which is defined as the amount of cherries processed in a given season divided by the total capacity of the mill in the season. Columns 5 to 7, instead, focuses on outcomes that we could measure only during the surveys conducted in the years of 2012, 2015 and 2017. In column 5 the dependent variable is the number of the casual labor (ln) the mill deploys in the season. In column 6 the dependent variable is installed capacity as a proportion of seasonal labor deployed at the mill. In column 7 the dependent variable is output to labor ratio.

Table III: **COSTS**

| Dependent Variable | (1) Reported Cost per Kg Output (fixed + variable, ln) | (2) Calculated Cost per Kg Output (variable,ln) | (3) Cherries Cost per Kg Output (ln) | (4a) Average Price per Kg Cherries (ln) | (4b) Conversion Ratio (ln) | (5) Labor Cost per Kg (ln) | (6) Procurement and Other Costs (ln) |
|---|---|---|---|---|---|---|---|
| **Panel A: Group Ownership** | | | | | | | |
| Mill belongs to group | 0.007 | 0.061 | 0.053** | 0.004 | 0.027* | 0.010 | 0.149 |
| | (0.026) | (0.038) | (0.024) | (0.014) | (0.095) | (0.095) | (0.125) |
| **Panel B: Foreign vs. Domestic Group Ownership** | | | | | | | |
| Mill belongs to a foreign group | -0.091** | -0.008 | 0.018 | -0.012 | 0.000 | -0.184 | -0.048 |
| | (0.046) | (0.059) | (0.035) | (0.022) | (0.024) | (0.137) | (0.214) |
| Mill belongs to a domestic group | 0.023 | 0.072* | 0.059** | 0.007 | 0.031** | 0.042 | 0.182 |
| | (0.027) | (0.038) | (0.024) | (0.015) | (0.013) | (0.097) | (0.124) |
| Observations | 854 | 854 | 854 | 854 | 854 | 854 | 854 |
| Mill and Year FE | Y | Y | Y | Y | Y | Y | Y |
| P-value [Foreign = Domestic] | 0.01 | 0.10 | 0.12 | 0.37 | 0.14 | 0.07 | 0.22 |

*Note:* Standard errors are clustered at the mill-level. $***$ (**) [*] indicates significance at the 0.01 (0.05) [0.1] level. Panel A reports results simply comparing mills belonging to groups versus not, while Panel B splits the group dummy between *domestic* and *foreign* groups and reports p-values for the joint test of equality. The data used in this analysis focuses on outcomes of processing costs that we could measure only during the surveys conducted in the years of 2012, 2015 and 2017. Column 1 uses the mill managers reported overall operating costs for the most recent completed harvest season and we divide these reported costs by the total output of the mill for that season. This provides us a summary measure that includes both variable and fixed production costs to produce 1 kg of the output material (parchment coffee). Columns 2 through 6 take advantage of the relative simplicity of the production process to ask managers directly about the structure of variable costs specifically. Column 2 uses only the variable cost of this total operating costs. Columns 3 to 6 considers the main components of the variable unit costs separately. The costs of procuring coffee cherries (columns 3), can be further broken down into two factors: the unit price paid to farmers for the cherries (column 4a) and the conversation ratio of converting cherries to parchment coffee (column 4b). The costs of labour (Column 5) and column 6 encompasses a number of other costs (including procurement, transport and commissions to coffee collectors).

Table IV: **ROBUSTNESS TO COUNTERFACTUALS**

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Panel A** | **Dependent variable: Mill Operating (=1)** | | | | | | | | | | |
| Mill belongs to a foreign group | 0.146*** | 0.126** | 0.148*** | 0.165** | 0.035 | 0.131 | 0.084** | 0.084* | 0.080* | 0.092* | 0.090 |
| | (0.039) | (0.056) | (0.052) | (0.068) | (0.040) | (0.083) | (0.039) | (0.045) | (0.043) | (0.055) | (0.062) |
| Mill belongs to a domestic group | 0.031 | 0.040 | 0.028 | 0.068 | -0.038 | -0.054* | 0.009 | 0.014 | 0.011 | 0.019 | -0.016 |
| | (0.027) | (0.038) | (0.031) | (0.050) | (0.032) | (0.031) | (0.026) | (0.033) | (0.027) | (0.036) | (0.043) |
| Observations | 2,391 | 996 | 1,096 | 755 | 1,131 | 826 | 2,406 | 1,517 | 2,225 | 1,347 | 1,125 |
| R-squared | 0.339 | 0.300 | 0.298 | 0.328 | 0.318 | 0.615 | 0.304 | 0.302 | 0.353 | 0.350 | 0.431 |
| Mean Dependent Variable | 0.890 | 0.851 | 0.891 | 0.850 | 0.925 | 0.941 | 0.927 | 0.922 | 0.931 | 0.919 | 0.913 |
| P-value [Foreign = Domestic] | 0.001 | 0.052 | 0.004 | 0.037 | 0.097 | 0.046 | 0.031 | 0.081 | 0.067 | 0.116 | 0.033 |
| **Panel B** | **Dependent variable: Utilization (ln)** | | | | | | | | | | |
| Mill belongs to a foreign group | 0.445*** | 0.324** | 0.367*** | 0.393** | 0.312** | 0.297 | 0.435*** | 0.482*** | 0.437*** | 0.568*** | 0.459*** |
| | (0.121) | (0.134) | (0.122) | (0.165) | (0.156) | (0.312) | (0.138) | (0.153) | (0.160) | (0.198) | (0.172) |
| Mill belongs to a domestic group | -0.216*** | -0.240** | -0.258*** | -0.213* | -0.211 | -0.109 | -0.126 | -0.105 | -0.054 | -0.036 | -0.082 |
| | (0.080) | (0.095) | (0.076) | (0.122) | (0.141) | (0.174) | (0.096) | (0.112) | (0.098) | (0.117) | (0.144) |
| Observations | 2,127 | 848 | 976 | 642 | 1,046 | 732 | 2,231 | 1,398 | 2,063 | 1,236 | 1,012 |
| R-squared | 0.645 | 0.629 | 0.631 | 0.633 | 0.639 | 0.778 | 0.617 | 0.595 | 0.663 | 0.640 | 0.707 |
| Mean dependent variable | 6.001 | 5.948 | 6.068 | 6.011 | 6.115 | 6.248 | 6.131 | 6.110 | 6.164 | 6.154 | 6.138 |
| P-value [Foreign = Domestic] | 0.000 | 0.000 | 0.000 | 0.000 | 0.001 | 0.102 | 0.000 | 0.000 | 0.001 | 0.000 | 0.007 |
| **Panel C** | **Dependent variable: Cost per kg of output (variable, ln)** | | | | | | | | | | |
| Mill belongs to a foreign group | -0.007 | 0.077 | 0.025 | 0.114 | 0.128 | 0.078 | 0.036 | -0.038 | 0.002 | -0.075 | 0.054 |
| | (0.056) | (0.063) | (0.058) | (0.083) | (0.095) | (0.082) | (0.083) | (0.075) | (0.076) | (0.087) | (0.100) |
| Mill belongs to a domestic group | 0.084** | 0.138*** | 0.094** | 0.183*** | 0.139** | 0.170** | 0.092** | 0.079 | 0.125*** | 0.098* | 0.138* |
| | (0.038) | (0.050) | (0.038) | (0.062) | (0.064) | (0.075) | (0.045) | (0.053) | (0.048) | (0.056) | (0.074) |
| Observations | 959 | 347 | 396 | 260 | 435 | 318 | 1,062 | 688 | 991 | 620 | 437 |
| R-squared | 0.447 | 0.436 | 0.452 | 0.446 | 0.388 | 0.771 | 0.446 | 0.427 | 0.549 | 0.535 | 0.554 |
| Mean Dependent Variable | 7.282 | 7.277 | 7.301 | 7.265 | 7.288 | 7.293 | 7.287 | 7.285 | 7.286 | 7.284 | 7.268 |
| P-value [Foreign = Domestic] | 0.044 | 0.197 | 0.126 | 0.185 | 0.871 | 0.159 | 0.374 | 0.049 | 0.028 | 0.011 | 0.153 |
| **Sample** | Baseline | Ownership Change | Ever in Group | Acquired by Group | Potential Target Match | Potential Target Match | All Sourcing Mills | Only Relational Sourcing | All Sourcing Mills | Only Relational Sourcing | Failed Acquisitions |
| **Fixed Effects All Panels** | | | | | | | | | | | |
| Mill and Year FE | Y | Y | Y | Y | Y | - | Y | Y | - | - | - |
| Mill and Year-Pair FE | N | N | N | N | N | Y | N | N | - | - | - |
| Mill and Year-Acquirer FE | N | N | N | N | N | N | N | N | Y | Y | Y |

*Note:* Standard errors are clustered at the mill-level. $***$ ($**$) [$*$] indicates significance at the 0.01 (0.05) [0.1] level. The Table focuses on three main mill performance outcomes: whether the mill is operational (panel A), capacity utilization (panel B) and processing costs per kilo of output (Panel C). Column 1 reports our baseline specification. Column 2 restricts the sample to mills that have switched ownership at some point during their existence. Column 3 restricts the sample to only include mills that have belonged to a group at some point in time. Column 4 restricts the sample to only include mills that have changed ownership and whose new owner is a group. Column 5 runs our baseline specification (column 1) but the sample now includes all mills the acquirer owns and provided a counterfactual mill. Note if a mill is mentioned as a target more than once it will appear in the sample the equivalent number of times. Column 6 further restricts the comparison to be within the pair-year of acquired and target mill. We construct pairs of mills (acquired and its target) and include interactions of pair and year- fixed effects as controls. In column 7 we continue using the acquirer survey. We asked the acquirer to provide a list of all the mills they source coffee from - we now use all the non-owned and non-rented mills as potential counterfactuals. Column 8 restricts the sample to only those mills the acquirer is in relational sourcing (i.e. those mills in which the exporting company and the mills repeatedly interact over the course of several seasons, often with forward contracts and pre-financing arrangements). Columns 9 and 10 repeats the analysis of columns 7 and 8 including acquirer-year fixed effects. Column 11 includes from the acquirer survey the failed acquisitions.

Table V: **MANAGER CHARACTERISTICS**

| Dependent Variable | (1) Manager Change Indicator | (2) Monthly Salary (ln) | (3) Incentive Pay Indicator | (4) Experience, in years | (5) Gender (1 = Female) | (6) Age, in years | (7) Secondary Education or more | (8) Post Secondary or more | (9) Trust (z-score) | (10) Raven Score (z-score) | (11) Raven Score (No Mill FE) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Panel A: Group Ownership** | | | | | | | | | | | |
| Mill belongs to group | 0.107*** | 0.255* | -0.007 | -0.169 | -0.005 | -4.817*** | 0.089** | 0.073 | -0.190 | 0.252 | 0.196** |
| | (0.037) | (0.146) | (0.057) | (0.400) | (0.062) | (1.701) | (0.045) | (0.074) | (0.158) | (0.190) | (0.090) |
| **Panel B: Foreign vs. Domestic Group Ownership** | | | | | | | | | | | |
| Mill belongs to a foreign group | 0.124* | 0.618*** | -0.036 | -0.622 | -0.105 | -6.992*** | 0.091* | 0.197** | -0.096 | 0.470 | 0.424*** |
| | (0.066) | (0.194) | (0.091) | (0.688) | (0.076) | (2.296) | (0.051) | (0.098) | (0.230) | (0.310) | (0.162) |
| Mill belongs to a domestic group | 0.103*** | 0.162 | 0.001 | -0.050 | 0.020 | -4.285** | 0.089** | 0.042 | -0.214 | 0.201 | 0.121 |
| | (0.037) | (0.150) | (0.056) | (0.438) | (0.065) | (1.791) | (0.045) | (0.082) | (0.163) | (0.202) | (0.095) |
| Observations | 1,583 | 547 | 550 | 1,583 | 554 | 545 | 552 | 552 | 549 | 312 | 442 |
| Year FE | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Mill FE | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | - |
| Cluster SE Mill level | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Mean dependent variable | 0.17 | 12.08 | 0.15 | 4.67 | 0.13 | 36.80 | 0.89 | 0.40 | 0.00 | 0.00 | 0.00 |
| P-value [Foreign = Domestic] | 0.73 | 0.00 | 0.65 | 0.43 | 0.08 | 0.20 | 0.94 | 0.14 | 0.57 | 0.40 | 0.07 |

*Note:* Standard errors are clustered at the mill-level. $***$ ($**$) [$*$] indicates significance at the 0.01 (0.05) [0.1] level. Panel A reports results simply comparing mills belonging to groups versus not, while Panel B splits the group dummy between *domestic* and *foreign* groups and reports p-values for the joint test of equality. Dependent variables are as follows: column 1 is as dummy variable taking a value of 1 if the manager is different from the previous season, column 2 is the monthly salary (ln) of the mill manager, column 3 is a dummy variable taking a value of 1 if the HQ of the mill offers mill managers incentive pay, column 4 is the number of years of experience in the coffee industry (ln), column 5 is a dummy taking a value of 1 if the gender of the manager is female, column 6 is the age of the mill manager (years), column 7 is a dummy variable taking a value of 1 if the mill manager had secondary education, column 8 is a dummy variable taking a value of 1 if they have completed post-secondary education, column 9 is a standardized z-score of World Value Survey questions and column 10 and 11 are standardized z-scores of raven tests. In our 2017 mill manager survey we are able to obtain the career history of managers and hence we are able to construct a manager-year panel from this information.

Table VI: **MINCER MANAGER SALARY**

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|---|---|---|---|---|---|---|
| Dependent Variable | Monthly Salary (ln) | | | | | | |
| **Panel A: Group Ownership** | | | | | | | |
| Mill belongs to group | 0.225*** | 0.239*** | 0.164** | 0.136* | 0.570*** | 0.453 | 0.462 |
| | (0.055) | (0.063) | (0.074) | (0.075) | (0.216) | (0.313) | (0.307) |
| **Panel B: Foreign vs. Domestic Group Ownership** | | | | | | | |
| Mill belongs to a foreign group | 0.586*** | 0.521*** | 0.416*** | 0.372*** | 0.921*** | 0.834* | 0.638 |
| | (0.069) | (0.082) | (0.096) | (0.010) | (0.295) | (0.490) | (0.503) |
| Mill belongs to a domestic group | 0.112* | 0.151** | 0.0979 | 0.0806 | 0.488** | 0.411 | 0.442 |
| | (0.058) | (0.067) | (0.076) | (0.076) | (0.224) | (0.322) | (0.316) |
| Observations | 635 | 454 | 454 | 454 | 344 | 294 | 281 |
| Sample | Survey (2012-2015-2017) | | | | | | |
| Manager Controls | N | Y | Y | Y | - | - | - |
| Mill Controls | N | N | Y | Y | N | - | - |
| Manager District of Birth | N | N | N | Y | N | N | Y |
| Year FE | Y | Y | Y | Y | Y | Y | Y |
| Manager FE | N | N | N | N | Y | Y | Y |
| Mill FE | N | N | N | N | N | Y | Y |
| P-value (Foreign = Domestic) | 0.00 | 0.00 | 0.00 | 0.001 | 0.09 | 0.25 | 0.65 |

*Note:* Standard errors are clustered at the mill-level. $***$ ($**$) [$*$] indicates significance at the 0.01 (0.05) [0.1] level. Panel A reports results comparing mills belonging to groups versus not, while Panel B splits the group dummy between *domestic* and *foreign* groups and reports p-values for the joint test of equality. Dependent variables across all columns is monthly salary (ln). Manager controls are the age, age squared, experience, experience squared, whether manager attended secondary school or not, whether manager attended college/university or not, gender dummy, province of birth dummy, marital status dummy and a z-score of cognitive ability (numeracy and raven tests). Mill controls are the mill age, installed capacity (ln), district of mill location, whether the mill is under private ownership or not, and whether the mill is new construction). Sample for all the columns is the panel of surveys fielded in 2012, 2015, and 2017 to mill managers.

Table VII: **FIRM PERFORMANCE - MANAGERS VS. MANAGEMENT**

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
|---|---|---|---|---|---|---|---|---|
| Dependent Variable | Operating =1 | | Cherries Processed (tons, ln) | | Quality, A Grade (%) | | Installed Capacity (tons, ln) | |
| Mill belongs to a foreign group | 0.146*** | 0.077** | 0.543*** | 0.396*** | 3.263* | 2.492 | 0.080** | 0.075* |
| | (0.039) | (0.04) | (0.121) | (0.123) | (1.791) | (1.871) | (0.040) | (0.042) |
| Mill belongs to a domestic group | 0.030 | 0.013 | -0.114 | -0.126 | 1.100 | 0.467 | 0.080** | 0.074** |
| | (0.027) | (0.024) | (0.083) | (0.079) | (1.411) | (1.393) | (0.036) | (0.033) |
| Observations | 2,391 | 2,391 | 2,127 | 2,127 | 999 | 999 | 2,127 | 2,127 |
| Manager Characteristics | N | Y | N | Y | N | Y | N | Y |
| R-squared | 0.339 | 0.407 | 0.699 | 0.712 | 0.967 | 0.969 | 0.863 | 0.868 |
| Mill and Year FE | Y | Y | Y | Y | Y | Y | Y | Y |
| P-value [Foreign = Domestic] | 0.00 | 0.06 | 0.00 | 0.00 | 0.15 | 0.23 | 0.99 | 0.98 |

*Note:*

Table VIII: **MANAGEMENT - KNOWLEDGE VS. RESISTANCE TO MANAGEMENT PRACTICES**

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| Dependent Variable | Total Attempted Management Practices | | Total Resistance to Management Practices | |
| **Panel A: Group Ownership** | | | | |
| Mill belongs to group | 0.199 | -0.169 | 0.638 | 1.079 |
| | (0.368) | (0.424) | (0.543) | (0.765) |
| **Panel B: Foreign vs. Domestic Group Ownership** | | | | |
| Mill belongs to a foreign group | 0.255 | 0.0961 | -0.216 | 0.304 |
| | (0.490) | (0.601) | (0.769) | (1.103) |
| Mill belongs to a domestic group | 0.169 | -0.268 | 1.110* | 1.368* |
| | (0.420) | (0.476) | (0.599) | (0.802) |
| Observations | 265 | 219 | 265 | 219 |
| Manager controls | N | Y | N | Y |
| Mill controls | N | Y | N | Y |
| P-value [Foreign = Domestic] | 0.868 | 0.568 | 0.100 | 0.311 |

*Note:*

Table IX: **CHANGES WITH REGARDS TO QUALITY**

| Dependent Variable | (1) # of Attempted Changes | (2) # of Attempted Changes | (3) # of Attempted Changes | (4) # of Successful Changes | (5) # of Successful Changes | (6) # of Successful Changes | (7) # of Resistance Instances | (8) # of Resistance Instances | (9) # of Resistance Instances |
|---|---|---|---|---|---|---|---|---|---|
| **Panel A: Group Ownership** | | | | | | | | | |
| Mill belongs to group | 0.238** | 0.229** | 0.187* | 0.301*** | 0.235** | 0.168 | -0.007 | -0.005 | -0.003 |
| | (0.094) | (0.109) | (0.113) | (0.090) | (0.104) | (0.114) | (0.129) | (0.150) | (0.174) |
| **Panel B: Foreign vs. Domestic Group Ownership** | | | | | | | | | |
| Mill belongs to a foreign group | 0.443*** | 0.373** | 0.357** | 0.519*** | 0.411*** | 0.422** | -0.194 | -0.128 | -0.115 |
| | (0.123) | (0.162) | (0.175) | (0.124) | (0.151) | (0.163) | (0.181) | (0.205) | (0.229) |
| Mill belongs to a domestic group | 0.126 | 0.157 | 0.112 | 0.181* | 0.147 | 0.057 | 0.097 | 0.056 | 0.045 |
| | (0.106) | (0.116) | (0.126) | (0.099) | (0.112) | (0.125) | (0.142) | (0.160) | (0.189) |
| Observations | 265 | 264 | 223 | 265 | 264 | 223 | 265 | 264 | 223 |
| Robust SE | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| District FE | N | Y | Y | N | Y | Y | N | Y | Y |
| Mill Controls | N | Y | Y | N | Y | Y | N | Y | Y |
| Manager Controls | N | N | Y | N | N | Y | N | N | Y |
| Mean dependent variable | 2.28 | 2.28 | 2.28 | 2.03 | 2.03 | 2.03 | 0.77 | 0.77 | 0.77 |
| P-value [Foreign = Domestic] | 0.044 | 0.249 | 0.318 | 0.065 | 0.264 | 0.334 | 0.009 | 0.155 | 0.199 |

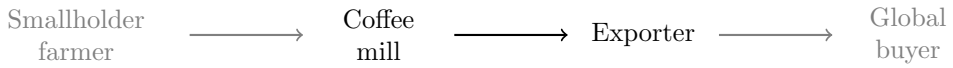
*Note:*

Table X: **MOTIVES FOR ACQUISITIONS**

| **Criteria for Acquisitions** | (1) **Domestic Group Rank** | (2) **Foreign Group Rank** |
|---|---|---|
| Density of farmers around the CWS | 1 | 3 |
| Quality of the Coffee | 2 | 1 |
| Quality of the terrain and weather around the CWS | 3 | 4 |
| Personal relationships with the owner/manager of the CWS | 4 | 9 |
| Quality of the relationship between the CWS and the farmers | 5 | 6 |
| Volume of Productive Capacity at the CWS | 6 | 2 |
| Personal relationship with other prominent businessmen near the CWS | 7 | 12 |
| Diversification of sourcing for quality purposes | 8 | 12 |
| Distance from Kigali | 9 | 12 |
| Quality of infrastructure (roads, electrification) at/around the CWS | 10 | 5 |
| Diversification of sourcing for supply-guarantee purposes | 11 | 7 |
| Certifications of the CWS (eg: Fair Trade, Rainforest, Utz, etc) | 12 | 8 |
| Presence of many other CWSs around the CWS | 13 | 10 |
| Number of Exporter Groups | 23 | 7 |

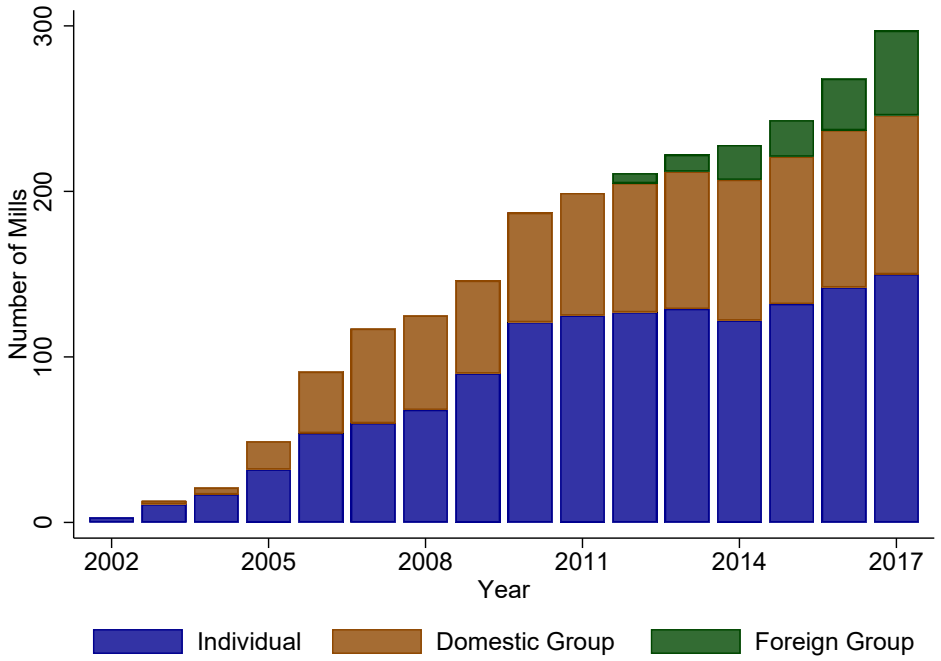
*Note:* This table ranks motives of acquisition by the CEO/MD of exporters that own or rent mills. Respondents were not constrained to rank all the criterion's, instead they could rank as few or as many. All the criterion not ranked get a ranking immediately below the last ranked criterion. We standardize the ranking by respondent to address the number of criterion's ranked. Standardized ranking criteria are averaged by domestic groups (23) and foreign groups (7), in columns 1 and 2 respectively. For clarity of exposition, domestic group's criteria are sorted in ascending order, with 1 indicating most important and 13 least important. Equal ranking reflects ties. Responses are from the acquirer survey conducted in the harvest season of 2017 of groups that acquired mills. Exporters that do not own or rent a station were not asked this question.

Figure I: COFFEE SUPPLY CHAIN IN RWANDA



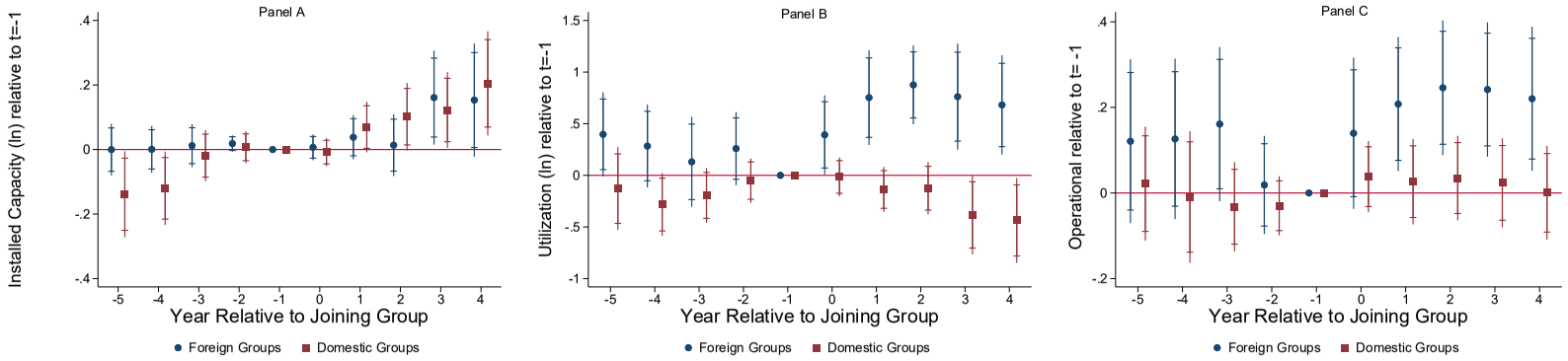

*Note:* This figure depicts the linear supply chain for mill processed coffee in Rwanda. Coffee cherries are produced by smallholder farmers and sold to mills (often referred to also as washing stations or wet mills). Mills sell or internally transfer parchment (the output of mills) to exporters. Exporters consolidate, dry mill, and mix parchment coffee into green coffee before exporting to a global buyer outside Rwanda. As illustrated by the figure our focus is on the backward integration of exporters and coffee mills.

Figure II: **INDUSTRY EVOLUTION**



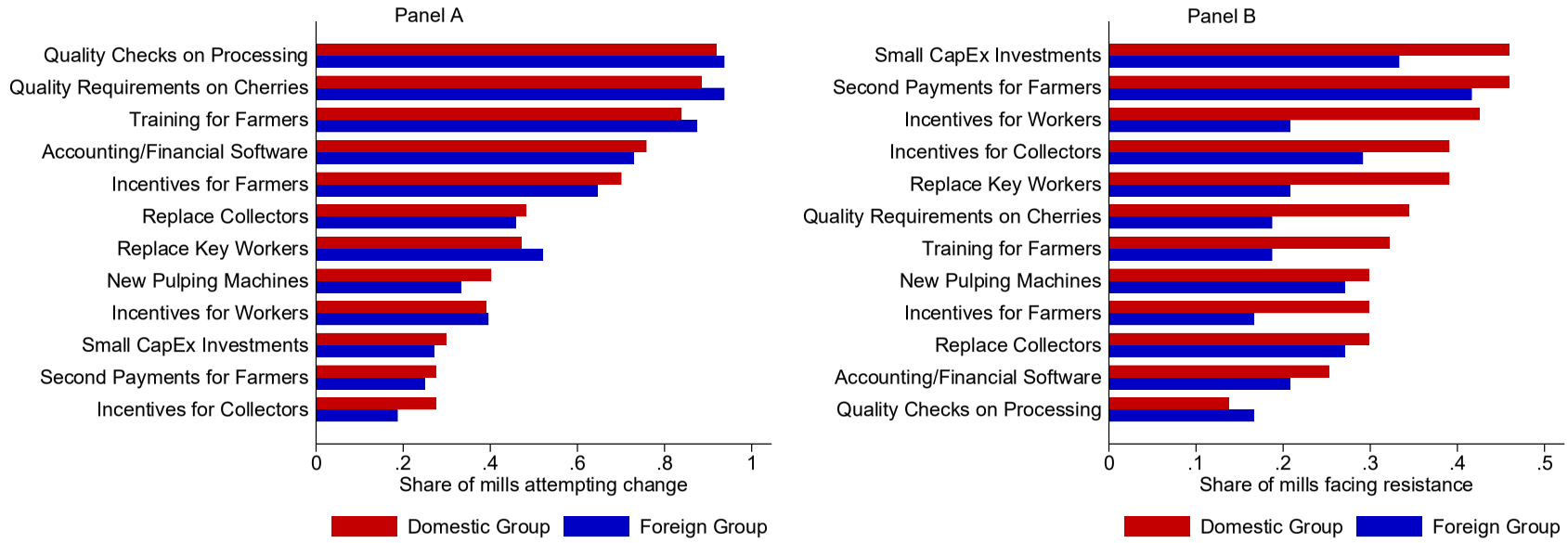

*Note:* This figure depicts the industry evolution of Rwanda's coffee mills for the period 2002-2017. In 2002 there were a handful of mills operating in the country. The figure displays a rapid growth and consolidation of the industry. Until 2011 all mills were under the ownership of domestic companies, either as entrepreneurs operating stand alone mills (referred to as *individual* above) or as groups, whereby the company owns at least 2 mills (referred to as *domestic group* above). From 2012 the industry experienced another change, the beginning of foreign multinationals owning mills (referred to as *foreign group*). By 2017, of the 297 mills 50% were under group ownership. There are 7 foreign groups owning a total of 51 mills of which majority of their portfolio is composed of brownfield investments (82%). In terms of domestic groups there are 45 groups owning a total of 96 mills of which 70% are greenfield.

Figure III: **EVENT STUDIES**




*Note:* Using our administrative panel dataset for the period 2002 to 2017 we have two key mill performance measures to enable use to conduct standard event study analysis. We modify our main specification by including a time interaction prior to the mill joining the group. Time is defined as the time relative to acquisition. The omitted category is the year before joining the group. On the x-axis 0 denotes the year in which the mill becomes part of the group, hence it is the year of purchase, 1 is the 1st whole season the mill has been part of the group and -1 is the season prior to purchase. In Panel A the outcome variable is installed capacity, in Panel B it is capacity utilization of the mill and in Panel C it is whether the mill is operational or not. Mill fixed effects are included in the specification and standard errors are clustered at the mill level. Note our sample only includes mills that have at most one change in ownership and that were not owned by a group at the time they were built. For estimation purposes, a dummy for each year relative to purchase is included in the specification. For exposition purposes, we include the coefficients of 5 years prior to acquisition and up to 4 years post acquisition.

Figure IV: **KNOWLEDGE VS. IMPLEMENTATION**




*Note:* Observations are manager responses to the *change at mill* module fielded in 2017 harvest season. Responses are organized in both panels as ascending order of domestic groups answers. For each management practice managers are asked if they attempted (Panel A) and faced resistance (Panel B) across all the 12 management practices. Across all the 12 management practices we observe domestic and foreign managers respond very similarly across all practices. However when it comes implementation of the 12 management practices we observe challenges are different across the two group types. Domestic group managers report uniformly across all 12 practises much more resistance.

# Appendix

# Acquisitions, Management and Efficiency in Rwanda's Coffee Industry

***by*** **Rocco Macchiavello and Ameet Morjaria**

**September 2021**

## Table of Contents

# A Additional Tables

## List of Tables

Table B1: **MILL CHARACTERISTICS – 2012 SURVEY**

| | (1) Mean | (2) $25^{th}$ Pct. | (3) Median | (4) $75^{th}$ Pct. | (5) Obs |
|---|---|---|---|---|---|
| Mill age, years | 4.090 | 2 | 4 | 6 | 178 |
| Theoretical Capacity (tons of cherries) | 423.1 | 250 | 340.9 | 500 | 173 |
| Production (tons of parchment coffee) | 46.01 | 15 | 32 | 60 | 177 |
| Cherries Purchased (tons) | 294.8 | 102.4 | 199.9 | 400 | 174 |
| Seasonal employees | 35.13 | 16 | 30 | 50 | 171 |
| Cooperative status, dummy | 0.466 | 0 | 0 | 1 | 178 |
| Farmers in catchment area that sell to mill | 396.0 | 170 | 310 | 500 | 170 |
| NGO-supported mill, dummy | 0.264 | 0 | 0 | 1 | 178 |
| Total Unit Cost (RWF per kg) | 1793 | 1600 | 1800 | 1956 | 178 |
| Total Processing Unit Cost (RWF per kg) | 705.3 | 500.0 | 699.0 | 831.0 | 177 |

*Note:* Mill characteristics are obtained from the survey of mills in 2012. Responses are by mill managers.

Table B2: **ORGANIZATIONAL FORMS BETWEEN EXPORTERS & MILLS**

| | Exporter Type | |
|---|---|---|
| Relationship with mill | Foreign Group (8) | Domestic Group (31) |
| Coffee Service Provider (CSP) | 2.00 | 0.81 |
| Arm's length (independent supplier) | 0.50 | 0.68 |
| Relational Sourcing | 12.38 | 0.32 |
| Rent | 0.88 | 0.16 |
| Own | 5.50 | 2.13 |
| Total Mills Sourcing | 170 | 127 |
| Average Relationships | 21.30 | 4.10 |

*Note:* In between owning mills and simply providing milling and marketing services to mills, there is a continuum of organizational forms that govern the relationship between mills and exporting companies. In increasing order of integration (i.e. more forward integration to complete backward integration), we can distinguish between (i) coffee service provider (CSP), in which the exporting company acts as a agent and provides only dry milling (final step prior to exporting to global buyers) and marketing services to the mills (ii) arm's length sourcing of coffee (independent suppliers); (iii) relational sourcing, in which the exporting company and the mills repeatedly interact over the course of several seasons, often with forward contracts and pre-financing arrangements; (iv) renting, in which the exporting company fully operates the mill, without owning its assets and (v) (backward) integration, in which the exporting company owns the assets invested in the mill and fully controls all its activities. Each interviewed exporter was asked to designate their relationship with *every* mill they source coffee from. This table provides a summary from those responses across group (foreign vs domestic) and relationship types the number of mills in each designated organizational form. Their are 8 foreign groups and 31 domestic groups who export close to 90% of Rwanda's exports. Responses for each relationship are average mill per group type, e.g. foreign groups on average own 5.50 mills. Note the total mills sourcing are all the mills each group sources from, the 8 foreign groups source and interact with 170 mills, where as the 31 domestic groups interact with 127 mills.

Table B3: **MANAGEMENT PRACTICES SURVEY MODULE**

| Area | Management Practice |
|---|---|
| Quality | Quality Checks on Processing |
| | Quality Requirements |
| Farmers | Training Farmers |
| | Incentives for Farmers |
| | Second Payments to Farmers |
| Collectors | Replace Collectors |
| | Incentives for Collectors |
| Operational | Accounting/Financial Software |
| | Small CapEx Investments |
| | New Pulping Machines |
| Workers | Replace Key Workers |
| | Incentives for Workers |

*Note:* The 2017 mill survey included an additional module titled *changes at mill* to understand the changes introduced at the mill after acquisition. This module asked questions with regards to management in five key areas of running mill operations: (i) processes with regards to managing coffee cherry quality, (ii) management of farmer incentives and training, (iii) management of coffee collectors (intermediaries), (iv) operations of the mill with regards to capex and IT investments and lastly (v) worker management. In total across these five areas we can investigate 12 important management practices that can be introduced and modified at the mill as outlined above. For each management practice we obtain information on whether the practice was *attempted* (and if so, when), how *difficult* it was to implement the practice, if there was any *resistance* in implementing the practise (and if so, from whom) and lastly how much *autonomy* the mill manager has in changing the management practise.

Table B4: **SOURCES OF WORKING CAPITAL FINANCE**

| | (1) Loans from financial institutions | (2) Internal funds | (3) Coffee suppliers | (4) Loans from friends/partners | (5) Advances from foreign buyers |
|---|---|---|---|---|---|
| Domestic Group | 0.168 | -0.064 | 0.077 | 0.042 | 0.151 |
| | (0.214) | (0.186) | (0.058) | (0.138) | (0.067)** |
| Exporter controls | Yes | Yes | Yes | Yes | Yes |
| $R^2$ | 0.04 | 0.03 | 0.03 | 0.02 | 0.04 |
| Observations | 39 | 39 | 39 | 39 | 39 |

*Note:* Standard errors are clustered at the exporter-level. $***$ ($**$) [$*$] indicates significance at the 0.01 (0.05) [0.1] level. All dependent variables are dummy variables in response to exporter groups' indicating different sources of working capital finances. Column 1 is loans from financial institutions (e.g. banks), column 2 is internal funds used for working capital needs, column 3 is borrowing from farmers, column 4 are loans from friends and partners and column 5 are advances from foreign buyers. Domestic group is a dummy taking a value of 1 when the interviewed group is a domestic company owning more than one mill. Exporter controls are age of the group and size (as measured by number of employees). Responses are from exporter group interviews.

Table B5: **MILL TECHNOLOGY – PULPING MACHINES AND OTHER INFRASTRUCTURE**

| | (1) Disks per machine | (2) Standard Machine | (3) Eco-pulper Machine | (4) Other type of Machine | (5) Access to Electricity | (6) Generator at Mill | (7) Water Tank Capacity ($m^3$) | (8) Avg Size of Drying Table ($m^2$) | (9) Ratio of Water Tank to Drying Table |
|---|---|---|---|---|---|---|---|---|---|
| **Panel A: Group ownership** | | | | | | | | | |
| Mill belongs to a group | 0.404** | 0.117 | -0.138* | 0.022 | -0.003 | 0.034 | 0.660*** | 0.017 | 0.104*** |
| | (0.160) | (0.074) | (0.071) | (0.031) | (0.070) | (0.058) | (0.157) | (0.055) | (0.039) |
| Observations | 265 | 265 | 265 | 265 | 265 | 265 | 265 | 265 | 265 |
| Adjusted $R^2$ | 0.14 | 0.050 | 0.092 | -0.069 | 0.18 | -0.0032 | 0.21 | -0.0096 | 0.064 |
| **Panel B: Domestic vs. Foreign groups** | | | | | | | | | |
| Mill belongs to a foreign group | 0.111 | 0.031 | -0.109 | 0.077 | -0.024 | -0.044 | 0.856*** | -0.085 | 0.114** |
| | (0.219) | (0.110) | (0.101) | (0.069) | (0.102) | (0.087) | (0.206) | (0.083) | (0.048) |
| Mill belongs to a domestic group | 0.519*** | 0.150* | -0.150* | -0.000 | 0.005 | 0.064 | 0.583*** | 0.057 | 0.100** |
| | (0.169) | (0.079) | (0.078) | (0.022) | (0.074) | (0.061) | (0.163) | (0.060) | (0.042) |
| Equality of Coefficients, p-value | 0.049 | 0.281 | 0.686 | 0.206 | 0.770 | 0.212 | 0.140 | 0.115 | 0.738 |
| Age controls | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Mill type | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Geographic controls | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Mean dep. var. | 3.235 | 0.498 | 0.468 | 0.034 | 0.453 | 0.819 | 2.788 | 3.596 | 0.684 |
| Adjusted $R^2$ | 0.147 | 0.052 | 0.089 | -0.057 | 0.173 | -0.000 | 0.210 | -0.003 | 0.060 |
| Observations | 265 | 265 | 265 | 265 | 265 | 265 | 265 | 265 | 265 |

*Note:* Standard errors are clustered at the mill-level. $***$ ($**$) [$*$] indicates significance at the 0.01 (0.05) [0.1] level. Dependent variables in columns 1 to 4 investigate mill technology of the pulping machine: column 1 is the number of discs per pulping machine, column 2 is a dummy variable taking a value of 1 if the mill has a standard machine (the McKinnon brand) and 0 otherwise, column 3 is a dummy variable taking a value of 1 if the mill has a eco-pulper machine (the Pinhalense, Penagos or Toto brand) and 0 otherwise, and column 4 is dummy variable taking a value of 1 if the mill has any other type of machine, often a non-branded make and 0 otherwise. Dependent variables in columns 5 to 9 focus on other mill infrastructure: column 5 is a dummy variable taking a value of 1 if the mill has grid electricity, column 6 is a dummy variable if the mill has a generator, column 7 is a measure of the water tank capacity, column 8 is the average size of the drying table and column 9 is the ratio of the water tank to drying tables. Sample is 2017 mill survey. Mill controls are age of the mill, mill type (private or cooperative) and geographical district.

Table B6: **WHO ARE THE TARGETS?**

| Dependent Variable | (1) Operating = 1 | (2) New = 1 | (3) Private = 1 | (4) Installed Capacity (tons, ln) | (5) Processed Coffee (tons, ln) | (6) Utilization (ln) | (7) Labor (# of workers,ln) | (8) Capital to Labor (ln) | (9) Output to Labor (ln) | (10) A Grade (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| **Panel O: Change in Ownership** | | | | | | | | | | |
| Mill changes Ownership in (t+1) | -0.133*** | -0.053** | 0.033 | 0.052 | -0.125 | -0.185** | -0.020 | 0.015 | -0.105 | -2.426 |
| | (0.037) | (0.020) | (0.048) | (0.051) | (0.103) | (0.086) | (0.090) | (0.101) | (0.086) | (1.831) |
| **Panel A: Acquired by a Group** | | | | | | | | | | |
| Mill acquired by Group in (t+1) | -0.122** | -0.050** | 0.119* | 0.214*** | -0.017 | -0.223 | -0.084 | 0.317* | -0.074 | -0.303 |
| | (0.057) | (0.020) | (0.072) | (0.069) | (0.168) | (0.145) | (0.183) | (0.176) | (0.144) | (1.724) |
| **Panel B: Acquired by a Foreign Group vs Domestic Group** | | | | | | | | | | |
| Mill acquired by foreign group in (t+1) | -0.114 | -0.067*** | 0.349*** | 0.414*** | 0.189 | -0.212 | -0.355 | 0.549*** | -0.342*** | -2.066 |
| | (0.073) | (0.009) | (0.066) | (0.066) | (0.209) | (0.188) | (0.222) | (0.183) | (0.073) | (2.007) |
| Mill acquired by domestic group in (t+1) | -0.124 | -0.030 | -0.154 | -0.049 | -0.261 | -0.211 | 0.254 | 0.028 | 0.260 | 2.797 |
| | (0.086) | (0.040) | (0.111) | (0.104) | (0.244) | (0.209) | (0.200) | (0.253) | (0.210) | (2.441) |
| Observations | 1,740 | 1,740 | 1,740 | 1,565 | 1,565 | 1,565 | 745 | 745 | 745 | 788 |
| Year FE | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Cluster SE Mill level | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Mean of Dep. Var. | 0.899 | 0.106 | 0.564 | 12.82 | 12.04 | 6.125 | 11.11 | 8.612 | 8.113 | 47.74 |
| SD of Dep. Var. | 0.301 | 0.308 | 0.496 | 0.547 | 0.991 | 0.886 | 0.560 | 0.549 | 0.590 | 38.10 |

*Note:*

Table B7: **QUALITY INDICATIONS**

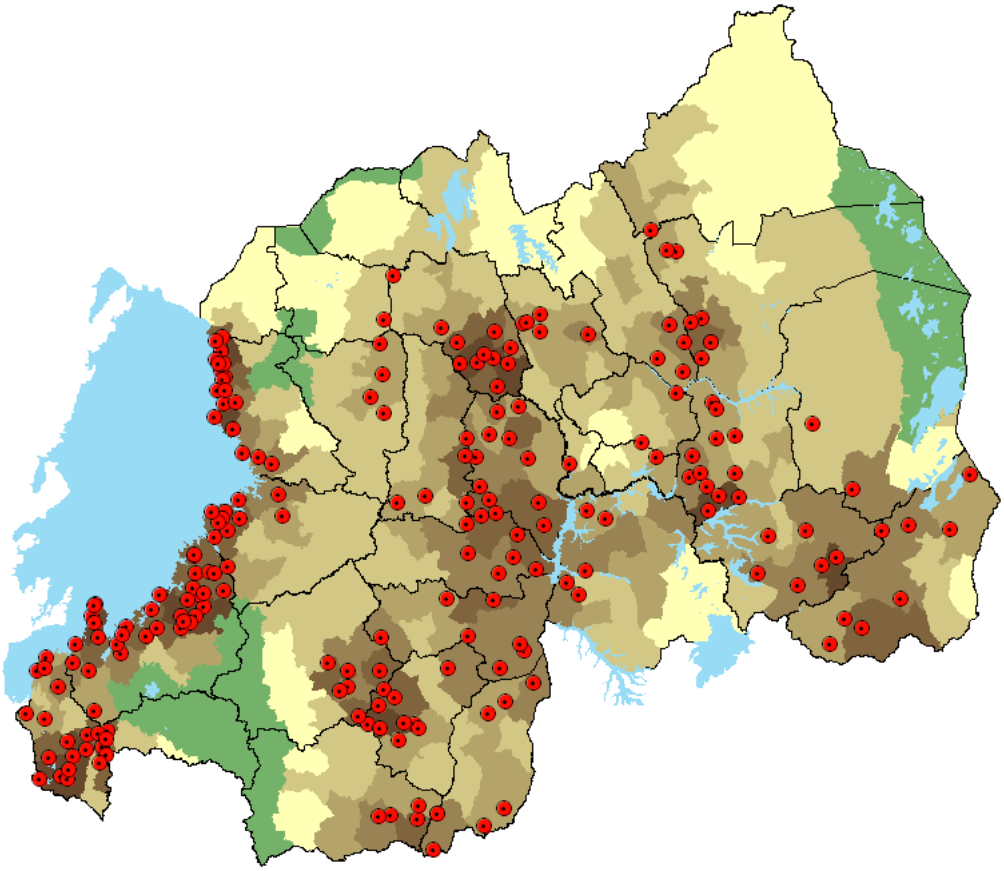
| Dependent Variable | (1) Any Certification | (2) Rainforest Alliance | (3) 4C | (4) UTZ | (5) C.A.F.E Practice | (6) Fairtrade | (7) Total Cupping Points (lab tests) | (8) Total Cupping Points (lab tests) |
|---|---|---|---|---|---|---|---|---|
| **Panel A: Group Ownership** | | | | | | | | |
| Mill belongs to group | 0.049 | 0.071** | 0.018 | 0.020 | 0.021 | -0.021 | 0.824 | 1.323** |
| | (0.035) | (0.030) | (0.025) | (0.017) | (0.023) | (0.022) | (0.592) | (0.544) |
| **Panel B: Foreign vs. Domestic Group Ownership** | | | | | | | | |
| Mill belongs to a foreign group | 0.428*** | 0.225*** | 0.293*** | 0.236*** | 0.349*** | -0.003 | 1.006 | 1.895** |
| | (0.063) | (0.054) | (0.072) | (0.055) | (0.063) | (0.047) | (0.869) | (0.729) |
| Mill belongs to a domestic group | -0.070** | 0.023 | -0.069** | -0.048** | -0.082*** | -0.026 | 0.788 | 1.109* |
| | (0.029) | (0.023) | (0.028) | (0.024) | (0.025) | (0.021) | (0.592) | (0.569) |
| Observations | 2,009 | 2,009 | 2,009 | 2,009 | 2,009 | 2,009 | 274 | 274 |
| Year FE | Y | Y | Y | Y | Y | Y | Y | |
| Mill FE | Y | Y | Y | Y | Y | Y | Y | Y |
| Cluster SE Mill level | Y | Y | Y | Y | Y | Y | Y | Y |
| Mean dependent variable | 0.17 | 0.04 | 0.02 | 0.02 | 0.04 | 0.12 | 83.03 | 83.03 |
| P-value [Foreign = Domestic] | 0.00 | .0001 | 0.00 | .0001 | 0.00 | 0.613 | 0.752 | 0.218 |

*Note:*

# B Additional Figures

## List of Figures

Figure C1: Mill Placement in Rwanda, 2012



*Note:* This figure illustrates in 2012 the spatial distribution of mills in Rwanda denoted by red dots. In the 2012 harvest season there were in total 214 mills of which 197 were operating. Green shade indicates national parks and conservation areas. Blue shade indicates water bodies. The background overlay in brown is the number of coffee trees at the sector level (the third administrative unit of Rwanda). The darker the shade of brown the higher the number of coffee trees in that sector. This figure is for illustration purposes only.