Acquisitions, Management and Efficiency: Evidence from 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 capital. 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 (Hseih and Klenow (2009, 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 2013).

How can management practices in such environments be improved? 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 competition can give firms incentives to improve performance (see, e.g., Schmitz (2005)) and reduce dispersion in performance (Syverson (2012)) 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 explore a third channel: acquisitions, i.e., 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 structure 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 war 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

[1] With few exceptions, most notably Bloom et al. (2013), 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 and Duflo (2015) and Hsieh and Olken (2015)).

[2] To illustrate this point, 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.

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 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 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]

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 employ the same amount and type of processing mill technology) and access to 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: 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 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 dif-

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

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

To add paragraph on market outcomes

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 (Hseih and Klenow, 2009 and 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 CEOs/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

[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's (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 at 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.

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 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 presenting a battery of robustness checks, focusing particularly 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 and policy implications are discussed in Section 6.

[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.

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 season 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 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

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

[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

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. The beans are then laid out on drying tables and frequently and carefully turned by hand until completely and uniformly dry. 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, 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, sent to the Port of Mombasa in Kenya, loaded onto a ship, and typically 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 (Appendix Figure C1). Summary statistics for mills in Rwanda in 2012 are reported Appendix Table B1. The survey covered nearly all operating mills in the 2012 harvest season. 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 cherry processing per season. 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

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.

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 more than one coffee mill 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, these 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, in which the exporting company acts as a 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 do relational sourcing (53% of all their mill interactions) and own mills (23%). Domestic groups interactions with mills are more likely to be under ownership (48%) as well as coffee service provider (24%) and arm's length relationship (16%).

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.

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 − the government institution in charge of the coffee sector. The training of the survey modules was done by one 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 lab 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 titled *changes at mill* was introduced.[15] This *change at mill* module asks questions

[15]This *change* at the mill module is inspired from first generation of management studies e.g. Black

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 (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 on the processes through which they select targets. One of the authors interviewed face-to-face all downstream buyers over 2-6 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 IVs for acquisition. Essentially by constructing better control groups 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-season panel data set from 2002 (when there were only 3 mills in the country) till 2017. Given the industry's importance as a foreign exchange earner, mills are required since 2012 to report various performance measures in each season they operate. These include their operating capacity to process cherries for the season, and how many tons of cherries they processed. Using archival sources 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 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.

we are able to designate to each mill its owner. This information assists us to categorize which groups the mills belong too, foreign or domestic.

3 Theory [to be added]

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

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, 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. Foreign groups pay more to their managers (this might not be surprising as these managers are supervising larger mills) and hire more seasonal workers to help at the mill gate to manage cherries as well as the tasks of sorting and drying parchment.

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 season t, ϕ_i are mill fixed effects, η_t are season fixed effects and ϵ_{it} is an error term. The independent variables of interest are dummies $\mathbf{I}_{it}^{g}$ 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.[16]

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-season. Columns 2 to 4 are conditional on the mill being operational in that season, 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 seasons of 2012, 2015 and 2017.

Column 1 shows that mills that belong to *foreign*, but not to *domestic*, groups are more likely to be operating in any given season. 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 season, 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 in 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 0.14 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 season 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 season. 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.

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

Column 3 shows that mills that belong to *foreign*, but not to *domestic*, groups are more likely to process more cherries in any given season conditional on being operational. The dependent variable y_{it} is the amount of cherries that the mill has processed in a given season (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 in 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 with a very large 54.3%-age points increase in procuring coffee cherries and this 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 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. 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 labour ration. 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 mill utilizes capacity in line with the amount of labour they have hired. 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.

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.

4.2 Costs

Table III 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 seasons of 2012, 2015 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 take 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 capital in greater 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 5% 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 the Identification Strategy

We now discuss threats to the identification strategy.

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/or access to finance, two important factors highlighted by the previous literature.[17] 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 there is no difference in the number of discs per pulping machine (column 1) nor in the type of

[17] On differences in technology between domestic and foreign firms see, e.g., Guadalupe et al. (2015). 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.

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). 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). 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).[18] 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 appear to be better managers: i.e., 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.[19] Differences in performance appear thus to be driven, at least in part, by differences in management *implementation*.

[18] 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.

[19] 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.

5.1 Managers vs Management

We begin our mechanism discussion by first looking at the managers deployed at the mills. Table IV documents that both domestic and foreign groups change the mill soon after acquiring a new mill (column 1). In general a manager is changed every five seasons (mean 0.17), acquisitions nearly doubles the probability of a manager switch to 2-3 seasons. 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 V and find that managers earn a premium even after controlling for manager characteristics from IV (column 2) and also after controlling for the type of mill they are managing (column 3). In essence, foreign groups hire better managers, pay them more even relative to their skills, ability, experience and type of mill they run.

5.2 Management: Knowledge vs Implementation [to be added]

5.3 Resistance to Change [to be added]

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.

References [to be added]

Table I: **DESCRIPTIVE STATISTICS**

	Foreign Groups Mean	Domestic Groups Mean	Non-Groups Mean
Manager monthly salary, USD	$311	$224	$192
No. of permanent workers	5.68	5.55	4.58
No. of seasonal workers	100.18	83.36	63.25
Cherries processed (total, tons)	478.07	369.28	195.24
Capacity of pulping machine (tons)	598.03	528.12	338.33
Total production parchment (tons)	102.15	75.34	45.42
Grade A Parchment (%)	78.9	74.74	74.21
Conversion rate (kgs)	5.07	5.13	5.25
Observations	51	96	150

Note: This table presents key performance measures of mills from the survey in 2017 across three organizational forms in the industry: foreign groups of which they are 7, domestic groups of which there are 45 and non-group domestic owned stand alone mills of which there are 150. Mills procure cherries and convert them into parchment. The output of the mill is know as parchment and that can be graded into 4 categories: A (the highest), B, C and triage. Conversion ratio 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 and total observations reflect the number of mills in each group.

Table II: **OPERATIONS**

Dependent Variable	(1) Operating = 1	(2) Installed Capacity (tons, ln)	(3) Cherries Processed (tons, ln)	(4) Utilization (%)	(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
Cluster SE Mill level	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-season 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 seasons 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
Cluster SE Mill level	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 seasons 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: **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-season panel from this information.

Table V: **MINCER**

Dependent Variable	(1) Monthly Salary (ln)	(2) Monthly Salary (ln)	(3) Monthly Salary (ln)	(4) Monthly Salary (ln)	(5) Monthly Salary (ln)	(6) Monthly Salary (ln)
Mill belongs to a foreign group	0.631***	0.493***	0.332***	0.832***	0.587	0.576
	(0.083)	(0.090)	(0.113)	(0.201)	(0.356)	(0.535)
Mill belongs to a domestic group	0.235***	0.178**	0.073	0.364**	0.360	0.375
	(0.080)	(0.075)	(0.088)	(0.165)	(0.284)	(0.461)
Observations	265	224	224	435	309	245
Sample Year	2017	2017	2017		2012,15,17	
R-squared	0.158	0.400	0.481	0.624	0.644	0.694
Year FE				Y	Y	Y
Manager Characteristics		Y	Y	Y		
Mill Characteristics			Y			
Mill FE				Y		Y
Manager FE					Y	Y
Cluster SE Mill level				Y	Y	Y
P-value [Foreign = Domestic]	0.00	0.00	0.01	0.01	0.40	0.48

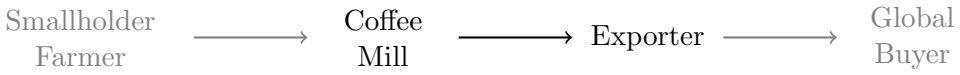
Note: Standard errors are clustered at the mill-level. $***$ ($**$) [$*$] indicates significance at the 0.01 (0.05) [0.1] level. Panel A reports results simply comparing mills belonging to groups versus not, while Panel B splits the group dummy between *domestic* and *foreign* groups and reports p-values for the joint test of equality. Dependent variables across all columns is monthly salary (ln).

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

VARIABLES	(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
	Quality								
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
P-value [Foreign = Domestic]	0.044	0.249	0.318	0.065	0.264	0.334	0.009	0.155	0.199

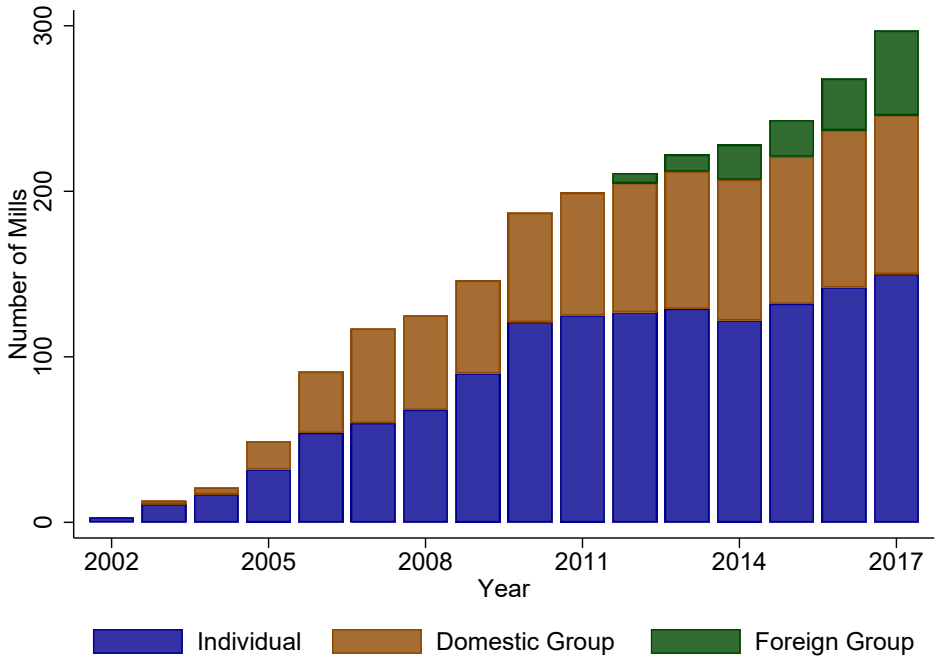
Note:

Figure I: COFFEE SUPPLY CHAIN IN RWANDA



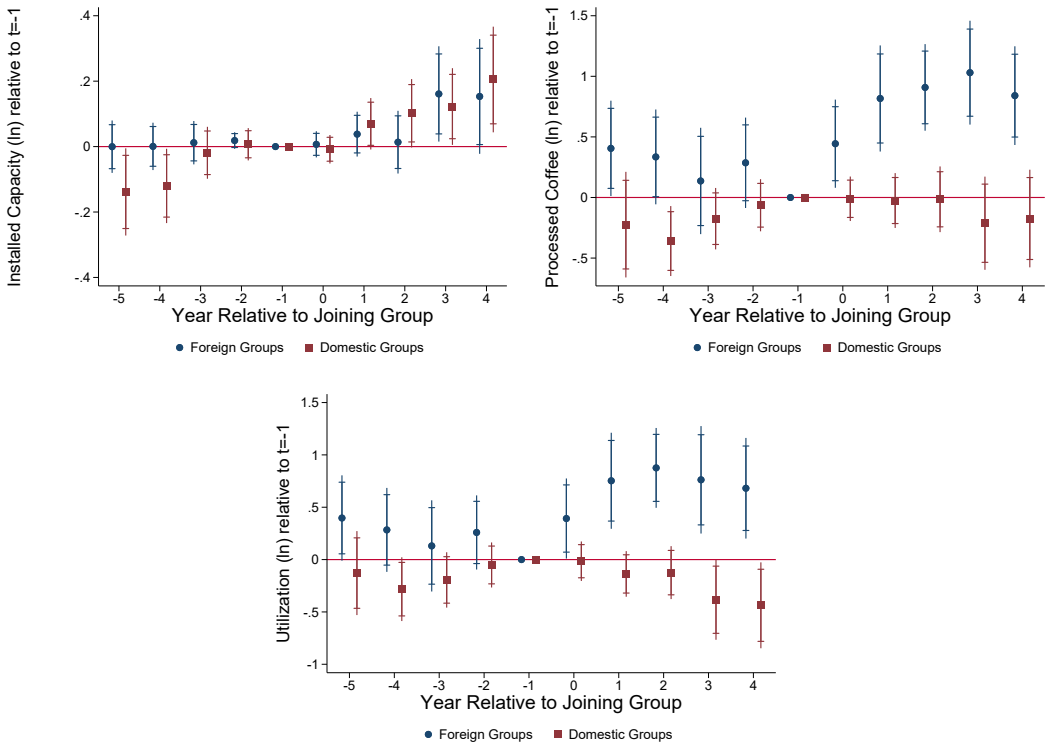
Note: This figure depicts the linear coffee value chain in Rwanda. Coffee cherries are produced by smallholder farmers and sold to mills (referred to also as washing stations or wet mills). Mills sell or internally transfer parchment (the output of mills) to exporters. Exporters consolidate, mix and mill the 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, 2002-2017**



Note: This figure depicts the industry evolution of Rwanda's coffee mills (also referred to as wet mills or washing stations). By 2002 there were a handful of mills operating in the country. The figure displays a rapid growth and consolidation of the industry. Until 2011 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 arrival 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 owning a total of 96 mills of which 70% are green field.

Figure III: **EVENT STUDIES**



Note: Using our administrative 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. In the above depiction 0 on the x-axis denotes the year in which the mill becomes part of the group, hence it is the year of purchase, and 1 is defined as the 1st whole year the mill has been part of the group and hence -1 is the one year prior to purchase. In Panel A the outcome variable is installed capacity, in Panel B it is the amount of processed coffee (tons) and in Panel C it is the mill utilization measure. Mill fixed effects are included in the specification and standard errors are clustered at the mill level.

Appendix

Acquisitions, Management and Efficiency: Evidence from Rwanda's Coffee Industry

by **Rocco Macchiavello and Ameet Morjaria**

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Table B1: **MILL CHARACTERISTICS**

	(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 and author's GIS dataset. Responses are by mill managers.

Table B2: **ORGANIZATIONAL FORMS: EXPORTERS AND MILLS**

	Exporter		
Relationship with mill	Foreign Group (7)	Domestic Group (33)	p-value
Coffee Service Provider (CSP)	14%	24%	0.05**
Arm's length (independent supplier)	3%	16%	0.00***
Relational Sourcing	53%	8%	0.00***
Rent	6%	5%	0.70
Own	23%	48%	0.00***
Total Mills	116	103	

Note: In between owning mills and simply providing milling and marketing services to mills, 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 (i) coffee service provider (CSP), in which the exporting company acts as a agent and provides only dry milling and marketing services to the mills (ii) arm's length sourcing of coffee (independent); (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.

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: **EXPORTER GROUPS - SOURCES OF FINANCE**

	(1)	(2)	(3)	(4)	(5)
Dependent variable	Loans from financial institutions	Internal funds	Coffee suppliers	Loans from friends/partners	Advances from foreign buyers
Domestic Group	-0.001	-0.177	0.002	0.076	0.100
	(0.178)	(0.183)	(0.002)	(0.071)	(0.055)*
Exporter controls	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.01	0.05	-0.08	-0.06	-0.05
Observations	35	35	35	35	35

Note: Standard errors are clustered at the exporter-level. $***$ ($**$) [$*$] indicates significance at the 0.01 (0.05) [0.1] level. All dependent variables are responses from exporter group sources indicating percentage of 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: **TECHNOLOGY: PULPING MACHINES AND OTHER MILL INFRASTRUCTURE**

	(1) Disks per machine	(2) Standard Machine	(3) Eco-pulper Machine	(4) Other type	(5) Electricity	(6) Generator	(7) water tank capacity (m^3)	(8) avg size of drying tables (m^2)	(9) Water tank and drying table ratio
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?**

VARIABLES	(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: **MANAGERS VS. MANAGEMENT**

VARIABLES	(1) Operating	(2) Operating	(1) Processed Coffee (ln)	(2) Processed Coffee (ln)	(3) A Grade (%)	(4) A Grade (%)	(5) Installed Capacity (ln) *Placebo*	(6) Installed Capacity (ln) *Placebo*
	w/o Manager Chars	w/ Manager Chars	w/o Manager Chars	w/ Manager Chars	w/o Manager Chars	w/ Manager Chars	w/o Manager Chars	w/ Manager Chars
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
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
Cluster SE Mill level	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 B8: **QUALITY INDICATIONS**

VARIABLES	(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
P-value [Foreign = Domestic]	0.00	.0001	0.00	.0001	0.00	0.613	0.752	0.218

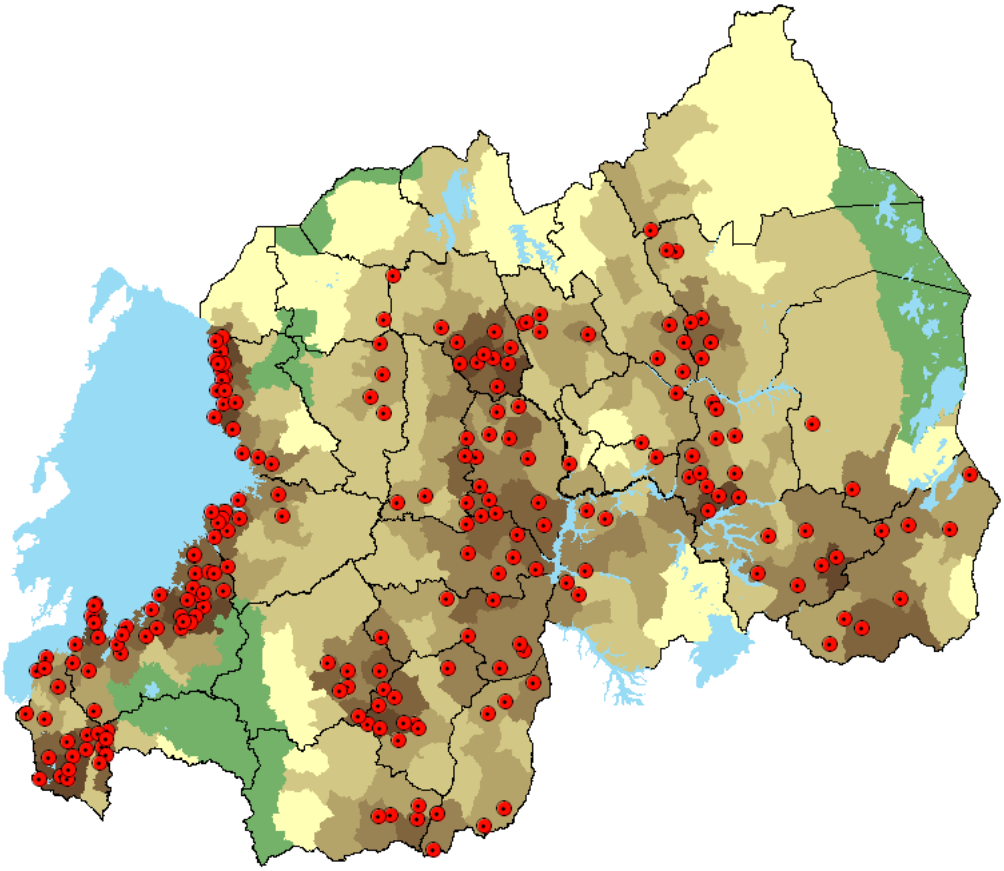
Note:

B Additional Figures

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C1 Mill Placement in Rwanda, 2012 . . . . . A.11

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.