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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 signicant 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-mill groups. We combine administrative data with original surveys of mills and acquirers to understand the consequences of this consolidation. Difference-in-difference results find that, controlling for mill and year fixed effects, a mill acquired by a foreign group, but not by a domestic group improves productivity. 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 (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 rest reects superior implementation, rather than management knowledge: following an acquisition, managers in domestic and foreign groups try to implement the same management practices 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)). 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 mostly on micro-enterprises, finding rather modest 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 mills. Combining

[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.

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 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 also considered as alternative targets. This allows us to construct pairs of mills (acquired and counterfactual 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 *man-*

[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.

agers and *management* as candidate explanations for the difference in performance. 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.

Differences in *management* thus likely play a role. 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 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 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. Most closely related work is 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. 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.

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.[7]

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

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.[8] 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.[9]

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 describes our surveys and administrative datasets. Section 3 investigates the impact of acquisitions on mills performance. We distinguish between foreign and domestic acquires 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 4 investigates the mecha-

[8] 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.

[9] 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.

nisms underlying the difference in firm performance. After ruling out differences in mill technology and access to working capital as key explanations, we focus on the role of both managers and management, on knowledge versus implementation and challenges of change. Concluding remarks are discussed in Section 5.

2 Industry Background

This section provides background information on the industry. We first describe the key actors and their roles in the supply chain. With that background we then focus on the industry evolution and describe entry and acquisitions in the industry. We then briefly describe the survey and original administrative data we collected and compiled.

2.1 Coffee in Rwanda

Sector Overview. Coffee became widespread in Rwanda in the late 1930s following mandatory coffee-tree planting imposed by the Belgian colonial administration. At independence, in 1962, coffee represented 55% of Rwanda's exports. The decline in coffee exports started in the 1980s, accelerated with the demise of the International Coffee Agreement in 1989 and the subsequent collapse of coffee prices in the global market, and further contracted with the political instability leading to the 1994 genocide. Since the end of the genocide the sector has steadily recovered. In 2017 coffee contributed almost 10% of the country's total export earnings and 23% of total agricultural export value.[10] Figure I illustrates how majority of the coffee moves through the supply chain in Rwanda.

Farmer Harvesting. Like in many coffee producing nations, Rwanda's supply chain starts with smallholder farmers. In 2015, the most recent census, there were around 355,700 smallholder farmers growing coffee on an average of less than 0.25 hectare of land holding. Farmers grow coffee cherry which are the fruits of the coffee tree. As coffee cherries mature at harvest time they ripen and turn from green to red, at which point they should be picked. While the harvest period varies depending on geography, it typically lasts four months. Coffee cherries are harvested by hand, a labor intensive process requiring both care and effort.

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

[10] Source: NISR Statistical Year Book (2017) and BNR-National Bank of Rwanda (2021), https://www.bnr.rw/browse-in/statistics/external-sector-statistics/, accessed November 2021.

home-processed and wet-mill method. We focus on the wet method when the coffee cherries are taken to a mill.[11] Once cherries are picked if the farmer is selling to the mill the delivery takes place within the day, otherwise the cherries start to ferment. Mills are therefore scattered around the countryside; farmers closest to the mill often take cherries to the mill's gate directly.[12] Farmers further afield from a mills' catchment area bring cherries to village markets where traders, known as coffee "collectors" buy coffee. Collectors could be buying coffee on their own account and/or on behalf of a mill.

Mill Processing. Mills require specific equipment and substantial quantities of clean water. Upon receipt of cherries the skin and pulp are removed with a de-pulping machine and then sorted by immersion in water. The bean is then left to ferment for around 30 hours to remove any remaining skin layers. When fermentation is complete, beans are thoroughly washed in large water tanks, carefully laid out on drying tables and frequently turned by seasonal laborers until uniformly dried. These processes need to be managed with utmost care and can take up to 15 days. Once the drying process is completed coffee (now converted to parchment) is bagged and stored.

Mill Manager. To ensure throughput risk of the mills process is appropriately managed, a competent manager is essential. The role of the manager is paramount if the cherries are efficiently and carefully converted into parchment. The manager is responsible for overall running of mill operations and ensuring coordination among typically 4 sub-ordinates who are involved in production, quality, accounting and security. Managers oversee recruitment, pay and incentive payments for the seasonal workers and coffee collectors. Prior to harvest, managers in collaboration with HQ staff can be involved in farmer training programs and communicating quality requirements as well as overseeing payments to farmers. Managers are responsible for ensuring workers handle efficiently and timely the cherry reception before de-pulping and coordinating with other workers to ensure passage of cherries through the immersion process, water tanks and onto drying tables. While large cash outlay decisions (e.g. purchases of pulping machine, and generators) are managed by HQ or the owner of the mill, smaller cash expenditures like rehabilitating storage facilities, paying incentive pay by volume

[11] In the home-processed method, farmers de-pulp cherries at home using rudimentary tools like rocks before drying the bean on tarpaulin. This process produces coffee parchment of lower and less consistent quality. In terms of value, the wet-method yields significantly higher value addition for the Rwandan coffee chain as a whole, even after accounting for costs of processing (Macchiavello and Morjaria (2015)).

[12] In Macchiavello and Morjaria (2021) we note 98% of farmers report selling cherries to mills is more profitable than home processing, and 99% of farmers say that they do home processing to save, which is an inefficient saving technology.

to collectors, repairing drying tables and petty cash items are at the discretion of the manager.

Exporter. Upon completion of the mill processing steps, the bagged parchment coffee is ready to be transported to the exporters warehouse in the capital city. The export company further dries the parchment and hulls using a dry mill.[13] Additional processing takes place in the form of cleaning and polishing the hulled coffee before grading the beans by size and weight. The output of the hulled coffee, known as "green coffee" is bagged and transported to the nearest port (in Mombasa, Kenya) for loading onto cargo ships destined to a roaster in the consuming country.

2.2 Industry Evolution and Acquisitions

Figure II reveals that the development of the industry went through several stages. In 2002, there were 3 one-mill firms operating in the industry owned by indigenous Rwandan companies.[14] The first stage involved the remarkable ascendance in mill entry that continued for the next 15 years, by 2017 a total of 310 mills were constructed.

The second stage, beside the remarkable expansion in the number of mills and, consequently, in installed capacity, the ownership of 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 indigenous Rwandan companies who own at least two-mills. These domestic groups already existed in the industry as exporters. By 2011, domestic exporters had backward vertically integrated and owned 35% of the 200 mills constructed. The rest of the industry were one-mill firms owned by local companies.

Starting in 2012, the industry witnessed another remarkable transformation, backward integration by *foreign groups*, defined as companies controlled by multinationals that own at least two-mills. This was largely driven by the unprecedented rise in international coffee price in early 2011 and increasing awareness of consumers on authenticity and traceability, often referred to as the "third-wave" of coffee. These foreign groups are prominent companies in the global coffee trade like Sucafina (Switzerland), Olam (Singapore), Dormans (Kenya), and Café de Gisagara (South Korea) amongst others. By 2017, 7 foreign groups owned 17% of the 297 mills operating in the coun-

[13] At the time of our survey in 2017 exporters owned 12 dry mills located in the vicinity of the capital city. Typically large exporters own dry mills and smaller exporters pay a usage fee for dry mill services.

[14] Entry dates of these 3 one-mills were in 1956, 1977 and 2001.

try.[15] Similar to the domestic groups, foreign groups had also been involved in the exporting of coffee as their core activity in all the cases before they started acquiring control over mills. The emergence of groups is thus closely associated with backward integration strategies pursued by these companies.[16]

To further understand the asset transfers driving the accumulation of mills by groups in Figure II, Table II disentangles the exact changes in mill ownership. First, column (1) shows at entry of mills in the industry: 71% of the mills are built by one-mill firms (owned by locals), 27% of the mills are built by domestic exporting groups and only 2% of mills are built by foreign exporting groups. Over time we observe relative to domestic groups, foreign groups predominantly acquire brownfield mills (82%). In contrast, domestic groups backward integrate by mainly building greenfield investments (70%). Next, column (2) provides a snapshot of ownership status in 2017. Mills under one-mill firms has fallen to 50% of the industry, domestic groups have increased ownership of the industry to 32% and the most dramatic change has been that foreign groups now own 17% of the mills.[17]

With these drastic changes in the industry, from whom did the new owners obtain their mills from? The next set of columns digs deeper into this question. Column (3) first details in aggregate numbers how many mill ownership changes have taken place across the three types of owners. Majority of ownership changes have taken place under one-mill ownership (59%). The recipients of these prior one-mill owned firms are broadly equally dived up across all three types of owners (other one-mill firms, domestic groups and foreign groups), as illustrated in columns (4a) to (4c). Domestic group mills have also seen substantial ownership changes (40%). Columns (4a) to (4c) shows that that the main (53%) new owners of domestic group owned mills are foreign groups and the rest of their mills have been transacted with local one-mill firms (27%) and other domestic groups (20%). Strikingly, foreign groups hold onto their mills upon acquisitions. We have only one mill from the foreign group holdings being sold to a one-mill firm in the last 15 years. To conclude, domestic and foreign groups appear to

[15] We bundle ownership and rental agreements of mills into a unique category and label it as ownership. Rental is when the exporting company fully operates the mill, without owning its assets. In our study period only 30 out of the constructed 310 mills are ever rented. Results are robust to excluding rented mills.

[16] Note, by design, full forward integration in which the mill directly exports to a global buyer is not in our survey as our sample is only of exporters. However direct exporting in 2017 by mills is extremely rare in Rwanda, 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 exports.

[17] The discrepancy in the total number of mills between column (1) and (2) is due to 13 mills being dismantled in the industry, 11 of those mills belonged to one-mill firms, and 2 belonged to domestic groups.

be quite different in their entry into the industry in terms of ownership of mills.

2.3 Data

Mill Surveys. Our main source of data is mill-level data which is based on bespoke surveys we designed and implemented in collaboration with the National Agricultural Exporting Board (NAEB) − the government institution in charge of the coffee sector.[18] The survey was implemented towards the tail end of the harvest season (typically end of July), in 2012, 2015 and 2017 by survey teams led by a qualified NAEB staff member. Interviews were pre-arranged and mill manager's participated for 4 to 6 hours to complete the survey.

The three rounds of surveys enable us to construct a mill-level panel data-set with unusually highly detailed information on mill operations and managers. In particular, the data contain: processing capacity of the mill; data on inputs (prices and quantity of cherries processed) and mill output (parchment produced) allowing us to calculate physical efficiency (or conversion ratio); grade of the mill output; total variable cost of producing a kg of output and the components of variable costs; mill technology (pulping machine model and number of discs in the machine, size of drying tables, water tank capacity and availability of power generators); number of mill-floor employees (workers and collectors) and their wages. We also collected representative samples of the mills output (parchment coffee) and assessed its quality attributes at a coffee laboratory.

Our surveys covered nearly all operating mills in the harvest season. The response rate was close to 100%. The average mill employed around 70 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 year.

Management Practice Survey Module. In late 2015 we noted the increase in consolidation and backward vertical integration by domestic and foreign groups in the industry. To better understand the phenomenon the 2017 survey fielded an additional module on management changes at the mill. This module asked questions on operational aspects in five key areas of running a mill (i) processes to manage input quality, (ii) management of farmers, permanent workers, seasonal labor and coffee collectors, (iii) mills' capex, and IT investments. For each operational management issue we asked 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,

[18] We describe only the most important features of our data here.

from whom) and lastly how much *autonomy* the mill manager had in changing the management practice.

Manager Surveys. Given the importance of the manager, our survey modules covered manager characteristics and their career history in the coffee industry. In particular, the data contains the managers: experience; gender; martial status; district of birth; education achievements; raven test scores and World Value type trust question responses.

Administrative Data. To complement our three rounds of surveys, we compile from annual records of the government mill-level data. For this paper, we have collected and processed all the available data for the years 2002-2017. Given the industry's importance as a foreign exchange earner, mills are required to report performance measures in each year they operate to the regulator. These include the mills' cherry processing capacity, and how many tons of cherries they processed. Thus our data contains inputs used and capacity by each mill in a given year in physical units. We obtain a list of owner names from the Rwanda Development Board, Commercial Registration Agency, and in combination with our detailed interviews we are able to construct the ownership history of each mill from its entry. Thus we observe which firm and type of organization (one-mill owner, domestic group, and foreign group) owns each mill at a given time, so we can compare mill-level outcomes before and after ownership changes.

Survey of Exporters. To understand the motives of the acquirer groups to integrate backward, the process of selecting target mills and all the relationships they have with mills, in 2017 we directly interviewed the owners of the groups. One of the authors interviewed face-to-face all the downstream buyers over 4-6 hour interviews. Our sample consists of 41 CEOs/MDs of groups, representing 91% of the export market. We collected systematically information on the reasons why they integrated with specific mills, whether they considered other mills and – if yes – why they did not proceed on acquiring. Besides aiding us to understand acquisitions by directly asking acquirers about their motives, this information allows us to explore a variety of counterfactual targets for acquisition to check the validity of our empirical strategy and understand issues of selection. In the spirit of Greenstone et al. (2012)), the survey allows us to compare changes in outcomes at each acquired mill against changes at another mill that was also considered for acquisition by the same acquirer at the time of the acquisition.

3 Empirical Analysis

3.1 Acquisitions and Firm Performance

Given the vast existing literature's (and policy) interest to understand exactly how foreign direct investment impacts the recipients local economy, our object of study in this paper is to understand ownership by foreign firms. It turns that in our context, there are no one-mill owned foreign firms and hence our lens is on foreign groups. In order for us to make comparisons on performance to foreign groups the appropriate entity for the exercise is domestic groups. While 30% (33 out of 107) acquisitions were undertaken by one-mill firms, they are likely to have all sorts of challenges in performance due to being small. Hence comparing them to foreign groups will likely be impacted by various other confounding factors, making it difficult to understand drivers of performance differences.

This section investigates the effect of acquisitions by groups on firm performance. Aside the academic relevance we also see in our data groups by 2017 own nearly half the industry (147 of the 297 mills in 2017, Figure II) and they have partaken in 70% of acquisitions (74 of the 107 mill ownership changes, Table II). It is important to distinguish between the two types of groups, both are serial acquirers responsible for 74 acquisitions − 42 mills (57%) are completed by foreign groups and 32 mills (43%) by domestic groups.

Operations. We start by considering performance differences on operational outcomes at the mill-level when there is an ownership change. Table III 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, ϕ_i are mill fixed effects, η_t are year fixed effects and ϵ_{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.[19]

Panel A reports results simply comparing mills belonging to groups versus one-mill firms, 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 op-

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

erational in that year, hence the different number of observations from column (1). Columns (5) to (7), instead, focus on outcomes that we measure during the surveys conducted in the years of 2012, 2015 and 2017. Note in the surveys we also solicit responses for the prior non-surveyed years to create a larger 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.

Next in column (2) we look at the key physical infrastructure at the mill - the capacity of the pulping machine. We find 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) probability 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. In later part of the paper, Section 4 we will unravel factors driving performance differences between domestic and foreign firms, we already see suggestive evidence from column (2) that access to finance across the two types of groups is not different. Pulping machines are the largest single most expensive item in setting up a coffee mill.

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 input (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 is highly statistically significant. The two estimates are significantly different from each other (p-value < 0.01). While at first pass, it might be seem that foreign groups might have access to a bigger envelope when it comes to working capital (which is important for procuring inputs at harvest), we will later show in Section 4 that access to working capital is not different across the two types of groups.

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 these results and shows that mills that belong to *foreign*, but not to *domestic*, groups are more likely to increase capacity utilization of the mill. The dependent variable y_{it} is the 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 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 (7.2%) whereas ownership of mills by foreign groups is instead associated with a very large increase in utilization (23%). 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 workers (ln) the mill employs in the season. As discussed earlier seasonal laborers are essential for managing the throughput risk of converting input (coffee cherries) into output (parchment). Panel A shows that ownership to a group is not associated with more seasonal workers. However, Panel B reveals that there is difference between the two types of groups when it comes to employment of seasonal labor. 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). Foreign groups hire more seasonal labor to manage the input procured.

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 mill's capacity. 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 that domestic mills are less productive, 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 in foreign groups deploy does not have encounter decreasing marginal returns, the new seasonal workers are as productive as the existing workers at the mill.

In sum, Table III 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.

3.2 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.

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 (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. 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).

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 one-mill firms, 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 Section 4 when we use the acquirer survey, the main takeaway on the analysis is access to working capital is not different across the

two types of groups.

Column (3) shows that, relative to one-mill firms 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 cherries to parchment coffee (i.e. how many kgs of cherries are needed to obtain one kg of parchment). Columns (4a) and (4b) considers these two elements separately and finds that most of the difference is driven by a worse conversation ratio. The conversion ratio is a physically efficiency measure of the machines, and as machines are the same across the types of groups, there should be no discrepancy across the two types of groups on this outcome. 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 indicates a lower physical efficiency in domestic groups, 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) could be driving this finding.

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 III. Column (6) encompasses a number of different costs, including procurement, transport and commissions to collectors. The results indicate these costs to be lower in foreign groups, but not statistically significant given the noisy measures.

In sum prices paid to farmers are not different across the two types of groups.

3.3 Robustness Checks

We now discuss various potential threats to our empirical strategy and 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. Table V 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.[20] For exposition simplicity, Table V 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 was discussed. Among those, we elicited, for each separate mill in the groups portfolio, a set

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

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 group.[21] Of these 61 counterfactual mills, 75% of them at some point belonged to a group.[22]

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.[23] 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

[21] 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.

[22] 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.

[23] 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.

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 (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 III and Table IV.

4 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.[24] In particular, we show that the exact type of equipment invested in mills owned by foreign and domestic groups is nearly identical. Appendix Table B4 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)

[24] 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.

is similar across domestic and foreign groups.[25] 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).[26] We note in Appendix Table B3 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).[27]

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 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 we define as *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.[28] Differences in performance appear thus to be driven, at least in part, by differences in management *implementation*.

[25] 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.

[26] 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.

[27] 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.

[28] 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.

4.1 Managers vs Management

Table VI 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 frequency 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.

Managers in foreign groups are paid more. Mincer-like wage regressions in Table VII and find that foreign group managers earn a premium conditional on manager characteristics (column 2) and mill characteristics (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 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. Column 6 includes also mill fixed effects and we find results qualitatively similar to our baseline. 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 3 can be explained by foreign groups having "better" managers running the mill? Table VIII 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 III 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.

4.2 Management: Knowledge vs Implementation

Both domestic and foreign group managers know what to do (Figure IV) across all the key operational management practices. Taking the Figure IV to regression analysis

Table IX reveals that even after controlling for manager and mill controls (column 2) both domestic and foreign group managers attempt the appropriate management practices columns 1 and 2. However it is the domestic group managers that face resistance in the implementation (column 4).

5 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: **INDUSTRY DYNAMICS – CHANGES IN MILL OWNERSHIP ACROSS 2002-2017**

	(1) Mill ownership status at entry		(2) Mill ownership status in 2017	(3) Total mill ownership changes	(4a) Mills to one-mill firms	(4b) Mills to domestic groups	(4c) Mills to foreign group
One-mill firms	220	$\longrightarrow$	150	62	20	23	19
Domestic group	83	$\longrightarrow$	96	44	12	9	23
Foreign group	7	$\longrightarrow$	51	1	1	0	0
Total mills	310		297	107	33	32	42

Note: This table disentangles all the changes in mill ownership that took place between 2002-2017 in Rwanda's coffee industry. Column (1) provides the industry structure at mill entry in the industry. Local one-mill firms built the majority of the mills 71% (220 mills), domestic groups built 27% (83 mills) and only 2% of mills are built by foreign groups (7 mills). Column (2) next provides a snapshot of the industry in 2017: mills under one-mill firms has fallen to 50% (150 mills), domestic groups have increased their ownership of the industry to 32% (96 mills) and the most dramatic change has been that foreign groups own 17% of the industry (51 mills). In total across the 15 years, 108 mills changed owners, column (3) provides these changes broken by the original owner. Irrespective of the final buyer of the mills: 59% of ownership changes involved one-mill firms, 40% of ownership changes involved domestic groups and 1% of owner changes involved a foreign group. Columns (4a) to (4c) provide further details on exactly which types of firms are the new owners. Recipients of prior one-mill owned firms are broadly equally dived up across all three types of owners (other one-mill firms, domestic groups and foreign groups), as illustrated in Columns (4a) to (4c). Columns (4a) to (4c) show that that the main (53%) new owners of domestic group owned mills are foreign groups and the rest of their mills have been equally bought by local one-mill firms (27%) and other domestic groups (20%). Strikingly, foreign groups hold onto their mills upon acquisitions. Only one mill from the foreign group holdings has been sold to a domestic one-mill firm in our period of study. The discrepancy in the total number of mills between column (1) and (2) is due to 13 mills being dismantled in the industry.

Table III: **OPERATIONS**

Dependent Variable	(1) Operating = 1	(2) Installed Capacity (tons, ln)	(3) Cherries Processed (tons, ln)	(4) Utilization (ratio)	(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	-0.007	0.075	-0.013	-0.098
	(0.026)	(0.032)	(0.078)	(0.038)	(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***	0.228***	0.285**	-0.275**	0.068
	(0.039)	(0.040)	(0.121)	(0.059)	(0.114)	(0.119)	(0.117)
Mill belongs to a domestic group	0.031	0.080**	-0.114	-0.072*	0.020	0.056	-0.141*
	(0.027)	(0.036)	(0.083)	(0.040)	(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 IV: **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 V: **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 VI: **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 VII: **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 VIII: **FIRM PERFORMANCE - MANAGERS VS. MANAGEMENT**

Dependent Variable	(1) Operating =1	(2) Operating =1	(3) Cherries Processed (tons, ln)	(4) Cherries Processed (tons, ln)	(5) Quality, A Grade (%)	(6) Quality, A Grade (%)	(7) Installed Capacity (tons, ln)	(8) 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

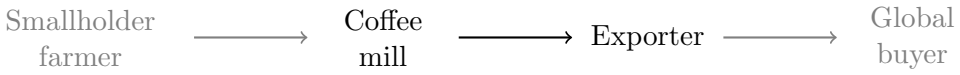
Note:

Table IX: **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

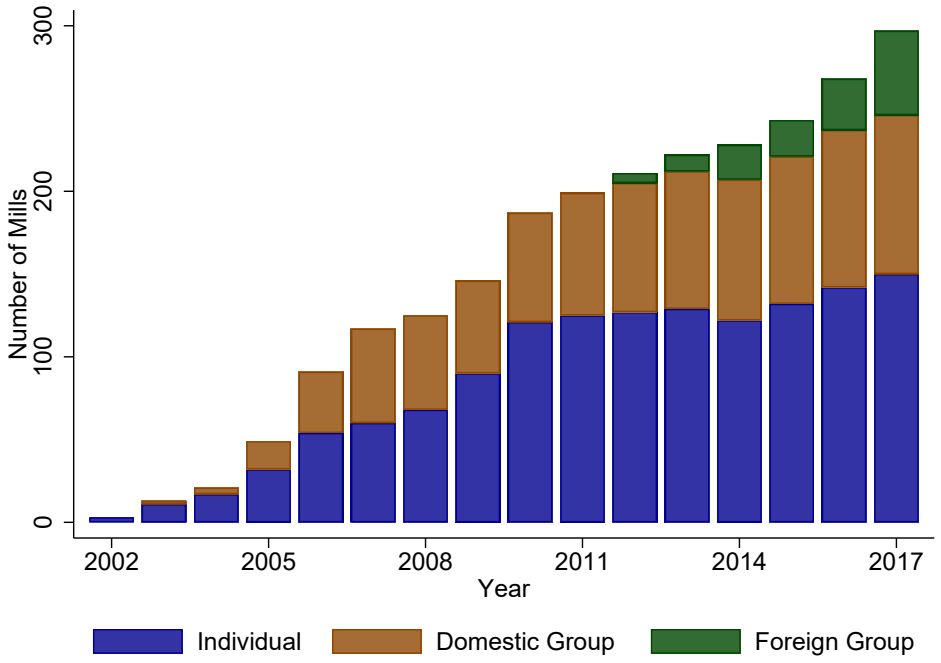
Note:

Figure I: COFFEE SUPPLY CHAIN IN RWANDA



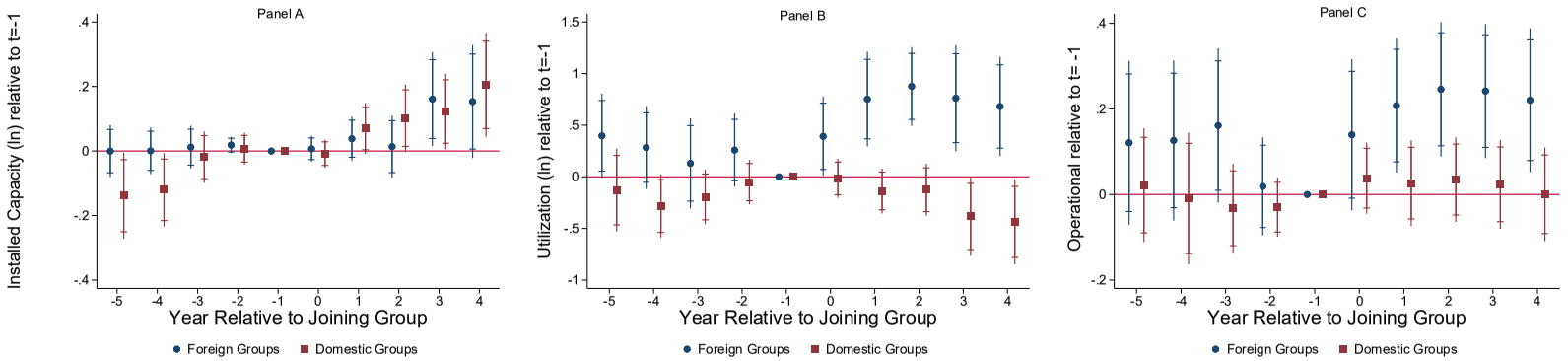
Note: This figure depicts the linear supply chain for mill processed coffee in Rwanda. Coffee cherries are produced by smallholder farmers and sold to mills (often referred to also as washing stations or wet mills). Mills sell or internally transfer parchment (the output of mills) to exporters. Exporters 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**



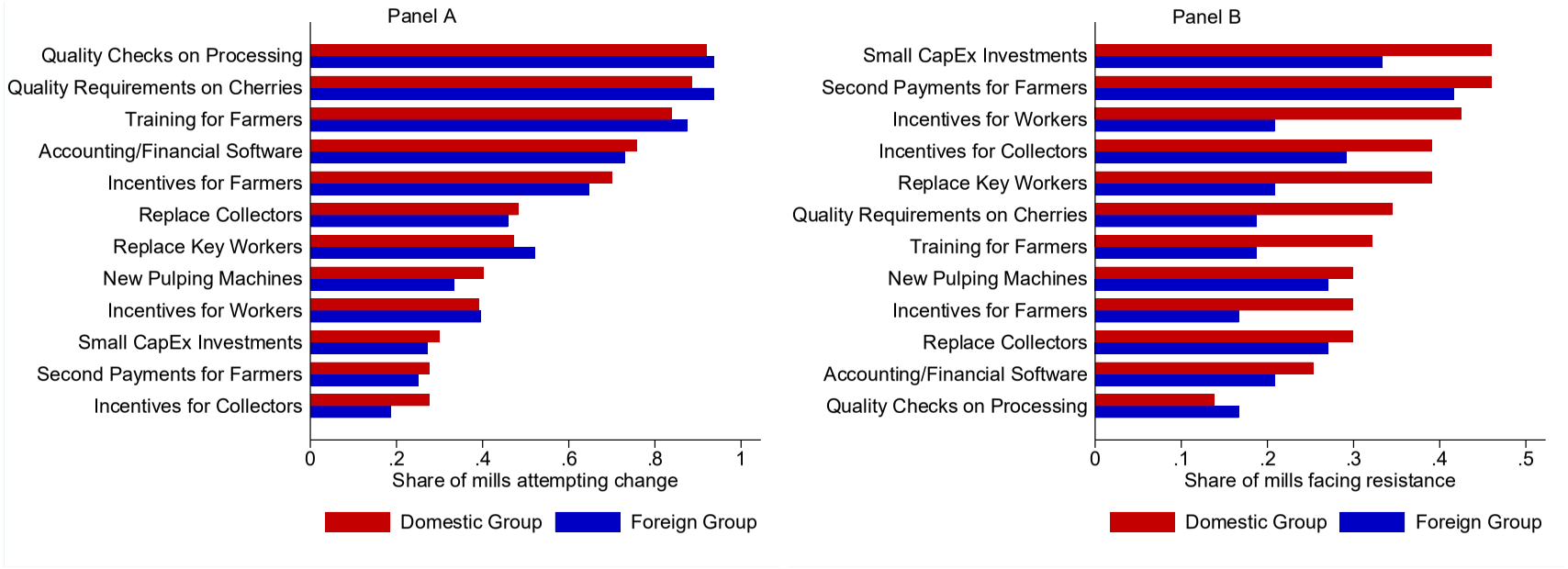
Note: This figure depicts the industry evolution of Rwanda's coffee mills for the period 2002-2017. In 2002 there were a handful of mills operating in the country. The figure displays a rapid growth and consolidation of the industry. Until 2011 all mills were under the ownership of domestic companies, 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**

January 2022

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A Additional Tables

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Table B1: **ORGANIZATIONAL FORMS: 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 B2: **OPERATIONAL MANAGEMENT PRACTICE SURVEY**

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 B3: **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 B4: **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.